



**TRAINING INDUSTRY PERSONNEL
AS INSTRUCTORS FOR
COMMUNITY COLLEGE BIOTECHNICIAN EDUCATION PROGRAMS**

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ADDENDUM

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This monograph is one of a series being prepared by the Southwest Regional Center of Bio-Link for national dissemination. The series focuses on the documentation of innovative, successfully implemented, instructor development programs performed as special projects by the Southwest Regional Center. These projects are intended to demonstrate effective transferable models designed to improve the preparation of instructors to staff biotechnician education and training programs at the nation's community and technical colleges.

This monograph is the first in the series and documents an innovative instructor training program that utilizes community college classrooms as living laboratories to prepare biotechnology industry personnel to serve as effective visiting, adjunct, and/or full time instructors in biotechnician education programs.

The second monograph in the series, which also became available in Fall 2002, documents a successfully implemented multidisciplinary / multi-college industry internship program conducted at a bio-pharmaceutical manufacturing company for faculty currently developing and/or operating biotechnician education programs.

For additional information about these projects and related training opportunities, contact Bio-Link's Southwest Regional Center @ 619-388-3081, or e-mail Richard Buecheler: rbuecheler@cact-sd.org; Herald Kane: hkane@sdccd.net, or Joan Stepsis: jstopsis@cact-sd.org; or connect with us through our link on the Bio-Link website at www.bio-link.org .

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The purpose of the project documented by this monograph has been to develop and field test a transferable model for training bioscience industry personnel to serve as instructors in community college biotechnician education programs. The project has been funded through a sub-grant to San Diego City College (SDCC) from City College of San Francisco (CCSF), which serves as the primary grantee and administrator for the National Science Foundation's (NSF) National Advanced Technological Education (ATE) Center for Biotechnology (Bio-Link). Dr. Elaine A. Johnson is Director of Bio-Link's National Center headquartered at CCSF. San Diego City College utilizes its sub-grant funds to operate the Southwest Regional Center of Bio-Link, which serves five southwestern states. The project described in this monograph has been a special project of the Southwest Regional Center.

DOCUMENT CREDITS:

Final project documentation was prepared by Dr. Joan A. Stepsis, Dean of Applied Competitive Technologies at San Diego City College (SDCC), and Director of the Southwest Regional Center of Bio-Link. Dr. Stepsis has over twenty years of experience in the development and implementation of technician education programs and in the training of industry personnel to teach in community college classrooms and laboratories. Dr. Stepsis assisted in the conceptual design of the project, served as project manager during its implementation phase, and became lead technical writer for the current dissemination phase.

The resulting monograph is based on the findings and results of an evolving biotechnician education program developed and conducted at SDCC for which Dr. David L. Singer, Professor of Biology/Biotechnology has served as faculty coordinator and lead instructor. The preparation of the current manuscript utilized observational notes and draft materials submitted by Dr. Singer. Dr. Stepsis integrated these materials into the conceptual framework of the project to produce the final monograph.

ACKNOWLEDGEMENTS:

Neither this project, nor the resulting monograph, could have been conducted or completed without the advice and assistance of the many bioscience industry personnel who contributed their time, materials, equipment and expertise to the project. In particular, we want to thank those industry instructor participants and biotechnician student-trainees who subjected themselves to our "experimental design". Hopefully, all benefited and have become better instructors/trainers and biotechnicians as a result of their involvement in the project.

Lastly, we wish to express our genuine appreciation for the support and patience of Dr. Elaine Johnson, and the assistance of her staff, both in the conduct of the study and the preparation of its documentation.

ABSTRACT

Training Industry Personnel as Instructors for Community College Biotechnician Education Programs: The Industry Instructor Practicum Model

Bio-Link is the National Advanced Technological Education (ATE) Center for Biotechnology funded by the National Science Foundation (NSF). Bio-Link's mission is to strengthen and expand biotechnology technician education at community and technical colleges throughout the nation. In order to achieve its mission, Bio-Link funds the development, implementation and dissemination of models and methodologies designed to increase the number and diversity of well-trained biotechnicians in the workforce. Critical to this effort is the systematic preparation of qualified instructors to staff these biotechnician education programs. This monograph is a product of Bio-Link that clearly focuses on this latter goal. The monograph has been prepared to facilitate the dissemination of a tested and proven model of instructor training that can be utilized by colleges throughout the nation to guide the systematic preparation of qualified instructors in numbers adequate to staff industry responsive, regional biotechnician education and training programs.

- The monograph offers community college faculty and administrators, now contemplating or currently implementing biotechnician education programs, the justification, guidelines, and a proven methodology that may be utilized to enhance the involvement of local industry personnel in the cooperative planning, teaching, and assessment of such programs.
- The monograph can also function as a manual for operating a teacher-training program that utilizes the community college classroom as a living laboratory to prepare industry experts to serve as effective biotechnology instructors while simultaneously enhancing the employment preparation and prospects of students enrolled in biotechnician education programs.

The monograph begins with an overview of the advantages of utilizing industry instructors as Community College instructors; while cautioning that although industry personnel bring up-to-date expertise to college classrooms, they often have little direct experience in how to effectively transfer their knowledge and skills to students. It then explains how instructional competencies can be developed through the use of the Industry Instructor Practicum model. This discussion begins by reviewing the tasks and responsibilities of the faculty coordinator in developing and implementing the model. Next, the recruitment/selection of industry instructor interns is described in detail. The subsequent section of the manual sets the scene for the instructional environment that must be created for a successful Practicum to occur. This section discusses the instructional sessions, describes the interplay of roles and responsibilities during these sessions, and outlines the manner in which instructional interns can be taught to evaluate student outcomes in this unique contextual teaching/learning situation. The manual then covers the strategies that the faculty coordinator can utilize to teach instructional methodologies in the living laboratory provided by the community college classroom and goes on to describe how a faculty coordinator can systematically accumulate observational data to produce performance reviews of industry instructors. These performance reviews generate specific recommendations for more effective teaching, which if implemented will also translate into more effective learning outcomes for students. Finally, administrative issues and fiscal considerations are delineated and recommendations for implementing the model are discussed. The appendix provides several documents necessary to understand and/or utilize this monograph as a training manual.

TITLE PAGE/ ADDENDUM

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ABSTRACT

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Training Industry Personnel as Instructors for Community College Biotechnician Education Programs

CHAPTER ONE: Introduction to the Industry Instructor Practicum Model

1. Bio-Link

Bio-Link is the National Advanced Technological Education (ATE) Center for Biotechnology funded by the National Science Foundation (NSF). Bio-Link's mission is to strengthen and expand biotechnology technician education at community and technical colleges throughout the nation in order to:

- Increase the number and diversity of well-trained technicians in the workforce;
- Meet the needs of industry for appropriately trained technicians; and
- Institutionalize community college educational practices that make high-quality biotechnology education available to all students.

In order to achieve its mission, Bio-Link funds the development and implementation of activities intended to:

- 1) Develop, implement, and then disseminate, industry responsive technician education and training programs designed to increase the number of skilled workers available to the biotechnology industry as regionally appropriate.
- 2) Design, field test, and disseminate models and appropriate methodologies for the systematic preparation of qualified instructors in numbers adequate to staff the programs referenced in goal number one (1) above.
- 3) Provide a sophisticated, time-sensitive, user friendly, web-based, national communications link and clearinghouse for information and curricular materials pertinent to biotechnician education and training. (www.bio-link.org)
- 4) Design a responsive and manageable referral system, which facilitates the matching/utilization of the specialized expertise of the various Bio-Link partners and associates to provide person-to-person consultation, coaching, and direct technical assistance to start-up programs within and among regions.
- 5) Appropriately coordinate the Community College focused efforts of Bio-Link with the related programs of educational providers at the middle school, high school, four-year college, and university levels through joint activities, networking, and articulation agreements.

This monograph is a product of Bio-Link that clearly focuses on goal number two (2) above. The monograph has been specifically designed to disseminate a model and relevant methodologies which can be utilized by community and technical colleges throughout the nation to facilitate the systematic preparation of qualified instructors in numbers adequate to staff industry responsive, regional biotechnician education and training programs.

2. Specific Purpose of this Monograph

This monograph has been produced by Bio-Link's Southwest Regional Center at San Diego City College (SDCC) in Southern California for the purpose of disseminating a successful model developed and implemented at SDCC to prepare industry personnel to serve as instructors in the College's biotechnology capstone courses.

- The monograph offers community college faculty and administrators, now contemplating or currently implementing biotechnician education and training programs, the justification, guidelines, and a proven methodology that can be utilized to enhance the involvement of local industry personnel in the cooperative planning, teaching, and assessment of such programs.
- The monograph is also a manual for establishing and conducting training programs for industry personnel, which will prepare such professional experts to serve as effective instructors in community college classrooms.

3. The Capstone Biotechnician Education Program at San Diego City College

History: In the fall of 1994, SDCC inaugurated a "capstone" course ("Biotechnology Instrumentation") to prepare students having prerequisite coursework in chemistry and biology for entry-level Research and Development (R&D) technician positions in local biotech companies. The 6 unit (200+ hour) evening course was patterned after one originally offered at Contra Costa College, in the San Francisco Bay area, wherein industry personnel served as guest lecturers and lab instructors, while a full-time faculty member was the instructor-of-record. The faculty member served as the course "coordinator" who recruited the guest instructors, chaired curriculum planning meetings, assisted the guest instructors in lesson planning and presentation methods on an as-needed basis, and then, informally evaluated the industry personnel and formally evaluated participating students.

The catalog description of SDCC's Biotechnology Instrumentation course reads: "An advanced laboratory/lecture course implementing major techniques used in the biotechnology industry. It includes experiences in media preparation, assays and manipulation of DNA and protein, growth of cells and viruses, scientific information retrieval, and technical writing." In the spring of 1999, a separate industry-taught "capstone" course ("Bioproduction Technology"), which was also preceded by chemistry and biology prerequisites, was launched at SDCC to begin addressing the local industry need for qualified entry level technicians in small batch bio-production and large scale bio-pharmaceutical manufacturing. The catalog description of the Bioproduction Technology course reads: "This course prepares students to work in the bioscience industry as production technicians. A production technician operates and maintains the equipment used to manufacture pharmaceutical products. Students will grow cell lines such as bacterial, yeast, insect, and mammalian and will then recover

desirable end products. They will follow good manufacturing practices by maintaining records in order to comply with quality assurance procedures and government regulations.”

Outcomes: As of 2001, seventy-seven industry instructors representing 29 companies/institutes have been involved in the development and implementation of these two courses at SDCC. Due to the skill training and positive job references provided by these instructors, 78 students who enrolled in these two courses have obtained employment in the biotechnology sector. Many of these instructors have subsequently taught and/or been instrumental in the development of technician training programs at five other community colleges in the San Diego region. Several industry instructor trainees have gone on to teach as part-time (adjunct) instructors of the prerequisite courses (General Biology and Microbiology) and/or of biotech courses at other regional colleges. In the fall of 2001, one of these industry instructors accepted a tenure track position in biology/biotechnology at another local community college.

4. Evolution of the Industry Instructor Practicum Model

In 1998 when SDCC became the Southwest Regional Center for Bio-Link, the opportunity arose to further professionalize and field test the industry instructor training model, which had been in development since 1994. The Bio-Link funding allowed faculty to formalize both the model and its methodologies, and ultimately, to prepare a manual that would facilitate dissemination of the model nationally. Therefore, release time was provided via Bio-Link funding to allow the lead faculty person at SDCC to formalize the program components, including the faculty guided student-teaching experience that has come to be known as the *Industry Instructor Practicum*, and to document the program model and methodologies. Bio-Link also provided stipends to the industry instructor trainees who participated in the program. This allowed the faculty coordinator to establish more formal requirements for program participants and a more rigorous evaluation procedure for those industry personnel participating in this innovative contextual teaching/learning opportunity.

5. A Roadmap for the Reader

The remainder of the monograph is organized as follows:

- **Chapter Two** begins with a review of the potential advantages of utilizing industry instructors as community college instructors; while cautioning that although industry personnel bring up-to-date expertise to college classrooms, they often have little direct experience in how to effectively transfer their knowledge and skills to students. It then explores issues that need to be considered when making the decision to involve industry personnel in the development and implementation of community college curriculum and programs. If the decision is made to involve industry personnel in actual teaching situations, the chapter goes on to explain that

instructional competencies can be developed through the use of the Industry Instructor Practicum model. This discussion begins by emphasizing the importance of a clear delineation of roles and responsibilities that will need to be established for this unique teaching/learning situation to be successful. The tasks and responsibilities of the faculty coordinator in developing and implementing the model are then outlined. Finally, criteria that can be utilized to recruit and select industry instructor interns are presented and described in detail.

- **Chapter Three** sets the scene for the environment that must be created for a successful Practicum to occur. This chapter discusses the instructional sessions, describes the interplay of roles and responsibilities during these sessions, and outlines the manner in which instructional interns can be taught to evaluate student outcomes in this unique contextual teaching/learning situation.
- **Chapter Four** covers the strategies that the faculty coordinator can utilize to teach instructional methodologies in the living laboratory provided by the community college classroom. The chapter goes on to describe how a faculty coordinator can systematically accumulate observational data to produce performance reviews of industry instructors. The performance reviews generate specific recommendations for more effective teaching techniques that, if implemented, will also translate into more effective learning outcomes for students.
- **Chapter Five** provides a summary of the foregoing chapters, reviews administrative issues and fiscal considerations, and provides additional recommendations for implementing the model described in this manual.
- **Appendix:** The appendix provides several documents necessary to understand and/or utilize this manual. These include:
 1. **Instructional Planning Guidelines for Industry Instructor Participants**
 2. **Forms for Use by Industry Instructor Participants to Rate Students**
 3. **Forms for Use by Students to Rate Industry Instructor Participants**
 4. **Sample of a “Final Evaluation Report” of Participating Industry Instructors Prepared by the Faculty Coordinator**

CHAPTER TWO: Industry Professionals as Community College Instructors

1. Advantages of Utilizing Industry Professionals as Instructional Personnel in Community College Bio-Technician Education Programs

a) Industry professionals serving as instructional interns and part-time instructors can form a highly effective internal advisory team for faculty.

When industry professionals become involved in the actual design, implementation, and evaluation of community college bio-technician training programs, the college immediately gains an “internal” advisory board far more effective than the more traditional “external” advisory board composed of visiting industry experts. Industry personnel involved in the actual delivery of community college courses can more effectively serve to bridge the gap between theoretical knowledge and current industry practice, thereby helping to create a truly contextual training environment. A team of industry instructors “live” the subject matter content on a daily basis. Instructors currently working in industry have constantly updated perspectives that can at best be only simulated by a college faculty member.

Advisory boards composed of industry personnel who have not been involved in college-level teaching, often do not appreciate the differences between educational programs and skill-training programs or between pre-service training in an educational context and inservice training delivered in the context of the workplace. These external advisors often fail to anticipate the adjustments that need to be made in adapting inservice training packages for incumbent workers to pre-service training in the educational context of the college classroom. Likewise, faculty members who have never functioned in an industrial environment often fail to appreciate the need to translate theoretical concepts into the practical applications and skill-based competencies critical to the future employability of their students as bio-technicians. Therefore, when industry personnel and the faculty academician can directly interact in the development and implementation of a pre-service training program, their respective experiences are modified to optimize the teaching/learning environment and to facilitate the efficient and effective delivery of bio-technician education.

b) Industry personnel serving as instructional interns, adjunct, and visiting instructors in community college classrooms can benefit personally and professionally, thereby strengthening collegial bonds and collaborative ventures.

To create an optimum industry-taught pre-service training environment, there must be benefits for the participating industry instructors as well as for students. These perceived benefits should be greater than the apprehension created by the prospect of teaching in a college classroom. Instructors need to have reassurance that their concerns about teaching for the first time will be allayed by a supportive atmosphere.

Prospective industry instructors evidence a wide variety of personnel and professional motives for becoming involved in community college instructional activities. Prospects might be former community college graduates who would like to “repay” the college for their practical education. Others become involved in teaching in order to have the opportunity to develop the skills necessary to function as in-service trainers in their current workplaces. Other potential instructors have advanced to an executive administrative position, which excludes them from supervisory work in the laboratory; and therefore see the pre-service program as an opportunity to return to their former role in technician training and supervision. The pre-service training environment also enables industry personnel to reliably screen candidates for positions in their own company, which may also make them eligible for employee referral bonuses. One industry executive, whose company has hired a number of students from community college biotechnician training programs, remarked that graduates of such programs represent reduced hiring risks in that they demonstrate accelerated learning curves, more positive attitudes in the workplace, and lower rates of attrition.

Besides the satisfaction of performing a genuine service to the community, there are many “closet teachers” who find teaching itself to be highly rewarding. A number of industry instructors involved in the internship program at San Diego City College have actually decided to turn their avocation for teaching into a vocation and have applied for (and even secured) tenure track faculty positions at area community colleges.

c) Industry instructors can bring new excitement and energy to college classrooms.

Industry instructors, often aware of their particular teaching assignment well in advance, devote long hours in preparation, and come to class with a level of commitment & enthusiasm that is difficult (if not impossible) to sustain when a course is taught by a solitary professor. Students tend to reciprocate the “energy levels” evidenced by this succession of industry instructors, and they are reinvigorated with each change in instructional personnel.

d) Industry instructors often bring loaned/donated equipment and laboratory supplies to college classrooms that are unavailable or in scarce supply.

When industry personnel become immersed in pre-service training, they develop a clearer perspective of the equipment & supply needs of the program. They also have a greater personal stake in effecting actions to improve the situation. This heightened commitment to the program often translates into substantial contributions of needed equipment and supplies. Most biotechnician training programs begin with supplemental equipment funded by state or federal agencies. Both the R&D and BioProduction capstone courses at SDCC have received significant contributions of equipment and supplies from industry. When SDCC inaugurated its R&D course in 1994, a single company (Stratagene) of less than 200 employees (at the time) supplied the course with

access to essential equipment, professional expertise, and all necessary materials and supplies.

Equipment donated by industry for biotechnician training can also be used in other college biology and chemistry courses. The receipt of such equipment frees up limited institutional funds to purchase other needed equipment. Moreover, colleges can use the verified value of such donations as matching contributions for current and/or proposed grants.

e) Industry instructors provide performance reviews to students that reflect current industry standards and allow biotechnician trainees to adjust to different supervisory styles.

One of the most valuable aspects of an industry-taught biotechnician training program is the potential feedback students can obtain from the instructors. Not even in the workplace, do technicians receive weekly performance reviews. With each review, students obtain new feedback on the behaviors and attitudes that industry personnel perceive as positive, as well as those they perceive to be in need of improvement. If several industry instructors independently come to similar conclusions about an individual, the student is much more likely to accept his/her performance evaluation and be willing to accept help to remedy identified problems. The faculty coordinator and the individual student can judge the effectiveness of this behavior modification strategy by examining successive performance reviews. Managers tend to have a particular supervisory style. This environment, more than any other, promotes rapid adaptability to supervisory styles.

f) Industry instructors accelerate the placement of a program's students.

Many open positions are first advertised inside a particular company. Therefore, utilizing instructors from many different companies gains students access to information about job vacancies before they are published. In addition, students' participation in the college training environment allows them to informally "apply" and try out for jobs as they routinely progress through the program. Students know they are being informally interviewed as they interact with industry instructors and learn laboratory protocols from them. Rather than being harmful, this environment of "positive stress" further motivates students and assures their best effort.

Students hired by industry from community college biotechnician education programs serve as the best advertisements for these programs, while industry personnel who have helped develop, implement, and improve these programs are the most effective marketers of program graduates.

g) Availability of a pool of trained industry instructors can accelerate development of community college bio-technician training programs in a region.

The greater the availability of trained industry personnel to serve as visiting, adjunct, and full-time instructors in community college programs, the more quickly new programs can be set up when needed. The more companies that are involved, the more opportunities there will be to obtain equipment and supplies for new programs and to find employment for program graduates.

h) Involving industry in program development and implementation can result in new cooperative ventures and income generating activities.

Industry partnerships and involvement in community college program development and delivery can serve to increase both the capacity and the credibility of community colleges as qualified providers of direct technical assistance and workforce training to regional companies. The development and delivery of industry relevant fee-based seminars, workshops, and customized contract training can produce income to enhance and support college programs. Such local revenue can be utilized to purchase equipment and supplies, and/or to maintain and upgrade laboratory equipment and facilities.

i) Industry involvement makes the college more attractive to funding sources that promote industry/education collaboration in program development.

Partnerships with industry to develop, teach, and/or improve pre-service training programs can increase the likelihood of receiving funding from local, state and federal agencies, which often require evidence of industry involvement and private sector matching contributions when grant proposals are submitted to them.

j) Industry involvement can provide the college with “positive press” portraying it as an institution sensitive to the employment and training needs of the community.

News reports in the local media which portray the college as pioneering industry relevant technician education programs offering local residents specific pathways to employment in high-skilled, high paying jobs will not only serve to increase enrollment in the school’s industry specific courses, but in its prerequisite courses as well.

2. Special Pedagogical Issues to Consider When Utilizing Industry Personnel to Develop and Teach Biotechnician Education Programs

a) Recognition of the college faculty member's pedagogical expertise

A college faculty member, contemplating the investment of an “extra-ordinary” type of effort to organize a course, which will be serially taught by recruited industry professionals, must be convinced that the advantages of this approach outweigh disadvantages and alternatives. Besides harboring a belief that an academic and industry partnership would best achieve the goal of effectively educating students for careers in biotechnology, the faculty member must also feel assured that s/he has the background to initiate this effort. Successful college teachers have experience in establishing environments that promote learning in adults. Lessons the faculty member has learned and practiced repeatedly to improve the teaching/learning environment can be tapped to develop and implement an industry instructor training program.

Prospective industry instructors will more likely want to teach if they are assured that their teaching experience will be successful. College faculty can prepare and guide fledgling industry instructors to increase the instructional value of their efforts. It is the college faculty member who is best qualified to become a teacher-trainer by utilizing general pedagogical lessons learned from the practice of his/her profession to make the industry experts more effective instructors. “Supervising supervisors” requires that the faculty member, who coordinates the effort, reflect on past pedagogical practices and convert them into transferable lessons for industry instructors.

b) Recognition that the pre-service training environment is not an in-service training environment

Industry instructors are accustomed to training a previously qualified and screened individual for an approved and carefully described position, function, or specific task in the workplace. This would be considered “in-service” training. An in-service environment assumes incumbent workers are functioning at a level of sophistication that pre-qualifies them for re-training on specific tasks and/or for up-grade to a new functional level or job classification.

At the college level, students are in a “pre-service” training environment. This environment is significantly different from the in-service environment. In the pre-service environment, a group of adults representing a range of competency and confidence levels is being prepared and qualified for employment. Although there are many valuable lessons to be transferred from the in-service to the pre-service environment, attempting to simply replicate a collection of industry in-service training events in the context of a community college classroom will not suffice to satisfy the requirements of a collegiate course of instruction.

Therefore, the pre-service training environment prioritizes time for students to understand the principles underlying the experienced protocols. It systematically develops documentation, communication, problem solving and analytical skills in addition to the development of specific skill sets and work attitudes that are positively associated by industry with the employability of biotechnicians.

c) Recognition that the faculty coordinator and industry instructors have complementary experiential perspectives that need to be adapted to the collegiate level pre-service training environment.

College faculty in biology and biochemistry who are considering becoming involved in the coordination of an industry-taught bio-technician training course typically come from academic rather than vocational/technical departments. They have proven professional expertise in systematically developing conceptual knowledge and cognitive and manipulative abilities among adult populations. Although the courses they teach have an applied aspect, they often have little experience in teaching vocational/technical courses that produce skilled technicians ready to apply for industry employment immediately following course or program completion.

Expert teachers meld knowledge from 3 sources: expert knowledge of their field (subject matter content), basic teaching methods (general pedagogy) and knowledge of tactics that facilitate the teaching of the specific discipline (pedagogical content knowledge). When organizing and implementing a pre-service biotechnician training program, there is no single expert. The “expert teacher” in an industry instructor taught college course is, in effect, a consortium, where the faculty coordinator supplies the general pedagogy, the industry professionals are responsible for the subject matter content, and both work from their experiential vantagepoints to jointly develop competent biotechnicians.

3. The Decision to Implement the Industry Instructor Practicum Model

The two preceding sections of this chapter have provided a review of the advantages to be gained from utilizing industry personnel as instructors in community college biotechnician education programs. Industry experts can bring a wealth of current conceptual knowledge and practical application skills to the college classroom. In return, college faculty can contribute the pedagogical expertise needed to assist industry personnel convert these resources into effective classroom instruction. If a successful partnership is forged, the synergistic output will be sophisticated biotechnicians who can appropriately analyze, troubleshoot, and systematically document technical processes and procedures in research and development and/or production settings in biotechnology enterprises. However, prior to making a final decision to implement a practicum program to prepare industry personnel to serve as college instructors, two additional issues need to be carefully considered:

- 1) Is a faculty member available who is willing and able to invest the extraordinary effort required to successfully implement the model?
- 2) How will industry personnel be recruited and selected to participate as interns in the program?

4. Faculty Responsibilities in Practicum Development & Implementation

Listing the major obligations/responsibilities of the faculty internship coordinator helps to define the personal and professional investment that a faculty member must be prepared to make in order to assume this role. It also provides justification to college administrators and department chairs for requested adjustments to the faculty member's teaching load and/or for his/her re-assignment to release time.

The faculty coordinator who will oversee the development and implementation of an Industry Instructor Practicum will have the following programmatic responsibilities:

a) Serve as spokesperson and champion for the program, and be prepared to invest extra-ordinary amounts of time in recruiting/selecting/training industry interns and in soliciting additional resources for the program.

In addition to the already demanding course preparation and student recruitment activities that are required for the effective operation of any pre-service biotechnician education program, the practicum coordinator will also be responsible for recruiting and selecting the industry instructor interns who will participate in the program. The coordinator may also be expected to take responsibility for securing additional program resources that will be required to implement the internship model and will be expected to work with industry, and with local, state and federal funding sources to secure these resources. Although still serving as the instructor-of-record for the course, the coordinator will also be expected to cede significant portions of the course content to the interns to teach. And inevitably, the coordinator will also find him/herself called upon to serve as the main spokesperson, champion, and cheerleader for the industry instructor internship model before a wide variety of audiences including stakeholders and potential benefactors.

b) Perform the following programmatic activities which represent added tasks and responsibilities resulting from the overlay of the internship model on the operation of a pre-service biotechnician education program: (Note that these activities will be discussed in further detail in the next two chapters of this manual.)

- **Recruit and select industry instructor interns.**
- **Prepare for and conduct pre-semester meeting(s) at which interns will receive an orientation to the program, complete necessary paperwork, be scheduled/assigned to instructional sessions/modules, and be taught the basic requirements of lesson planning for college-level lecture/lab classes.**
- **Work with instructional interns to develop protocols and exams. Preview planned lessons, revise/refine written protocols and planned laboratory**

activities, and review/modify student assessment strategies and suggested exam questions.

- **Arrange a pre-semester “icebreaker” event for instructional interns and student-trainees that showcases the industry credentials of the instructional interns, and the program relevant backgrounds that the student-trainees bring to the course. The event facilitates name/face recognition among and between the two sets of participants and helps each group to better understand the other’s individual and collective goals/roles.**
- **Formally address the class briefly at every session to link sessions, coordinate activities, review deadlines, go over exams, and provide supplementary information necessary to facilitate curriculum integration.**
- **Serve as an auxiliary lab tech and secondary teacher/mentor to bridge information gaps and to capture and verbalize important conceptual connections to prior sessions, while being careful to supplement, not challenge the contributions of the instructional interns.**
- **Participate in intern-led sessions as an empathic student to better assess and provide feedback on teaching effectiveness; gather both written documentation and videotaped segments for use in preparing intern evaluations.**
- **Maintain a session-by-session chronology of class proceedings; and issue a weekly e-mail update/report to all instructor interns to keep them involved and informed.**
- **Serve as instructor for special sessions as necessary and relevant, and proctor exams.**
- **Serve as the “conduit” between instructional interns and student-trainees, collecting, clarifying, and communicating feedback on each other’s performance so that instruction and learning can be improved.**
- **Market and track students capitalizing on the performance appraisals and industry contacts developed as result of the internship program.**
- **Market the pool of newly trained industry instructors to other regional community colleges starting biotechnician education and training programs.**

5. Recruitment Criteria for Industry Instructor Practicum Participants

In recruiting and selecting industry instructor practicum participants, the faculty coordinator should seek out industry personnel who meet the following criteria:

a) Can support the proposition that community college students having mastered one year of lower division college-level chemistry and one year of biology (including a lab-oriented microbiology course) can be taught the skill-sets necessary for employment as biotechnicians in entry level positions in industry when offered only six (6) additional units of college level industry specific laboratory instruction.

If potential instructors have the mind set that a bachelor's degree is an essential requirement for entry level technicians in the biotech industry; they are likely to communicate this bias in interacting with student trainees. Such instructors may be perceived as favoring those students who have completed upper division coursework and/or already possess a four-year degree. Such students often enroll in community colleges courses that focus on industry relevant lab skills. This could, of course, result in discouraging the native community college students, who have only the prerequisite coursework noted above, from persisting in the course of study and achieving the goal of employment in a bioscience company.

b) Have hands-on experience as a technician and/or in the training and supervision of biotechnicians.

Industry instructors must have been a technician, supervised technicians, and/or trained technicians to have an experiential understanding of the concepts, skill-sets and attitudes that need to be fostered in the pre-service environment.

c) Enjoy the prospect of teaching a diverse group of individuals of various ages, cultures, academic and occupational backgrounds.

Industry instructor interns must not only exhibit flexibility in adapting to the particular demographics of the class, but should also be able to welcome the opportunity to adjust their supervisory style in response to these population factors.

d) Have empathy and patience with students, and remember that proficient technicians do not arrive full-born, but rather need to be “incubated” to mastery through skillful training and artful instruction.

Tasks quickly achieved in an in-service training environment will take much longer to teach in a pre-service environment. Certain students, given minimal laboratory experience, and possibly faced with other obstacles to learning (e.g., limited English proficiency) may come across as unprepared in the eyes of an instructor who is applying an in-service perspective to a pre-service situation. Students learning a

protocol for the first time, require signs of encouragement from their instructor, not displays of impatience.

e) Be willing to design and teach a complete laboratory protocol either alone or as a member of an instructional team and be willing to accept performance feedback from the faculty coordinator, peers, and student-trainees.

In Chapter 4, characteristics associated with the development of a complete protocol are identified. The effectiveness of the design and delivery of this laboratory activity will be evaluated by the faculty coordinator so that the instructor-in-training can assess the impact of his/her instruction on student-trainees in the development of workplace skills and attitudes. Students will also assess the instructional intern, as will peers, as appropriate.

f) Strive to obtain (from other colleagues if necessary) most of the reagents and equipment necessary to effect the intern's protocol.

Instructional interns should expect to use their company contacts and ingenuity to obtain equipment and supplies necessary to present his/her protocol. Effective trainees do not let the college's lack of industry standard equipment and restricted supply of materials, thwart the teaching of key laboratory methodologies. However, when college equipment is to be used for an instructional session, the intern takes responsibility for making the necessary arrangements with the coordinator and/or the departmental lab technician to ensure the timely arrival of the equipment. Alternately, if company equipment or supplies are to be utilized for an instructional session, the intern takes the initiative to make the necessary arrangements through appropriate company personnel; and/or if an instructional session is to be held at a company, the intern obtains required clearances for access to and use of the company facilities during non-operational hours.

g) Be willing to practice-teach the protocol before presenting it to the student-trainees, and then be willing to modify the written format (and any ancillary materials including background information and quizzes) in consultation with the coordinator in order to improve its effectiveness as an instructional tool.

Chapter 4 comments further on the preparation of the written protocol and development/delivery of laboratory activities. Industry instructors must recognize that to improve instruction and learning, preparation must be a deliberate, revisionary process involving input from the faculty coordinator.

h) Schedule and prioritize teaching dates so that the prospect of potential absences during one's assigned instructional sessions is minimized.

It is understood that training to teach is secondary to an industry instructor intern's company responsibilities. It is acknowledged that job responsibilities and schedules can change and conflict with an instructor-trainees preparation, implementation, and evaluation of a pre-scheduled teaching assignment. When an industry instructor intern agrees to teach a certain block of sessions, s/he must be certain that her/his schedule

can accommodate this responsibility. In addition, the intern should have a pre-arranged alternative plan (such as trading sessions with another intern) just in case an emerging work situation, or health emergency, precludes the instructor's involvement in a pre-scheduled session.

i) Be prepared to fully participate in the practicum experience.

Although an instructional intern's primary focus is on designing and delivering his/her protocol session(s), the instructor needs to be prepared to fully participate in the practicum experience by actively collaborating with his/her colleagues and demonstrating an interest in the progress of the entire course. The instructional intern will need to participate in a pre-semester orientation and planning session, and be willing to attend pre/post semester informal get-togethers with fellow interns, students, and the coordinator. The intern will also need to visit the classroom at least one session prior to the first assigned instructional session to become familiar with the facilities and the students. The intern should be willing to volunteer to join other instructors-trainees as evaluators of special sessions such as student seminars and mock employment interviews, and should read and respond to weekly e-mail reports chronicling sessions taught by predecessors and successors.

j) Remain available (by e-mail, phone, and/or fax) for discussions with students following one's teaching assignment.

Industry instructor interns should recognize that their instructional obligation doesn't conclude with the delivery of their session or module. Due to the serial teaching approach of the practicum model, the "deepest" student questions pertaining to a protocol often arise after the lab is completed and the instructor has been replaced by a successor. An instructional intern concerned about the accomplishment of learning objectives would encourage post-session communications with students.

k) Maintain long-term contacts with student graduates of the program.

Ideally, industry instructors remain as role models and vocational mentors to the students they have trained. Instructors market "promising" student graduates and help them prepare for available and appropriate positions in the industry. They also check on their students periodically to assess the success of these placements.

o) Be willing to share the curricular materials developed during the internship experience and be willing to have these materials adapted by others who will follow as practicum participants.

As industry instructor interns "graduate" from the practicum, the protocols they have prepared for their assigned instructional sessions can begin to form a resource library of curricular materials reflective of regional company practices and procedures. These materials can be utilized by subsequent interns, by faculty, and by trainers preparing industry responsive workshops and worksite training programs.

CHAPTER THREE: Setting the Scene for the Industry Instructor Practicum

1. Optimizing the Interactive Roles of Industry Instructor Intern(s), Biotechnician Students, and the Faculty Coordinator During the Instructional Session(s)

The utilization of community college classrooms as living laboratories for instructor training creates a teaching/learning environment characterized by a complex interplay of roles and responsibilities necessitating careful management by the faculty coordinator. The faculty coordinator, who officially serves as the “instructor of record”, has two distinct student populations with very different learning needs. One group consists of the college students enrolled in the institution’s biotechnician training program; the other group consists of the industry instructor trainees who are serving as “student teachers” in the program. Further complicating the situation is the fact that the model requires participating industry instructors to deliver their protocols more than one time in order to demonstrate improved performance based on the evaluation of the initial teaching assignment. Most industry instructors remain “interns” for several semesters or years in order to repeat the delivery of their protocols until they are satisfied with their performance evaluations. First-time teachers obviously require more time and attention from the faculty coordinator than do “returnees”.

Each of these groups has different and distinct needs for instruction, mentoring, and evaluative feedback from the faculty coordinator. The coordinator must create a positive contextual learning environment in which each group feels that its needs are being met and that each has an equal opportunity to attain the competencies promised by participation in the program. Therefore, successful facilitation of instructional sessions utilizing this format requires careful attention not only to the content and instructional methodologies being employed during the session, but also to the interplay of roles and responsibilities among the various types of participants. Careful pre-planning and the use of structured assessment and evaluation procedures are vital to managing this complex educational environment.

Chapter 3 addresses methods and instruments, which have been tested and found to be effective in the management and facilitation of community college classrooms, in which biotechnician trainees and industry instructor trainees are simultaneously receiving skill training.

2. Suggested Initial Start-up Activities: Diagnostic Tests, Formation of Lab Groups, and Morale Building

a) Diagnostic testing of prerequisite conceptual knowledge base

While undergraduate biotechnician training programs typically require that specific prerequisite courses be taken prior to entry into a program, it is nevertheless prudent to assess each incoming group of students to determine individual and collective mastery

of the underlying scientific and mathematical concepts upon which laboratory training in biotechnology is dependent. This is critical as students need to be given a gauge of how much they recall from their past academic experiences and how much they need to review to effectively maintain learning pace. At the same time, instructors and instructional interns need to be made aware of the general knowledge base that can be “tapped” to construct more advanced industry pertinent concepts and laboratory skills.

The faculty coordinator needs to a) identify key concepts from prerequisite courses that will be utilized as a knowledge base for industry instructors and students to build upon, b) design exam items to assess comprehension of these concepts, and c) identify prescriptive measures (tutors, websites, textbooks and problem-solving workbooks) to compensate for lack of prerequisite conceptual understanding indicated by specific blocks of missed questions.

The diagnostic test developed at San Diego City College for this purpose currently consists of 40 multiple choice questions to test students’ knowledge of “biotech-applicable” principles of chemistry and microbiology. The faculty coordinator at City College, who also teaches General Microbiology (an essential prerequisite for any biotechnology program) initially designed the exam and then had a chemistry instructor review/modify the chemistry portion of the test. The instrument has been continuously modified and revised over a seven-year period in response to evaluative feedback from faculty, students and industry instructors. Such modifications have resulted in a reduction of evaluative student comments such as “Most of what we were tested on was not relevant to the course or protocols” and to an increase in comments such as “Put me in my place! Frightful but necessary.” “This test gave me much needed awareness of where I had been and where I need to go.” “Many facts forgotten had to be resurrected.” “Valuable for letting students identify deficiencies in knowledge base.”

The diagnostic test (unannounced in advance) is administered over a 75-minute time period. Students at SDCC taking the exam over the past several years have averaged 53-60% on both the chemistry and microbiology portions. Students are responsible for correcting and explaining all missed questions, and are required to include corrections in their portfolio notebooks. It is advisable for industry instructor interns to review the diagnostic exam so that they can suggest ways to make it increasingly industry pertinent. Most importantly, however, the exam gives the industry instructor interns a clearer understanding of the prerequisite knowledge students are expected to bring to the course. This information is critical to the effective preparation of lesson plans by the instructional interns.

b) Suggestions for lab-group composition and management

It is suggested that at the first session, students be arranged into lab groups composed of 3-4 students each. The number per group depends on the size of the class and the availability of materials to enable hands-on opportunities for all students. Groups should persist for 4-5 weeks, then be rearranged so that students can learn to collaborate with the differing personalities of co-workers, just as they are likewise expected to adapt to a series of new industry instructor “supervisors” over the course of the semester. Industry

instructors have recommended group rearrangement several times in the semester because instructors hope to increase opportunities for conflict resolution when personalities initially fail to mesh. The coordinator determines the first lab group arrangement. Criteria used to designate groups may include such factors as: 1) having at least one person with some biotech industry experience per group, 2) equalizing gender, 3) separating “friends” (from the same prerequisite class or co-workers from the same company), and 4) splitting up ESL (English as a Second Language) students (to reduce conversing in a language foreign to other members of the group). On the first day of class, students are given a brief group assignment, which requires them to collectively present their conclusion on the blackboard or overhead projector. This activity allows the faculty coordinator to check the viability of the groups s/he has initially composed.

Industry instructor interns who have already taught the class should recommend subsequent group compositions. These recommendations are often based on assessment of interpersonal, “soft” skills. Students tend to appreciate the positive trade-off of rearranging groups just as they become comfortable with their present one. Semester-end evaluation comments typically are: “Allows us to get to know each other; I was able to work with people who already work in the industry and gain knowledge and learning from them.” “This benefits students to experience dealing with different groups of people and learn how to handle situations.” A reflection of what happens in the real world; different projects may have different groups working on them.” “Excellent, you get to know everyone and learn from them.”

c) Morale building and group cohesion

Given the complexity of goals and roles necessitated by the Industry Instructor Practicum model, it can be extremely helpful to give all of the participants an opportunity to get to know each other a little better by holding a pre-semester get-together before actual instructional sessions begin. Such an “ice-breaker” event provides an opportunity for both instructional interns and their biotechnician student-trainees to get to know one another prior to their initial interaction in the classroom. This is especially important if the industry instructor interns are each teaching only a single module of the upcoming course. Meeting beforehand allows students to get a sense of who the instructional staff will be over the length of the semester, while also giving them a good feel for the wealth of professional expertise that will be upcoming and available to them during the course of the program.

On the first day of class, it is also advisable, if possible, to invite several former industry instructor interns and past student-trainees (if the course is in its second-plus offering) to stop by and give the new recruits a “pep talk”. These talks help to validate individual participant decisions to invest personal time and energy in the program. Since it is natural for the student-trainees to be apprehensive about enrolling in a rigorous course of study essential to hoped-for employment, the identification of the rewards to be reaped by successfully completing such a program will serve to fortify student convictions of the rightness of their enrollment decisions. Likewise, industry personnel who have decided to participate in the internship program, also require reassurance that the ultimate rewards for participation will outweigh the large investment of time and the

predictable performance anxiety that can be expected to accompany their involvement in the program.

3. The Dual Roles & Responsibilities of the Community College Faculty Coordinator during Instructional Sessions

a) The process and importance of initial role clarifications

As previously noted, the faculty coordinator serves in dual roles during the instructional session. While engaged in the education of the students enrolled in the college's biotechnician training program, the faculty member is simultaneously training industry personnel to function effectively as community college instructors. During a particular instructional session the coordinator has interactions with both the biotechnician students and the industry instructor intern(s). The faculty member is responsible for maintaining course continuity for his/her students but is not the principal instructor of the class when the interns are present. The faculty coordinator also serves as the expert in pedagogical methodologies for the "student teachers" but rarely delivers instruction when they are present. Given the complexities of this teaching/learning environment, it is critical that during the first session of the course, these multiple roles are thoroughly explained to the biotechnician student trainees. As students review the course syllabus on the first day of class, they will become aware of the number of industry instructional personnel who will be conducting and/or team teaching laboratory modules and even sub-modules of the course of study. As a result, they will naturally be concerned about who will actually be evaluating them and assigning a grade. Therefore, the instructional methodologies and evaluation procedures to be utilized in the course need to be clearly explained, and student concerns addressed, at the onset of the term. Otherwise, students may continue to be confused and anxious throughout the semester about how to cope in this complex learning environment. If so, there is the risk that these students will be distracted from the more important instructional tasks at hand and will fail to fully benefit from the bounty of industry expertise available to them via the industry instructor-trainees in this resource rich, laboratory learning situation.

b) Faculty coordinator activities during instructional sessions

At the beginning of each session, the faculty member can reaffirm his/her role as course coordinator by leading a 10-20 minute "Coordinator's Corner" for students. This activity can include such items as: 1) local biotech company news, 2) job announcements, 3) job tracking news of current & past students, 4) identification of new handouts such as upcoming protocols and articles to improve job hunting skills, 5) announcements of upcoming biotech-relevant events such as free public seminars, 6) a review forum of past instructor sessions, 7) reminder of assignment deadlines, 8) announcement of availability of coordinator-graded and past instructor-graded assignments as well as instructor performance reviews of students, and 9) introduction of the current industry instructor taught session (and integration to past instructor sessions). The Coordinator's Corner topics are presented in an outline format and printed copies are made available

for students. If an instructor anticipates a long laboratory session, the Coordinator's Corner is postponed to the "down" (incubation) period associated with most laboratory protocols.

The primary role of the coordinator during sessions is evaluation of the teaching /learning dynamic between industry instructor intern(s) and students. The faculty member collects raw observational data of this dynamic by videotaping up to 20% of the class as well as recording information in a notebook. When the camcorder becomes a permanent fixture of the instructional sessions, students become relatively insensitive to its presence. Written remarks by students at the conclusion of the semester regarding the use of videotape in the classroom typically include such comments as "I didn't even notice after the first session." or "Sometimes a little distracting, but for the most part I think it is beneficial, especially the video snapshots printed from them." Chapter 4 will further describe the observational data recorded by the coordinator and how it is used to complete a performance review of instructors.

Industry instructor interns are encouraged to visit the classroom at least one session before his/her teaching assignment begins. During these visits the coordinator takes time to assist the instructor-to-be in locating college-kept materials required for upcoming sessions and reviews lesson plans that have been undergoing revision. It is particularly helpful if the instructor-trainee can observe the conduct of a class session by another instructor-trainee and ask questions of the coordinator, thereby facilitating the "handoff " of instructional duties from one industry instructor to the next.

During an industry instructor intern-taught session, the coordinator may take the role of empathic student (e.g. collecting any handouts distributed by instructors to students and taking quizzes). He may also serve as an auxiliary lab tech to the industry instructor, obtaining materials requested on the spot when the regular lab technician is unavailable. When an industry instructor intern teaches alone, the coordinator can also serve as a secondary instructor, by asking questions to clarify ideas, referring to text pages to illustrate concepts introduced by the industry instructor, or by asking the instructor or a student to review past activities before progressing to the next procedure or conceptual point. The coordinator strives to adjust the pace of instruction with these "interruptions" so that learning by students can be optimized and instructors have a momentary respite to collect their thoughts, and informally receive feedback on their teaching.

During down periods, the coordinator stages 5-minute one-on-one sessions with students during which he/she goes over student materials graded by him/her and performance reviews of students by a past instructor. These sessions provide an ongoing mechanism for students not only to find out about teacher impressions, but to air current concerns about one's progress in the course. The format for performance reviews will be examined at the end of this chapter and again in Chapter 4.

Besides the first day of class, there can be several sessions during which the coordinator actually serves as the course instructor. He or she may lead sessions on Good Laboratory Practice or library information retrieval. Faculty coordinators need to

be reminded though, that each session taught by a faculty member is one less session taught by an industry instructor intern who can market the program and its students to his or her own company as well as to other companies in the region.

c) Using two or more industry instructors during one class session

One of the advantages of using two (or more) instructor interns per instructional session is that industry participation in community college pre-service biotechnician training classes is increased. Another major advantage of utilizing dual (or multiple) instructors is that they serve as mutual sounding boards to each other in lesson planning. In addition, dual instructors can offer students different perspectives on the same topic, which can add to the development of more flexible viewpoints in the students. With two or more industry instructor interns, there are also more technical experts to help when troubleshooting is required. Multiple instructor interns can also serve to ensure that industry-supplied materials necessary for instruction, or to effect a particular lab protocol, are available to the program either through their own companies or from specific vendors/suppliers.

On the other hand, there is an “art” to team teaching that can make such instruction more complicated than solo teaching. It is the responsibility of the coordinator to assure that the benefits of team teaching a single session outweigh the added complexity. For example, when utilizing multiple interns during an instructional session, lab procedures should be scheduled prior to planned lectures to ensure that an instructor trainee facilitating a lab activity is not shortchanged due to an overly long lecture presentation given by his/her predecessor. During a presentation by one instructional intern, the other intern should serve as a secondary teacher asking or adding points of clarification much like a faculty coordinator would do, if he/she were the secondary instructor. During a lab procedure, both instructor interns should circulate among student groups to assess group progress and assist if necessary. If one instructor works with the students and another only works in the background with the equipment, then the “background” instructor will not get practice time in front of the class and cannot, therefore, receive feedback from the faculty coordinator on his/her performance. All instructional materials prepared by one instructional intern must be examined by his/her partner to ensure that their teaching effort is coordinated and will not become disjointed within a session. Feedback has greater impact when given promptly not only to students but also to instructor trainees. During a presentation, the coordinator can sit alongside the secondary instructor and comment on the quality of ongoing instruction provided by his/her colleague.

4. Role of Industry Instructor Participants in Evaluating Student Performance

In traditional courses, a teacher has a large number of sessions to focus on instruction; at the end of instruction, there is a final (summative) assessment. Conversely, with industry-taught classes consisting of a “revolving door” of instructor interns, the number of interactive events between each instructor intern and each student trainee is limited,

making traditional evaluation difficult. Consequently, such instructional interns must be taught to assess as they teach. Interns should be given a standard evaluation form to complete on each student trainee with whom they will be expected to interact during their teaching assignment. The form provides specific cues that will enable the interns to plan ahead and to assess as they teach. Use of such a standardized format for performance evaluation also allows students, who are receiving feedback from a number of instructional interns sequentially during the course of the semester, to get a clearer view of their own progress and development in the course.

Prior to their teaching assignment, instructional interns are given a set of evaluation forms for the class. In addition, they receive a “mugsheet” containing photos of students with lines beneath each picture that can be utilized to document any interactive event between student and instructor that will provide data to help complete the form on that individual. Using the mugsheet and rating form, instructor interns then purposely assess as they teach and view each encounter with a student and each instructional phase as an opportunity to gain information to arrive at a more complete summative and prescriptive evaluation.

Thorough completion of such performance reviews depends on the number of hours per instructional assignment and number of students in the class. Instructor interns using this form typically require 15-20 minutes to complete forms on each student. The completed rating form should include prescriptive information about a student’s employability. Each instructor then meets with the faculty coordinator in a two-hour debriefing session during which they: 1) review each student using the rating form as a guide; and 2) receive student ratings on their performance (See Chapter 4). The faculty coordinator encodes the evaluative information supplied by instructors into a computer to be made available to: 1) students in 5 minute one-on-one meetings during breaks in current instructional sessions; and 2) hiring managers seeking job references on student graduates.

5. Utilizing Lesson Planning to Identify Objectives and Outcome Criteria

a) Assessing performance outcomes based on instructional objectives

As a first step in lesson planning, instructional interns are encouraged to design a list of learning objectives (“desired student outcomes that form the basis of evaluation”). First-time industry instructors often lack experience in writing educational/learning objectives. The faculty coordinator can compile a list of objectives for a session following his/her pre-screening of that session, and submit the list to the first-time instructor for modification, approval and inclusion in the revised protocol. Instructional interns, students, and the faculty coordinator can use specified objectives as a gauge to determine if an activity is “on-task” (i.e. addresses one or more objectives) or “off task”. Ideally, students should receive the learning objectives, prefacing the written protocol, before instruction begins. Instructor interns should spend time deliberately planning instruments (e.g. quizzes, overhead questions following a presentation or laboratory

phase, mini-lab practical, case history analyses, questions on a homework-assigned and protocol-pertinent journal article) to assess mastery of particular learning objectives during an instructor's assigned session(s). Opportunities for both the instructors-in-training and the student-trainees to access feedback on their skill levels and mastery of course objectives during the course of instruction are called "formative assessments". Formative assessments should be scored and evaluated by instructional interns to give both themselves and their students specific, graded, interim feedback. Students will evaluate an instructional intern's ability to formatively assess, as part of a rating form completed by them at the end of an instructor's assignment (See Chapter 4).

b) Developing and utilizing examinations to assess instructional outcomes

Instructional interns are also encouraged to design (and submit to the faculty coordinator for review) exam items after they construct objectives but before they construct their written protocol. If one designs objectives and exam items as part of lesson planning, then one has a clearer view of what needs to be taught and how to teach it. The faculty coordinator should also design and grade a final question per exam that requires students to demonstrate an ability to compare and integrate lessons learned from a number of previous instructional interns.

The faculty coordinator collates exam items submitted by instructor interns into a test ("summative assessment") covering a portion of the semester. Usually 2-3 "collective exams" are administered during the course of a semester. When submitting exam items, interns can indicate the relative weight of individual questions but it is the coordinator who assigns possible points per exam item. Instructor interns submit an answer key with their questions, since it will be the faculty coordinator who proctors the exam and who needs, therefore, to have on hand the answer that the instructor-in-training considers to be a full-credit answer. This enables the coordinator to respond to potential student queries during the exam. The type of exam question (short answer, multiple choice, matching, and true/false) depends on the objective being assessed and the type of in-class instructional and formative assessment experiences implemented. An exam item would be considered off-task if it did not parallel instructional and formative assessment experiences and gauge mastery of a specified objective.

Instructor interns should grade their own exam items, rather than having the faculty coordinator score them, because often instructors will obtain essential feedback on the efficacy of their teaching by evaluating student responses to their exam questions. Students understand that the exam is the final opportunity to express their learning to individuals who may play a significant role in their job placement; therefore, if allowed, students spend much longer on completing an industry-graded exam than a faculty coordinator-graded exam. The faculty coordinator can assist by giving all instructional interns the same prescriptive advice on scoring exam questions.

Exam design is a practice that can be improved with feedback from students and the faculty coordinator. A post-exam survey can be utilized to collect information about student impressions of the exam in general and impressions of specific intern

contributions. This information can then be collated and incorporated into the faculty coordinator's performance review of the instructor. When the assessors become assessed, more constructive suggestions emerge to improve the quality of instruction.

Instructor-designed exams necessitate a greater investment on the part of all three stakeholders. The coordinator works with instructional interns on exam design, collates essentially a series of "mini-exams" by up to eight instructors into one test, proctors the exam, delivers it to the interns at their respective companies for grading, picks up the graded exams, and reassembles them. As previously mentioned, instructional interns spend time in exam design and evaluation, and students prepare more intensely and take maximum time providing detailed answers. However, the collective investment in time in summative assessment further melds this pre-service training community and ultimately improves the quality of instruction and learning.

c) Utilization of industry personnel from Human Resources to develop and assess job seeking and job interviewing skills

Pre-service biotechnician training courses concentrate on the development of skills and attitudes that will make the student employable. However, a successful search for employment can utilize guidance. Students who practice and achieve feedback on how effectively they market their training will increase their employability. The faculty coordinator can assist in sensitizing students to think about how they will promote their acquired training to hiring managers and personnel from Human Resources (HR). Through most of the semester-long capstone course, industry instructor interns strive to develop job-based competencies in their student-trainees. It is recommended near the end of the course, that industry HR representatives lead a session on such job hunting skills as: 1) developing an awareness of employment trends & available positions; 2) planning a personal marketing campaign including networking; 3) writing cover letters & resumes; and 4) interviewing. In this manner the industry instructor interns and their student charges can form judgments as to the effectiveness of the course in preparing the student-trainees to enter the workplace.

CHAPTER FOUR: Training Practicum Participants in Instructional Methods

1. Primary Instructional Methodologies

This chapter covers the primary instructional methodologies that will need to be taught to industry personnel participating in the Industry Instructor Practicum to prepare them to effectively function as instructors in community college biotechnician education programs. The chapter also describes strategies and techniques that can be utilized by the faculty coordinator/mentor to teach these methodologies in the context of the living laboratory created by industry interns interacting with student-trainees in a college classroom. The primary instructional methodologies, which need to be mastered during the Industry Instructor Practicum, consist of the following:

- a) Planning and preparation for instruction utilizing the instructional protocol**
- b) Delivery of instructional sessions utilizing the lecture/laboratory method**
- c) Planning/implementing formative and summative assessment strategies**

In addition to effectively utilizing and implementing these primary instructional methods, prospective instructors are also expected to develop the behavior management and rapport building skills common to successful teachers. The faculty coordinator plays an essential role in imparting such “soft skills” by serving as a model and mentor to the instructional interns. Successful bioscience teachers, like successful managers in the bioscience industry, must demonstrate qualities and attitudes that support positive “work” environments. Such environments are characterized by respect for diversity, awareness of individual differences, competence in utilizing the scientific method, unswerving devotion to documentation, and sincere dedication to continuous process improvement. (See **Document #1** in the appendix of this manual for a copy of the instructional guidelines given to practicum participants beginning an instructional internship in the bioproduction technology course at San Diego City College.)

2. Planning and Preparation: The Instructional Protocol

Training Interns to Plan Instructional Sessions & Prepare a Written Protocol

- a) The purpose and function of lesson planning & the written protocol.**

Careful planning is critical to the successful delivery of instructional sessions. Industry personnel serving as visiting instructors in community college classrooms often “preach” their expertise. In such situations it is common for the industry expert to “lecture” using prepared slides, overheads, etc., without understanding that the students have become spectators rather than active learners. While such presentations may be carefully planned, they are not planned lessons. A **lesson plan** starts with a set of specific learning objectives and then utilizes relevant conceptual content and experiential activities, carefully sequenced and artfully presented, to facilitate student

attainment/mastery of pertinent knowledge, skills and attitudes. The series of lesson plans that make up a pre-service bioscience course serve collectively as an educational blueprint for the construction of the concepts and skill-sets required of biotechnicians in the workplace.

The **written protocol** required of industry instructor interns participating in the practicum serves both as a framework for lesson planning and as documentation that the process has been undertaken and accomplished. The written protocol also serves as a textbook and lab manual for students enrolled in the biotechnician education program. The written protocol is never a finished document, but will evolve based on changes in the bioscience field and on feedback from the faculty coordinator, students, and peers, before and after it is delivered.

b) Importance of linking course objectives to specific session objectives.

In a serially taught course, it is important for an instructor to build from what was taught before him and to prepare the class for his/her successor. As discussed above, it is the totality of the “blueprint” that results in the construction of the skilled, employable biotechnician. In addition to objectives for the individual instructional sessions and/or modules, there are objectives that reflect the priorities of the course. The overall course objectives establish the operational goals of the entire team of instructors. The course objectives tie the series of protocols together and should be underscored in the instructional interns’ written materials and discussions so that students can integrate their classroom activities into a single, integrated “big picture”.

c) The importance of early planning and preparation

First-time instructors often underestimate the time it will take to prepare curricular materials. Teaching is not their primary occupation and thoughts of preparing for their instructional assignment may not surface until the first session is imminent. Therefore, the faculty coordinator needs to develop a series of “deadlines” for each new intern to ensure timely delivery of specific sections of the protocol for preview and possible modification. First-time interns need to submit the final draft of the entire protocol to the faculty coordinator at least 10 days in advance of the first scheduled protocol session. This will allow enough time for the coordinator to meet with the intern and effect required improvements prior to delivery of the session.

First-time industry instructors also tend to overestimate the amount of reading materials required to provide conceptual background for the protocol. Consequently, the tendency (if not regulated by the coordinator) can be to distribute an excessive amount of preparatory reading materials to students. Students require 48 hours to read and prepare for a discussion of concepts underlying a protocol. Distribution of materials on the day they are to be discussed sends a negative message to students regarding the intern’s commitment to the learning process.

d) Preparing the written protocol

As noted above, the written protocol serves as both a documented lesson plan and as the textbook and lab manual for a specific lecture/lab module within a college level biotechnician education course. Each written protocol must contain the same basic component sections, but these may be organized in a number of different configurations. For example, some instructors prefer to have the ancillary reference materials bound apart from the lab protocol, or appended to it. Others prefer to follow the order of use and therefore place the text materials before the description of the laboratory materials and procedures. The essential components of the written protocol are as follows:

Ancillary Reference Materials:

The ancillary materials consist of two basic components: industry instructor bios, and conceptual reference materials. 1) The written protocol should offer short autobiographical statements, focusing on the educational credentials and the current industry experiences that qualify, and give credibility to the instructional intern(s) who will teach the module. Since students have only a short period of direct face-to-face interaction with the instructional interns, information on how students can appropriately contact these industry instructors also needs to be supplied. 2) Pertinent conceptual reference materials should be distributed for study prior to the first session. These materials provide the background knowledge and information necessary for students to understand the planned lectures and/or to participate in the laboratory exercises. Since these materials serve as the “textbook” for the session(s), the intern should prepare a short introduction for each reference provided, explaining its inclusion, author study questions that help students focus on key points and self-assess comprehension, and even prepare a glossary of terms, if appropriate.

Laboratory Manual:

The lab manual must include the following components: learning objectives for the specific protocol, short descriptive overview of the session, a list of equipment, reagents and supplies necessary for conducting the exercise, and a clear description of the procedural steps necessary to effect the desired outcomes of the laboratory activity. These components should be supported by figures, diagrams, flowcharts, and problem sets that facilitate learning and encourage deeper analysis and problem solving.

Ideally, the written manual would also include suggestions for organizing data from the protocol activities for inclusion in the student’s lab-notebook and/or for recording data and results as part of a standardized documentation process. Suggestions for the workplace utilization of the methods, techniques, and/or principles demonstrated during the laboratory exercises could also be included in the manual. The intern can further be encouraged to design and build into the manual, troubleshooting scenarios that test the student’s ability to systematically diagnose and resolve procedural errors that slow or halt the progress of the laboratory protocol.

3. Delivery of the Instructional Protocol: Lecture/Laboratory Methodology

Once planning for instructional sessions has been completed, attention shifts to delivery of the lecture/laboratory protocol. Having become highly involved in the preparation of the written protocol, instructional interns can lose sight of classroom dynamics and logistics that can make or break the actual presentation of the session. A critical prerequisite to successful classroom teaching and learning is the requirement to establish and maintain a rapport with students. Another prerequisite is the effective and efficient management of the teaching/learning environment, including such factors as time and materials management. Finally, the actual delivery of an instructional session utilizing a lecture/lab format requires careful attention and constant assessment as to how well the particular mix of listening and hands-on activities chosen for the session is contributing to the attainment of planned instructional outcomes among participating students.

Training Interns to Establish and Maintain Rapport with Students

Industry instructor interns can become caught up in the development of their specific protocols and can lose sight of the primary purpose of these documents. The function of a protocol is not to demonstrate the instructor's theoretical knowledge and laboratory skills, but to serve as a blueprint for transferring the instructor's knowledge and skills to a specific group of students to prepare them to function as effective biotechnicians. Helping interns to keep their focus on their student trainees, and to establish and maintain a rapport with this group, is an important function of the faculty coordinator/mentor. The faculty mentor can facilitate this process by shaping and modeling the following intern behaviors which communicate respect for students and concern for student success:

Communicate interest in students as individuals. Learn student names by attending "icebreaker" events, studying "mugshots", viewing videotapes. Be sensitive to cultural and language variations, and to differences in learning styles, that could require adjustments to lesson planning and delivery.

Demonstrate respect for students by being fully prepared for session(s), and by providing protocol materials at least one session prior to a scheduled presentation.

Communicate clear and consistent instructional objectives and expectations.

Stay attuned to student responsiveness to instructional activities throughout the session, constantly assess level of student involvement and alertness. Adjust behavior, activities, and breaks accordingly.

Interact with students before and after formal sessions, and during breaks, thereby providing opportunities for individual questions and the sharing of problems and concerns that could affect learning outcomes.

Training Interns to Manage Instructional Logistics

Instructional interns also need to attend to logistical considerations in preparation for the delivery of instructional sessions. Failure to appropriately manage time and materials can have especially negative consequences on instructional outcomes. Faculty coordinator/mentors can assist interns to effectively plan sessions and avoid potential pitfalls by asking them to implement the following procedures:

a) Perform a trial run of the protocol well before the scheduled classroom session to ensure proper sequencing and timing, and to validate the appropriateness/availability of equipment, supplies, and written materials.

Once the written protocol has been prepared, the intern should test-run the planned lecture and laboratory activities either in the college lab or at his/her company facility. If the instructional intern is a first-timer, this practice session should be observed by the faculty coordinator who can then assist the intern in adjusting the timing and/or sequencing of instructional elements, and suggest changes in the use of equipment, supplies and ancillary materials.

Instructors should include the order of planned activities in their written protocol for students, but should not publish the planned timeline for these activities, since the duration of each activity is likely to vary as a function of both the instructor's classroom experience and the particular make-up of the class. If timelines are provided for each step, keeping to the schedule can outpace the readiness of the class to move on in the lesson, thereby seriously threatening learning outcomes.

b) Prepare a comprehensive checklist of equipment/supplies/materials and other logistical arrangements that will need to occur prior to the instructional session. Carefully review this list with the college lab tech and the faculty coordinator to avert last minute emergencies and aborted laboratory procedures, which could adversely affect instructor credibility and student learning outcomes.

The instructional intern should prepare an item-by-item checklist for review by the faculty coordinator and by the college lab tech who may need to locate equipment and assist in the preparation of materials. Since forgetting to bring even one item can doom an entire lab session, using a checklist minimizes the likelihood of such disappointments and disasters. The timely delivery of audio visual equipment, and the reproduction of handouts, must also be arranged well ahead of time. Having all materials available for student use before the session begins is a sign of effective preparation for the lab. Even simple logistical arrangements (e.g. Will help be needed to transport industry-supplied materials from the college parking lot to the college lab?) are important in establishing a ready, yet relaxed, climate for teaching and learning. A college lab is a multi-purpose classroom. It takes time and thoughtful planning to convert such a classroom into a pre-service biotechnician-training environment.

Training Interns to Implement the Lecture/Laboratory Method of Instruction

The lecture/laboratory method of instruction represents a distinct approach to teaching and learning that is particularly well suited to the education of technicians. Therefore, lecture/lab is by far the most popular instructional methodology found in biotechnician education programs today. Courses developed in this format are designed so that short mini-lectures are quickly followed by hands-on application exercises. These activities allow students to immediately apply the knowledge they have just learned, or to develop additional data, which will soon be analyzed, discussed, and explained in another highly pertinent lecturette. This constant interplay of theoretical knowledge preceded or followed by experimental protocols, and/or by activities involving the real world application of knowledge and skills, is the hallmark of this method. Optimizing the benefits of this methodology can be taught to interns by having them implement the following strategies and techniques:

a) Optimize student involvement and learning by the appropriate distribution and assignment of class time to lecture presentations and laboratory exercises.

Individuals new to this instructional paradigm often fail to recognize the distinct advantage of this methodology, and may, therefore, plan to present all theoretical content at the beginning of the lecture/lab session. Confronted with a four-hour session, the new instructional intern, thinking it to be efficient, might plan to lecture for the entire first hour of class, leaving a block of three hours to conduct the laboratory protocol. Another intern, unaware of the commonly accepted 1 to 3 ratio of lecture to lab activities, might plan two or three hours of lecture, and having badly underestimated the time necessary to conduct laboratory activities among a group of naïve technicians-in-training, be left with inadequate time to conduct the lab.

The average attention span of students involved in a traditional college lecture course has been shown to plummet after about 20 minutes. Therefore, the faculty coordinator/mentor needs to assist instructional interns to optimize the advantages of the lecture/lab model, and to avoid boredom, by planning to present lecture material in short, not to exceed 20-minute segments. In a biotechnician-training course, the focus should be on active student participation. Therefore, the instructional intern should plan to punctuate teacher-centered transmissions with student centered discussions. To gauge student participation during instructor presentations, the coordinator can monitor how many student questions or contributions occur in a session and how many minutes of a presentation have gone by before a student question is asked or a contribution offered.

b) Optimizing lecture/presentations and related class discussion.

At the start of a new session, an instructional intern must relate the specific objectives of the current session to the overall course objectives, show how the session fits into the fabric of the entire course, and clearly communicate performance expectations. An intern should give the impression that s/he is part of a team and not the leader of a

separate mini-course. Instructional interns sometimes assume a zero biotechnological knowledge base and consume valuable time reiterating information taught in prerequisite courses or within the same training course taught by their predecessors. If interns stay current with the class by reading the coordinator's weekly e-mail report, they need not guess what has or has not been presented in prior sessions. If the material in a lecture/presentation does not address a session objective, either an additional objective must be constructed and handed out to the students, or the material should be deleted from the presentation.

It is far easier to plan an uninterrupted lecture than to plan a lecture punctuated by activities to assess comprehension and application of presented information. Questions such as, "Does that make sense?" or "Does anyone have questions?" often result in silent, nodding heads giving an instructor potentially false reassurance that content has been assimilated by the class. Instead, the intern should ask questions and stimulate discussions that force students to analyze data, apply theoretical concepts, and draw conclusions that clearly demonstrate they have understood the material. Visually presented information plays an important role in learning. Students recognize that transparencies/slides or PowerPoint displays used in class represent the priorities of the instructor and consequently prefer copies of these visuals. PowerPoint slide handouts can be printed with lined margins for student note-taking. Interns should make and distribute copies of these visuals before the presentation begins.

c) Optimizing laboratory instruction and mastery of troubleshooting skills.

The goal of lectures is to provide students with enough conceptual information to understand the purpose of the protocol, to interpret and evaluate results, and to perform basic troubleshooting when a procedure goes awry. In community college applied biology classes such as biotechnician education courses, students are relying on working scientists, technologists, and technicians to teach competencies and skills derived from practical experience. This is best accomplished through hands-on lab-oriented activities that closely replicate those of the workplace. Effective instructors plan lectures covering related conceptual information around the incubation or "down periods", which occur in most procedures. A lab activity can be started before being explained. The instructor then utilizes the just-performed lab steps as concrete experiential data points for a mini-lecture.

An instructor's job doesn't end once students have been given adequate directions and the materials needed to implement the protocol. Now the instructional intern monitors the pace of each lab group, provides demonstrations and guidance to further clarify particular steps, and assesses individual students for their manipulative accuracy and cognitive understanding. In protocols designed by instructor-interns, unexpected results can be common. When the lab activity falls short of expected results, the coordinator can observe how well the instructor converted this situation into a positive, troubleshooting opportunity for students. A thinking, reflective technician is a prized commodity in the marketplace.

5. Implementation of Formative & Summative Assessment Strategies

Training Interns to Utilize Formative Assessment Practices

a) Utilizing instructional sessions as opportunities to assess student progress

Instructional interns should be taught how to use the context of an instructional session as an opportunity to informally assess individual and collective student progress in understanding the course material. The faculty mentor can effectively model such behavior at appropriate times during class sessions while being careful not to produce too many interruptions in a presentation being given by an intern. Master teachers constantly check for understanding or stimulate problem analysis by asking pertinent and/or thought provoking questions throughout the presentation of lecture/laboratory materials. Such questions allow an instructor to perform a quick formative assessment to check whether or not students have understood material well enough to continue on or whether they need to review past lessons before moving on to the next point or procedure. Such questioning is also used by experienced teachers to encourage students to look ahead and see if they can predict outcomes and next steps based on past learnings and prior experiences with laboratory procedures. In this manner, the experienced, master teacher constantly takes readings on the progress of the class and adjusts the introduction of new materials and next steps in a laboratory protocol accordingly.

Another common method used to obtain a formative assessment of current student progress is to have lab-groups complete an exercise, and then organize and present findings to the rest of the class. Both the interactions of the students as well as the quality of their presentations can provide important clues as to their mastery of the subject matter. The faculty mentor can assist the intern to develop and integrate this type of activity into his/her lesson plan and protocol presentation. Having the lab groups present their findings in a visual format such as on the board, on posters, or with overheads, adds to the data available for evaluating both the conceptual understanding of lecture materials and the ability to apply the scientific method to problem analysis and solution.

b) Develop and administer formal and informal quizzes on a regular basis

Both formal and informal quizzes are another method of gathering formative evaluation data within the context of the instructional session. Formal quizzes can be pre-designed like exams or composed on the spot. Both options provide an additional opportunity for interns to practice developing and then assessing the effectiveness of their test questions. Quizzes can be formally graded or just informally scored but not counted towards the final course grade. They can be scored by the instructor, other students, or be self-scored. Some instructors quickly grade quizzes during a break and return them to the students during the same session so that they can be utilized in class discussion.

Training Interns to Utilize Summative Assessment Practices:

a) Complete a performance review on each student.

As discussed in detail in the previous chapter, the faculty coordinator assists instructional interns to develop a classroom environment that facilitates assessment of individual students to ensure mastery of protocol objectives. To facilitate this process, the coordinator needs to instruct new interns in observational methodologies and in the utilization of a standardized format to collect and organize observed data. In order to accomplish this, the faculty coordinator should introduce new interns to the rating form to be used to evaluate the student-trainees and then provide opportunities for these first-time instructors to become comfortable and effective in utilizing the instrument prior to their delivery of instructional sessions. The coordinator can use previously taped sessions of the current class to develop the observational and documentation skills of the first-time interns as they view classroom interactions and come to identify individual students by face and name. Interns can then sit in on the sessions of other instructional interns and practice making observational notes and completing forms. If possible, having several first-time interns go through this process together, under the guidance of the faculty coordinator, can serve to more quickly “calibrate” the new instructors as to significant observational indicators and the standard terminology to be used in documenting these behavioral indicators. (See **Document #2** in the appendix.)

b) Develop examination questions that assess mastery of course objectives

The development of specific exam questions by interns to test student mastery of course objectives was discussed in depth in Chapter 3. As previously described, each examination is composed of a coordinator-collated set of questions which have been submitted by a block of instructors covering material taught during a specific segment of the course. The coordinator enhances the ability of the instructor interns to contribute to the effectiveness of these summative student evaluations by helping them to develop test questions which clearly demonstrate student mastery of course objectives. As discussed in Chapter 3, interns submit exam questions along with course objectives as they initially plan for their sessions. The faculty coordinator provides feedback on how well the exam question accomplishes this goal and helps the intern modify the question as necessary. Then the intern is asked to provide a model answer for his/her question. The faculty coordinator again provides feedback and this process continues until the intern is able to generate exam questions and answers that satisfactorily assess desired student learning outcomes. The administration and subsequent grading of the exams, provide yet another opportunity for the faculty mentor to shape the ability of interns to use summative tests not only to evaluate student attainment of desired outcomes, but also to initiate corrective measures when tests reveal lack of mastery of learning objectives. The faculty coordinator can review the intern's grading of student responses and help the intern to provide feedback that will assist the student to remediate content and process errors involving lecture/lab materials covered in the course.

6. Collecting, Compiling, and Delivering Performance Feedback to Interns

Industry instructors are evaluated on the following key instructional methodologies:

- 1) Written Protocol
- 2) Lecture/Lab Presentation and Discussion of the Protocol
- 3) Strategies and Techniques for Formative &
- 4) Summative Assessment of student-trainees, and
- 5) Building Rapport with Students and Managing the Instructional Process

Data for the formative and summative evaluations of the industry instructor interns is collected as follows:

a) Observational Notes

The faculty coordinator is encouraged to make observational notes on each instructional intern giving particular attention to the teaching/learning dynamic. These notes should be made on a regular and systematic basis and should be organized by the five categories of key instructional methodologies listed above. These notes represent “data” that will enable the coordinator to subsequently determine how well the instructor-in-training mastered these key instructional methodologies. Notes on an instructor often begin during the recruitment/selection process, increase with the coordinator’s initial receipt of the instructor’s protocol, and end after the instructional intern’s final set of exam questions are graded and returned to the faculty coordinator. These notes will be “processed” into a final evaluation report. Observational notes reflecting practices that resulted in improved teaching/learning can be “highlighted” when written, to serve as easily located material for the weekly e-mail report and for later inclusion in the final written evaluation report for each intern.

b) Videotaped Instruction

Faculty coordinators should also consider videotaping segments of the instructional sessions as a supplement to their observational note taking. This “raw observational data” can then be utilized to illustrate and illuminate the coordinator’s evaluative conclusions and recommendations regarding the performance of industry interns in the instructional setting. Providing each intern with a copy of the videotape of his/her session also enables these instructors-in-training to become self-evaluators. Finally, a number of interns may wish to share the viewing of their tapes as a group. Such an approach fosters a process of peer review and mutual discovery wherein effective versus ineffective teaching techniques and methodologies can be studied and clarified.

c) Rating Forms

Rating forms to be used by the student-trainees to provide feedback to the industry instructor interns also provide additional data for the faculty coordinator's evaluation process. These forms have been designed to correspond to the categories represented by the key instructional methodologies. (See **Document #3** in the appendix.) Please note that the rating form included in the appendix to this manual and labeled "Student Rating Form" can easily be modified for multiple uses. Relabeled "Coordinator Rating Form" it can be used by the coordinator to rate the instructional interns on the five key methodologies and, re-named yet again, can be used by the interns to rate themselves or their peers. Comparison of multiple ratings can lend perspective to this evaluation procedure.

A copy of the seven-page form is distributed to students on the first day of class and its elements explained by the faculty coordinator. New sets of rating forms are handed out to students at the beginning of each intern's teaching assignment, to be completed and returned to the faculty coordinator at the end of the assignment. Although traditionally, student ratings of teachers are anonymous, students in the pre-service biotechnician-training environment are asked to identify themselves as evaluators. This practice enables the coordinator to keep track of those in the class who turn in the forms, and to identify students who prefer to bring up concerns in writing rather than face to face. Students are assured that instructional interns will receive the information from the ratings in a collated, anonymous manner, after the intern's assignment is concluded. It is important that instructors and the coordinator view information from student ratings as data to be analyzed in the process of evaluation. Students are not professional evaluators but contribute an important "consumer perspective" to the process of evaluation.

Data which has been collected via the processes described above is compiled and communicated as described below:

a) Weekly E-mail Report

Videotaped instructional sessions and the coordinator's observational notes can be "mined" for pertinent data to construct a weekly e-mail report that can serve to integrate this serially taught course while giving participants a greater sense of continuity. The report becomes a kind of weekly community newspaper that gives the consortium of instructors, who collectively teach the course, the necessary information as to what has transpired during the past week's instructional sessions, highlights pedagogical lessons learned, keeps past instructors connected to the course, and up-coming instructors attuned to events/outcomes that might require changes to their own lesson plans. The weekly e-mail report often galvanizes instructors to submit comments that are shared in later reports. The report can tend to be long, so the coordinator needs to include important notices at the beginning. The report is a summary of transpired events with

its priority being to identify pedagogical lessons that can be adopted by others. The coordinator can also use the report when compiling individual instructor evaluations.

b) Categorization of Key Instructional Elements

As an intermediate step in producing the final instructor evaluation report, the coordinator scans her/his observational notes and labels (in large boldface font) statements as pertaining to the five key instructional methodologies. Certain passages in the observational notes may apply to more than one category, in such cases they are “co-labeled” accordingly. The coordinator then sorts and rearranges the observational notes by key instructional methodology and session. Information from the student rating forms is collated, summarized, and assigned to a category.

c) Compilation of the Final Instructor Evaluation Report

The coordinator assembles the final evaluation report by key instructional methodology. Any recommendations for improvement are highlighted. Comments on each instructional category are concluded with an analysis of student ratings on that methodology. If an instructor has taught more than once, scores and comments from previous semester assignments are included so that the instructor & coordinator can perceive any trends/changes/improvements in the ratings over time. See **Document #4** in the appendix, for an example of a final instructor evaluation report.

b) Debriefings

Debriefing should occur shortly (within two weeks) after the conclusion of an instructor’s teaching assignment while the experience remains “fresh” in everyone’s mind. In preparation for the debriefing, the coordinator should read the evaluation report of that instructional intern from the previous year (if that instructor is a returnee), and should review current observational notes to assess the effectiveness of an instructor’s attempts to modify and improve her/his instructional skills. One goal of this phase of debriefing is to develop a consensus on “what worked” and what needs to be changed/improved the next time the instructional intern teaches. The second half of the debriefing focuses on instructor evaluations of the students. An instructor hands over to the coordinator the set of two-page performance reviews, and the coordinator checks to assure written comments are legible and understandable. The coordinator and intern then discuss individual student learning outcomes and resulting readiness to perform as a biotechnician in the workplace. The session concludes with a general discussion of the intern’s final thoughts and impressions on the practicum experience as a whole, and solicits feedback and recommendations for enhancing and improving the value of the experience in the future.

CHAPTER FIVE: ADMINISTRATIVE CONSIDERATIONS & RECOMMENDATIONS

1. The Decision to Implement the Industry Instructor Practicum Model Revisited

This monograph has described in detail a proven model for instructor preparation which can be utilized to train industry personnel in the instructional methodologies required to effectively function as visiting, adjunct, and even as full-time instructors in biotechnician education programs at community and technical colleges. The model uses community college classrooms as living laboratories to prepare bioscience industry experts to serve as biotechnology instructors while simultaneously enhancing the employment preparation and prospects of students enrolled in these college programs.

The model also facilitates the development of true industry/education partnerships as industry personnel work closely with college faculty to develop curriculum and courseware and then to deliver the resulting instructional protocols in college laboratories. In the Industry Instructor Practicum model, industry personnel become involved in the actual planning, preparation, delivery and assessment of pre-service biotechnician education rather than serving merely as outside observers and advisors. As a result of such participation, courses and programs are kept up-to-date, donations of relevant equipment and supplies are expanded and enhanced, and students are more realistically prepared for employment.

While this model offers the valuable advantages described above, there are a number of administrative and logistical issues, which need to be considered prior to making the final decision to replicate this approach. In Chapter 2 several of these topics were identified. This final chapter revisits these, and identifies other issues, which will need to be considered and resolved prior to implementing the model. The chapter will also offer recommendations based on lessons learned while experimenting with the model at San Diego City College over the past several years.

2. Administrative Costs, Complexities & Challenges of the Practicum Model

a) Availability and commitment of college faculty and support staff:

As discussed in Chapter Two, a decision to move forward with this program is highly dependent on the availability of a faculty member who is willing to commit an “extraordinary” amount of time and energy to the implementation of the model. The faculty member’s departmental colleagues need to be in agreement that the goal of developing a pool of well-trained visiting and adjunct instructors is important to the future of the biotechnician education program, their department and their school. Consequently, they should be able to agree that the faculty member designated to serve as program coordinator may be excused from committee assignments and be granted release time to attend to his/her Practicum responsibilities. This commitment must be made for a period of three years in order for the model to effectively produce qualified instructors.

Therefore, on the basis of lessons learned, it is highly **recommended** that in order to avoid faculty coordinator “burnout”, support for the program and the designated faculty member be carefully planned and institutionally sanctioned prior to initiation of the Practicum model.

b) Institutional commitment to program goals:

Beyond the departmental level, it is critical that support for the program include the relevant academic dean(s), and that it extend beyond the dean level to the chief instructional officer of the college, and finally to the college president. Again, college administrators need to embrace the overall goals of the program and understand the contribution the program can make to long term institutional effectiveness in order to accept current losses in efficiency due to the immediate costs of the program. If the mission of the college includes a strong commitment to meeting regional economic and workforce development needs, then support for the program will be easier to achieve. It is **recommended** that institutional support at the administrative level also be sought and obtained, and fiscal issues resolved, prior to formally inviting industry participation in the program.

c) Selection and commitment of industry instructor “interns”:

Chapter 2 discussed in detail, a set of criteria for the selection of industry interns. Industry participants are expected to devote significant time and energy in preparing to become effective community college instructors. They are also expected to assist in obtaining loaned equipment and donations of supplies/materials from their companies and to arrange their work schedules in compliance with the class schedule. While most interns devote only one to three weeks per semester actually delivering their instructional modules, they are typically involved for many more weeks in preparatory and follow-up activities. If industry personnel become involved in the program on their own and without the knowledge and consent of their supervisors/managers then they too may run into support problems. On the other hand, if these interns are part of a program sanctioned by their company, then it becomes much easier for them to borrow company equipment, gain permission to hold sessions in company facilities, and to get donations of supplies and materials for the class. Consequently, it is **recommended** that all industry personnel accepted into the internship do so with the knowledge, approval, and support of their immediate supervisors/managers.

d) Industry commitment to program goals:

It is important that industry executives and managers understand the value and importance of the program in meeting their own organizational goals and understand that the primary purpose of the program is to ensure the availability of an adequate supply of well trained biotechnicians for employment in their companies. They also need to understand that while the model is primarily designed to train instructors for pre-service college programs, it is simultaneously preparing trained-trainers who can more effectively conduct in-service training programs within their own companies. While it

may be difficult for college personnel to engage each potential industry partner on a one-to-one basis, it is often possible to work through industry trade associations, economic development corporations, and chambers of commerce to meet with and speak to groups of company representatives. Once such companies come “on-board,” support for industry employees participating in the program is ensured, while opportunities for cost sharing with the college are enhanced. Therefore, it is recommended that college personnel also attempt to gain industry approval and support before moving forward with the program.

3. Funding the “excess costs” of the Industry Instructor Internship Model:

Operating the Practicum model is more costly than simply conducting a biotechnician class taught by a contract faculty member or single adjunct instructor. It should be noted that in this model two groups of students are being taught at the same time, in the same space: the biotechnician student-trainees and the industry instructor interns. Excess costs/expenses typically involve funding the release time of the faculty coordinator, paying stipends to the interns for the hours they deliver actual instruction, while at same time the faculty coordinator continues to be paid his/her normal salary as instructor-of-record, absorbing the cost of lower than average student enrollment in the Practicum classroom, the possible cost of additional clerical support for the faculty coordinator, and the cost of supplementary supplies and materials above those used in an average biology/biotechnology class. Our experience in San Diego demonstrates that Colleges should plan on a minimum of \$30,000 in excess expense per year for delivery of 6 units of lecture/lab instruction utilizing this model. Most of this expense represents back-fill for faculty release time and stipends for the interns.

At San Diego City College these costs were funded as a special project of the NSF/ATE Bio-Link program. However, many state and federal agencies will provide fiscal support for programs such as this one through instructional improvement, vocational/technical education, and/or teacher-training programs. Most agencies would find that a cost of under \$100,000 for a three-year program to train a dozen or more vocational/technical instructors, to be quite a bargain, especially when compared to the cost of doing this through a state university teacher training program. Alternately, if industry were to match the college’s investment in faculty release time by providing release time or compensatory time for the industry interns in lieu of college paid stipends, loan equipment and provide most of the supplementary supplies/materials, then excess costs can be pared down significantly.

In conclusion, the industry instructor Practicum model serves as a cost effective method of bringing industry expertise into community college classrooms and laboratories while at the same time forging significant industry/education partnerships to prepare qualified biotechnicians for the workforce while providing excellent employment opportunities for community college students.

APPENDIX TO THE MONOGRAPH: Documents 1- 4

Bio-Link Industry Instructor Practicum:

Sample Documents

Document #1: Planning guidelines for industry personnel participating as instructors/instructional interns in a Community College biotechnician course: pages 41- 44.

Document #2: Forms for use by industry instructor practicum participants to rate students on technical and interpersonal skills required of biotechnicians in an entry-level position: pages 45-49.*

Document #3: Forms to be utilized by students or a faculty coordinator to rate practicum participants on pedagogical and management skills required of successful college-level biotechnician instructors: pages 50-56.

Document #4: Sample final evaluation report of industry instructor practicum participants by a faculty coordinator: pages 57-60.

*** This rating instrument was developed utilizing the recommendations of industry advisors and incorporating technician desirable characteristics as determined by the Skills Standards for the Bioscience Industry Project (1995).**

Bio-Link Industry Instructor Practicum: Sample Document

Document #1 Planning Guidelines for Industry Personnel Participating as Instructors in a Community College BioTechnician Course

Welcome to this year's bioproduction course! Following is a list of instructional guidelines and teaching tips to help you prepare for a successful experience:

Written Protocol

- 1) Submit all instructional materials to the faculty coordinator for review at least 10 days prior to your initial protocol session so that potential modifications can be made. Also be sure to have your final written protocol available for me to photocopy and distribute to students at least one class session prior your first scheduled session. That also includes your background reading materials. Avoid distributing information on the day that it will be used in class! There is no other text for this class so if students are to be prepared conceptually and procedurally, they need time to read and study the reference materials.
- 2) Preface your written protocol with learning objectives. Objectives can be defined as "desired student outcomes that form the basis for evaluation". These learning objectives clarify your priorities to students and afford direct linkage to the 15 course objectives. If you don't supply students with objectives for your session, I will. If I supply the objectives, be sure to examine them for your approval.
- 3) Students in the biomanufacturing course will not be maintaining lab notebooks but will be completing records and carrying out (and in some instances modifying) SOP's. Try to assemble your written protocol so that it is arranged in the SOP-record-specification-oriented format of production/manufacturing.
- 4) Include in your written protocol an autobiographical statement. There is typically an "icebreaking phase" when students interact minimally with the instructor as they get acquainted. This phase can be shortened if the class knows in advance something about their upcoming instructors. Include contact information so that students may reach you during/after you're teaching assignment with follow-up questions.
- 5) Include in your written protocol problems that are important to help master the learning objectives. These could be basic chem/math problems or troubleshooting scenarios that you will take time to discuss.

Document #1-Continued

Instructor Presentations

6) Establish rapport with students. Learn and use student names as much as possible (refer to their badges). An effective “icebreaker” is to come to class to interact with the students at least one session before your first instructional session. Spending a session with the group before your module formally begins, helps the class adjust to the constantly changing stream of instructors they face and will get you off to a flying start. (I will make your parking permit good for one session before your actual teaching assignment begins. If you want to come in even earlier to observe others teach and to meet the class, we can arrange that too.)

7) Instructor Presentations should underscore the principles needed to understand the protocol and/or lab procedures. Teach your expertise. I don't expect any instructor to burn the midnight oil looking up references to prepare a lecture. Natural attention spans of even the best students rarely exceed 20 minutes. So try to involve students as much as possible and punctuate your presentations with student activities that will let you and your students know how well they have understood what you just presented. These activities should include **specific** questions/problem-sets displayed on the overhead projector for individuals or groups to work on for a few minutes and then report out their answers/solutions. Avoid punctuating your presentation with such questions as "Does that make sense?" or "Does everyone understand?".

8) Be sure any overheads you produce are legible from the back of the classroom. Try to make copies of your overhead presentation available to students prior to the presentation so that they can take notes as you present.

9) Provide students with the background information necessary to understand and effect the procedures, but let them do the thinking (including data interpretation & presentation) and manipulations whenever possible.

Laboratory Activities

10) Notify me well ahead of your session(s) as to what materials we will need to provide for each of your scheduled sessions. You should also contact our lab techs prior to each session to confirm that we have the equipment/supplies ready. The lab techs can also meet you at a designated time to assist you in transporting equipment/supplies that you are bringing with you, from the parking lot to the lab classroom.

Document #1-Continued

11) No matter how much preparatory information you supply them and no matter how diligent the students are, plan on activities taking much longer than you ever anticipated. Its different training a relatively large group of pre-service technicians than in-servicing 1-2 newly hired techs. A ten-minute spin in the centrifuge somehow takes 35 minutes in a class. Students have been recruited with the understanding that there could be significant "spillover" time from the 10 PM official closure; they also understand that there will be non-class times they will have to come to lab to continue a project.

12) I typically give a "Coordinator's Corner" (announcing local biotech news, jobs, class deadlines etc.) lasting 15 minutes at the beginning of each class. If an instructor feels that due to the length/complexity of the protocol, the class needs to begin the lab activity immediately, he/she should inform me before class, so that I can reschedule the Coordinator's Corner to a more convenient time in the session.

13) The industry instructor is responsible for determining when to take breaks (typically lasting 10-20 minutes). Do not indicate specific breaks in the written protocol unless you are positive about adhering to those times. Even though in "real" laboratories methodologies run uninterrupted, in a pre-service group-training situation, planned breaks are critical to maintain attention spans and optimize learning. During breaks, informal spontaneous brainstorming conversations typically occur which may be almost as valuable as formal debriefings.

14) If the instructor is planning a series of sequential experiments, be sure to bring in back-ups of acceptable results at each experimental phase. This way if a particular phase goes "awry", the instructor can use that opportunity to hone student troubleshooting skills while not interrupting the "flow" of the project.

Formative Assessment

15) Plan on giving a quiz (for 10-20 points) each session. Quizzes for points give instructor & students specific feedback on how well they are mastering the learning objectives before they are assessed on an exam. Regarding grading, either grade the quizzes during a break, have the students grade their own or a colleague grade them, but be sure to review the answers the same evening of the quiz.

16) Be sure to give me a copy of all materials (including quizzes) you distribute to students. I need to examine all written materials before I can effectively evaluate the course and its instructors.

Document #1-Continued

Summative Assessment

17) I will ask instructors to give me a set of questions (with answers) to be used on the exam. All questions will test for mastery of learning objectives. The number of questions will be commensurate with the number of sessions taught. (I will let you know how many questions to submit after your teaching assignment ends.) Following the exam I will deliver the students' written answers to the instructors at their respective companies so that you can each grade the responses to your own set of questions and assess how well students achieved your learning objectives.

18) I will be evaluating instructors on the basis of their written protocol, presentation, lab activity, formative assessment and summative assessment using particular criteria that were distributed in a set of forms at our orientation meeting. Students will use this same set of forms to rate your instructional performance at the completion of your module. I will also expect instructors to fill out performance reviews on each student in the class. The two-page evaluation form that instructors will fill out on each student was also distributed at our orientation meeting.

19) Please look closely at these two sets of forms as you lesson plan. You will need to create not only an instructional environment but also an environment that will allow you to gather enough information to assess each student's potential to successfully become employed as a biotechnician. For example, the performance review form asks instructors to gauge students' documentation ability. Therefore, you will need to create an activity that can generate data, which you can use to assess each student's documentation skills. Some instructors actually begin filling out these forms on students AS they teach.

20) Approximately one week following your final session, we will meet to discuss your observations/impressions of each student including your specific recommendations for improving his/her prospects of employment in a biotech firm. At this meeting, I will stoke your memory by showing video snapshots of students during your sessions. I will also give you feedback on how the students viewed your instructional sessions and how effective they thought you were as an instructor. I will also give you a list of comments expressing what they enjoyed the most and least about your sessions.

Finally, I will give you my evaluation of your overall performance as an instructor and make suggestions for improvement. Based on all of this input, we can then come to consensus on a list of changes and improvements, which you can choose to implement the next time you are scheduled to teach in the program.

Document #2 Instructor Rating of Student

Date _____

Course # _____

Student name _____ Instructor/Rater's name _____

One of the most valuable aspects of the industry-taught approach is the feedback instructors relay to students on their performance as “pre-service” technicians and their potential as entry-level biotechnicians. The more comprehensive and constructive this feedback is, the more value it has for the student to improve her/his candidacy for a biotech position. In order to obtain data to rate students on specific characteristics expected of a biotechnician, instructors must develop lesson plans that not only facilitate learning but also facilitate assessment of individual understanding, performance and mastery of skill-sets.

Rate the student on the following abilities in comparison with candidates for entry-level biotechnician positions. Please include a comment (e.g., cite a particular classroom instance justifying your rating) particularly if you indicate a student is “superior” or “needs significant improvement”. “Fully Meets Expectations” = satisfactory completion of technical and interpersonal objectives. Partial/inconsistent (<70%) completion of instructor objective; significant improvement needed, <50% objectives satisfied and/or immediate behavioral modification recommended. Exceeds/frequently (>125%) surpasses competency required to meet objectives. Superior/consistently (>150%) surpasses competency required to meet objectives.

	SUPERIOR	EXCEEDS EXPECTATIONS	FULLY MEETS EXPECTATIONS	PARTIALLY MEETS EXPECTATIONS	NEEDS SIGNIFICANT IMPROVEMENT
1. LAB/PROTOCOL PREPARATION	•	•	•	•	•
Comment:					
2. LAB MANIPULATIVE SKILLS	•	•	•	•	•
Comment:					
3. FOLLOWING DIRECTIONS	•	•	•	•	•
Comment:					

	SUPERIOR	EXCEEDS EXPECTATIONS	FULLY MEETS EXPECTATIONS	PARTIALLY MEETS EXPECTATIONS	NEEDS SIGNIFICANT IMPROVEMENT
4. WRITTEN DOCUMENTATION	•	•	•	•	•
Comment:					
5. ASSIMILATION OF TECHNICAL KNOWLEDGE	•	•	•	•	•
Comment:					
6. PROBLEM SOLVING	•	•	•	•	•
Comment:					
7. DATA/SITUATION ANALYSIS	•	•	•	•	•
Comment:					
8. INTERACTION WITH LAB GROUP	•	•	•	•	•
Comment:					
9. INTERACTION WITH SUPERVISOR	•	•	•	•	•
Comment:					
10. PARTICIPATION IN CLASS DISCUSSION	•	•	•	•	•
Comment:					

IDENTIFY FROM THE FOLLOWING LIST OF ATTRIBUTES ANY THAT STAND OUT FOR THIS STUDENT. JUSTIFY EACH "OUTSTANDING" ATTRIBUTE WITH A COMMENT.

ATTRIBUTES: Accountability, Alertness, Common Sense, Compassion, Confidentiality, Conscientiousness, Creativity, Flexibility, Handles Constructive Criticism, Handles Failure, Hard Working, Honesty, Independent Worker, Integrity, Interest in Work, Leadership, Meticulousness, Observant, Patience, Positive Attitude, Professional Attitude/Behavior, Reliability, Responsibility, Scientific Curiosity, Self-Motivation, Sound Judgment, Tactfulness, Takes Initiative, Thoroughness, Willingness to Ask for Help, or ??????

OUTSTANDING ATTRIBUTE _____

COMMENT _____

DOES THE INSTRUCTOR HAVE ANY OTHER IMPRESSIONS HE/SHE WOULD LIKE TO ADD ABOUT THE STUDENT?

DOES THE INSTRUCTOR HAVE ANY OTHER RECOMMENDATIONS HE/SHE WOULD LIKE TO OFFER THE STUDENT?

Document #2 Continued

RECOMMENDATIONS/NOTES ON USE OF EVALUATION FORMS BY INDUSTRY INSTRUCTOR

When you first plan your lesson, remember you are being asked to assess as you teach. So in addition to creating an instructional/learning environment that optimizes student accomplishment of protocol objectives, you should design activities that provide opportunities for you to evaluate individual students on the 10 aspects indicated on the first pages of the form. Gauging performance on exams and possibly lab practicals will summatively assess student accomplishment of protocol objectives. An instructor's ability to assess as he teaches will be gauged by his ability to complete the three-page evaluation sheet (particularly the first two pages) for each student. Consider completion of this form for each student as important an objective for you to fulfill satisfactorily as any objective you wish a student to fulfill. Don't wait until after your session(s) to begin the evaluation process. Near the end of your module, identify students you have not gotten a complete "read on"; interact with them more to fulfill your evaluative objective.

1. A student "fully meets expectations" on one of the 10 hard/soft skills when he has satisfied what an instructor determines is "patently observed", satisfactory behavior associated with that characteristic for a student in a training class. This would be equivalent to a "grade" of C+ to B- for that behavior. Remember that your expectations should be tailored to the realization that you are training a student to become employed, not training an already-hired individual. Typically, a judgment of "fully meets expectations" on a characteristic does NOT include an associative comment.
2. If an instructor cannot come to a definite conclusion (due to lack of or contradictory observations), then he should indicate that the student "partially meets expectations" on that behavior and indicate this reason under the "Comment" section. Leaving a behavioral rating "blank" is NOT an option, because that option reduces the pressure for an instructor to plan to evaluate key aspects of student performance. "Partially meets expectations" therefore can either indicate incomplete interaction between instructor and student or complete interaction but inconsistent, less-than-satisfactory, performance which will be distinguished by a brief comment. This is equivalent to a grade of C- to D+ or <70% completion of instructor objectives and significant doubt of entry level employability at this time.
3. "Exceeds expectations" would be equivalent to a grade of B to A- (frequently surpasses instructor objectives; little doubt that you would hire). An instructor may or may not include an associative comment on a characteristic deemed to "exceed expectations".
4. "Needs significant improvement would equate to a grade of D to F (would not hire at this time based on currently poor demonstration of this characteristic)). "Superior" would be consistent, superlative demonstration of this rated behavior (equivalent to a solid "A" to A+ and no doubt the student would be a definite "hire" based on this characteristic). "Extreme ratings" (i.e., "Superior" or "Needs Significant Improvement" DEMAND a comment either on the front page of the rating form or back. If you cannot identify an obvious reason to justify (with a comment) why these extreme scores are deserved, then it is an indicator to you

(and the student) that these scores may not be deserved. Since a “commentless” extreme score challenges the validity of that score, do NOT assign an extreme score for a characteristic if it is unaccompanied by a comment.

5. Inconsistencies between teacher behaviors during classroom activities and teacher assessment of particular characteristics also can reduce student confidence in the validity of teacher ratings. For instance, if a teacher gives quizzes that include calculations and cannot make a judgment on problem solving, or countersigns notebooks and cannot make a judgment on documentation, students wonder about the value of the instructor’s quiz or countersignature, and overall his ability to assess. In other words, students will heed your evaluations more carefully if they perceive a consistency between your instructional activities and evaluative assessments.
6. If an instructor gives uniform ratings on the 10 characteristics listed on the first two pages, it will likely have the same effect as if a student gave uniform ratings of an instructor. The instructor (or student) will likely come to the conclusion that their evaluator did not discriminate apparent/possible strengths and weaknesses usually demonstrated by all individuals because the evaluator invested insufficient time to distinguish apparent/possible strengths and weaknesses.
7. Do not feel “obliged” to list ANY outstanding attribute on the third page unless you conclude that a student really stands out on a particular feature. If you cannot come up with a comment to justify an “outstanding attribute”, that should be an indicator to you to leave it blank. Students give less weight to “commentless” outstanding attributes; such designations compel the student to complete the evaluation and attempt to justify the exceptional attribute. A comment underlying an attribute indicates a genuine commendation; not a light pat on the back that an instructor feels obligated to give each student. In other words, students prefer to see one outstanding attribute with a justifiable comment than multiple identified outstanding attributes without comments. When you make a comment, clearly identify an instructional event that illustrates that identified attribute (which can come from the “menu” of 30 attributes or one of your own).
8. These “pre-service” training courses are designed to be more advisory (i.e. formative) than judgmental (i.e. summative). The pattern of instructors completing an evaluation form whose results are communicated to the “evaluatee” by the faculty coordinator, creates an atmosphere of honest, non-punitive evaluation (i.e. Instructors feel they don’t have to pull any punches with criticism or be unabashedly praiseworthy given this set-up). However, instructors should keep in mind that open-ended comments (e.g., placed in the “Other Impressions” section on the second page of the rating form) tend to have more “psychological impact” on students than the summative checkmarks on the first pages of the form. So be “diplomatic” with your impressions, particularly the negative ones. If you have an overly negative impression of a student or think that one aspect of a student’s behavior is so inadequate, it damages his candidacy for employment, focus on recommending ways to improve. For example, instead of writing “I would not hire this person” or “This person has a negative attitude”, consider writing “This person would increase his employability if he did (or avoided) the following...” If a student is further behind on a particular aspect than the rest of the class, don’t indicate that he is technically slower than the rest but recommend ways to accelerate development of this aspect. Students who get conclusive, “not-too constructive”, unelaborated remarks tend to blot out any other positive ratings made by the same instructor. As on the first pages, extreme judgmental comments require explanation; otherwise without clarification and guidance, students might devalue not only your evaluation but also the role of successive assessments by industry instructors, which I believe is one of the most valuable aspects of these courses. We are all here to improve our students’ vocational skills; utilize the evaluations to help attain this goal.

Document #3 Student (or Coordinator) Rating of Industry Instructor

STUDENT NAME _____ DATE _____ COURSE # _____

NAME OF INSTRUCTOR _____ PROTOCOL TOPIC _____

Directions: Respond to each of the numerical statements below by expressing the number (or "not applicable") which best expresses your judgment. Please write any personal comment or reaction to a particular statement directly beneath that statement.

1=strongly agree

4= slightly disagree

2=moderately agree

5= strongly disagree

3= slightly agree

NA= not applicable

Also, give an overall grade (A, B, C, D, or F) for each general category. (For example, grade the quality of the protocol, lecturer's presentation, and teacher qualities, etc.)

TYPED PROTOCOL:

1. Made available well before activity is conducted. 1. _____
2. Is neatly typed without spelling or grammatical errors. 2. _____
3. Contains clear objectives that communicate the main priorities of the activity. 3. _____
4. Provides enough background information/references to help understand the basic science underlying the activity. Instructor recommendations, written overview and/or questions supplied to help students use information/references. 4. _____
5. A list of reagents/supplies/equipment is provided and is complete 5. _____
6. Communicates clearly the procedural steps of the activity. 6. _____
7. The organization of the content follows the actual lab experience. 7. _____
8. Opportunities are provided (e.g. questions, fill-in tables, perform calculations) to test one's mastery of the objectives. 8. _____
9. Provides suggestions for organization and interpretation of data in the lab notebook. 9. _____
10. Provides suggestions for future use of the methodology or principles learned. 10. _____
11. Helpful biographic information about the instructor. 11. _____
12. Is structured overall so that the information is clear and easily understood. 12. _____

OVERALL LETTER GRADE FOR WRITTEN PROTOCOL _____

Document #3 Continued

INSTRUCTOR'S LECTURE/PRESENTATION/DISCUSSION:

1. Begins class on time in an orderly, organized fashion. 1._____
2. Previews the purpose of the lecture and relates to other lectures or labs. 2._____
3. Links lecture material to specific objectives. 3._____
4. Provides occasional summaries of material throughout the lecture. 4._____
5. Writes or shows key terms that are clearly seen on blackboard or screen. 5._____
6. Dwells on obvious points too long or wanders away from the major themes/objectives. 6._____
7. Proceeds at a pace and in such a manner to allow adequate taking of notes. 7._____
8. Makes content relevant with references to "real world" applications and student vocational goals. 8._____
9. Presents up-to-date developments in the field. 9._____
10. Overloads students with too much terminology. 10._____
11. Engages students by encouraging questions, involvement, and debate. 11._____
12. Instructor incorporates students' ideas into lecture. 12._____
13. Instructor explains how each topic fits into course as a whole. 13._____
14. Instructor summarizes main points at end of lecture. 14._____
15. Lecture assists in understanding and carrying out lab activity. 15._____

OVERALL LETTER GRADE FOR LECTURE/PRESENTATION/DISCUSSION _____

Document #3 Continued

LAB ACTIVITIES:

1. The lab instructor clearly explains directions or procedures. 1. _____
2. Necessary materials and equipment are readily available for individual and group use. 2. _____
3. Demonstrations are clearly visible to everyone. 3. _____
4. Careful safety supervision is obvious. 4. _____
5. Sufficient time is available for completion of the activity. 5. _____
6. Activity enables students to complete all objectives listed in protocol 6. _____
7. Activity allows opportunity for effective group interaction. 7. _____
8. Activity allows opportunity for individual hands-on learning and expression. 8. _____
9. Activity requires skills that are beyond reasonable expectations for students. 9. _____
10. Activity is sufficiently challenging so as to encourage students to think and reflect. 10. _____
11. Activity enables students to learn job-related skills. 11. _____
12. Allows sufficient time for clean up within the class session. 12. _____

OVERALL LETTER GRADE FOR LAB ACTIVITY _____

Document #3 Continued

FORMATIVE ASSESSMENT- Pre-Exam Practice in Gauging Mastery of Objectives

1. Written protocol includes practice problems 1._____

2. Instructor asks sufficient number of questions (verbal or written) to test for student understanding of protocol objectives. 2._____

3. In the middle of a presentation, instead of asking specific questions or problems on the blackboard or overhead projector to assess class understanding, instructor asks, “Does that make sense?”, “Is that clear?” or “Does anyone have any questions?” 3._____

4. Opportunities for students to individually or by group to show work on the blackboard or overhead projector. 4._____

5. Graded quizzes or homework on a regular basis with immediate feedback (both verbal & written) to students. 5._____

6. Opportunities to assess and provide feedback to students on their laboratory skills. 6._____

7. Assessment Items Linked to Measuring mastery of protocol objectives? 7._____

8. Instructor countersigns lab notebooks & make written or verbal recommendations for improvement of documentation skills. 8._____

OVERALL LETTER GRADE FOR FORMATIVE ASSESSMENT _____

Document #3 Continued

INSTRUCTOR QUALITIES- Organization, Credibility & Control

1. Appears well prepared for class and deals with content & procedures with confidence and authority. 1._____

2. Explains difficult concepts or problems in more than one way. 2._____

3. Speaks clear and loud at an appropriate pace, without excessive speech fillers (such as "um", "ah", "you know"). 3._____

4. Is able to admit error and/or insufficient knowledge. 4._____

5. Responds confidently to student inquiries for additional information. 5._____

6. Uses authority in classroom/lab to create an environment that favors learning job-related information and skills. 6._____

7. Promotes the steady transfer of responsibility to students for carrying out their own work. 7._____

**OVERALL LETTER GRADE FOR INSTRUCTOR ORGANIZATION,
CREDIBILITY & CONTROL**

Document #3 Continued

INSTRUCTOR QUALITIES- Interaction & Rapport

1. Answers questions clearly and directly. 1._____
 2. Presents challenging questions to stimulate discussion. 2._____
 3. Provides enough time for students to respond to questions
(Refrains from answering own questions). 3._____
 4. Praises students for good ideas and correct responses. 4._____
 5. Urges students to answer difficult questions by providing cues and
encouragement. 5._____
 6. Restates questions/comments to clarify for entire class. 6._____
 7. Respects diverse points of views. 7._____
 8. Knows and uses student names. 8._____
 9. Makes students feel at ease in conversations with her/him. 9._____
 10. Recognizes when students do not understand or are confused. 10._____
 11. Does not condemn student lack of knowledge or misunderstanding 11._____
 12. Treats class members equally. 12._____
 13. Encourages student feedback and responds positively to student contributions. 13._____
 14. Talks with students immediately before or after class. 14._____
 15. Interacts well with faculty coordinator. 15._____
- OVERALL LETTER GRADE FOR INSTRUCTOR INTERACTION & RAPPORT** _____

Document #3 Continued

INSTRUCTOR QUALITIES- Enthusiasm & Motivation

1. Speaks, moves about and gestures in a dramatic or expressive way. 1. _____
2. Establishes eye contact with a variety of students. 2. _____
3. Tells jokes or humorous stories. 3. _____
4. Smiles or laughs. 4. _____
5. Communicates a sense of enthusiasm and excitement towards the subject matter. 5. _____
6. Stimulates interest of the students in the subject matter. 6. _____
7. Motivates students to do their best work. 7. _____
8. Expresses a commitment in helping students achieve their short and long term goals. 8. _____

OVERALL LETTER GRADE FOR INSTRUCTOR ENTHUSIASM & MOTIVATION _____

OPEN-ENDED QUESTIONS (Write on back of this page if you need additional space)-

1. What was the most important "thing" learned during this instructor's sessions?
2. At what time(s) were you most confused?
3. What suggestions do you have to improve this instructor's sessions?
4. What could you have done to further promote your understanding and accomplishment of this protocol?
5. Do you have any additional comments you would like to relay to this instructor (or to the faculty coordinator) regarding these sessions?

Document #4 Sample Final Evaluation Report of Industry Instructor Practicum Participants by the Faculty Coordinator

Instructor(s): K & T (SPRING 2000)

Topic(s): Upstream Processing of Bacterial Strain Products

Instructional Dates: 3/13, 3/15 & 3/17 (at [REDACTED])

Final Evaluation Written: 12/5/00

WRITTEN LAB PROTOCOL

Like the previous year, your protocol was distributed in folders (that you prepared and I picked up at [REDACTED]) one session before the class met at [REDACTED], which is an “essential” practice if you expect students to have an opportunity to prepare for the protocol. You took my suggestion from last year and paginated all written materials for easier reference. You also took my suggestion to include autobiographical statements with “protocol-permanent factoids” such as you two have been indirectly responsible for 160 products worth more than \$20 million in our tenure at [REDACTED]. **RECOMMENDATION:** Next year include in your autobiography how students can contact you (email/phone). Your objectives were identical to the previous year, which is fine, as long as these remain your priorities. They were:

1. Become familiarized with fermentation equipment and uses.
2. Learn principles of fermentation.
3. Learn and practice aseptic technique.
4. Learn and work with scale-up issues and techniques.
5. Learn and plan a fermentation production schedule.
6. Understand and practice safety in the fermentation production environment.
7. Troubleshoot equipment failures.
8. Troubleshoot production issues.
9. Complete documentation and batch records.
10. Practice and appreciate the role of fermentation in the bioprocessing industry and internal corporate work environment.
11. Know distinctions between the roles and tasks of fermentation personnel in reagent-based versus pharmaceutical-based biotech industries.

Besides objectives and autobiographical statements your 32-page handout included a: table of contents, 3-day schedule overview, schedule with bulleted activities per session, separate cleaning & sterilization protocols for the 60 and 200 L bioreactors, media prep record sheet, worksheets for both bioreactors which was a combination batch record of observed sterilization parameters AND concepts discussed by instructors (representing a combination of pre-service

Document #4 continued

training notes & typical in-service documentation), data sheet for recording vessel temperature over 5 minute intervals during vessel heating and vessel cooling, a 3-day vessel verification protocol & checklist of 5 parameters (pH control, temp., D.O.%, agitation, media sterility) , fermentation protocol, fermentation batch record, harvest protocol, 4 pages of references on large scale centrifugation, 6 more pages of references on agitators, impellers, spargers, baffles, & foaming, 9 process development issues in fermentation, 4 pages describing advantages/disadvantages of using 5 host expression systems (265 uses 4, bacterial, yeast, mammalian & insect cells; 265 does not work with transgenic animals), page contrasting batch with continuous culture, and final sheet contrasting reagent-based with biopharmaceutical based companies. K & T pared down their materials from 1999 (by excluding journal articles & Bergey's pages they never got to in 2000). Did you discuss process development issues, advantages/disadvantages of different host expression systems, and differences between reagent-based & bio-pharmaceutical companies? **RECOMMENDATION:** You either needed to discuss material that addresses such objectives as #11 or remove the objective.

Overall, K & T pared down their material but more reduction may be necessary so that students are concerned specifically with what they are doing (and how they are documenting it) and why they are doing it. More paring down of distributed materials may be necessary in the future particularly this year with 4/7 students of limited English proficiency. **RECOMMENDATION:** Include only those materials that: 1) help students to address a specific objective 2) you will discuss & have students refer to in class 3) contain a few questions for students (not instructor) to figure out and help determine if they read the furnished papers with comprehension. Some students in 2000 remarked that they couldn't complete the protocol by just reading the written materials (with the exception of the accurate & most-detailed SOP for cell harvesting - use that procedure as our "internal model"). It was a good idea to include in the provided worksheet, blank spaces to record last-minute changes in the SOP.

K & T's ratings on the written protocols were "across the board" very good and an improvement (Grade Point Average [GPA] of 3.7) on already-good ratings in '99 (GPA 3.5).

LECTURE/PRESENTATION

K & T heeded students' '99 recommendations and took the whole class through most of the procedures with both instructors alternating as primary & secondary presenters (instead of the '99 situation where both instructors were talking to two groups simultaneously). Additional improvements from the previous year had the instructors starting with a disclosure that everyone will learn to do all manipulations (rather than working on one sized fermentor) and furnishing chairs for everyone in the fermentation room so that it becomes a comfortable area for discussion as well as lab. The instructors were effective at reviewing and previewing at the beginning of the second and third sessions. K also gave a good 3rd session preview of elements (e.g., IPTG - induced protein expression & Bradford Assay) that would be covered by her/her/his successor (R). It's good for an instructor to link past and future protocols to the current one so as to clarify & expand the "Big Experiential Picture" the team of instructors are collaborating to develop.

Document #4 continued

RECOMMENDATION: A few wished they had more background on the bacterial growth & “fermentation” process. The instructor did discuss bacterial growth curve but if more information is desirable, instructors could provide it over the Internet via email if in-lab time is restricted.

Overall, students gave K & T significantly superior ratings on their presentation compared to last year (GPA of 3.3 in '99; 3.8 in 2000).

LAB ACTIVITIES

K & T alternated how to batch and sterilize the 60 and 200 L bioreactor. Instructors used 25% of media amount used in '99 to save expenses but students still appreciated their first experience using relatively larger amounts than they have ever used for upstream processing. The instructors let students alternate performing all steps in prepping the vessels and had students monitor & document at 5-minute intervals vessel heat-up and cool-down parameters. In Session II, students inoculated bioreactors with recombinant *E.coli* expressing TAQ polymerase. This enzyme and lambda phosphatase (in bacterial cells upstream processed and stored from last year) were the primary protein purification targets for R & J. The boiler was on the fritz in Session I, but there was sufficient boiler pressure in Session II to accelerate vessel sterilization process. The instructors had the 60-L vessel operate at 37 C and the 200-L vessel at 30C. Students were asked to graph OD vs. time for both bioreactors as homework. T showed individuals how to take spectrophotometer readings (But he did not ask one trained student on the spec to train another- **RECOMMENDATION:** This form of “chain teaching” was practiced effectively in 1999 and should be considered for 2001. Also in Session II, students were showed lyophilized cultures used for scale-up, and they practiced scale-up techniques, particularly with *Streptomyces* species. In Session III, K worked primarily with 2 students who missed Session II to catch them up while T involved different students in assembling the Sharples centrifuge. K had different students remove Teflon strips with the bacteria. Students collectively harvested 228.5 g (compared to 180 in '99) and stored them in liquid nitrogen following a demonstration on “bacterial scraping” into liquid N₂ by K.

Students gave in '99 excellent ratings for the lab activity (GPA 3.7) and in 2000 gave more superlative, near-perfect ratings (3.9). One student mentioned it was difficult for all students to see the assembly & operation of the Sharples centrifuge. **RECOMMENDATION:** Perhaps a bit more time could be taken moving students around in that small alcove as the Sharples is being assembled. Several students mentioned they were most confused about the description of the parts/pipes of the 200-L bioreactor. Perhaps a simple labeled or part numbered schematic can be provided so that students follow along as the instructor points out the parts of the 200-L bioreactor. Also, one student mentioned that safety concerns seemed a bit lax particularly after their earlier safety sessions with Allison Fowler. **RECOMMENDATION:** For appearance sake, and setting a safety impression, perhaps instructors can wear lab coats along with the students. If a cloud of media is generated when pouring it into the bioreactor, perhaps masks (if available can be worn). Minimally, perhaps a safety-oriented comment might be warranted per session at appropriate times. The students sign company waiver forms (and we are supposed to have them sign similar college-based forms) so they expect safety measures to be a high, demonstrated priority.

Document #4 continued

FORMATIVE ASSESSMENT

Quizzes were given each session (An excellent practice which was begun in '99). K & T responded to recommendations made in '99 and had students exchange quizzes, grade & review them which provided students with more valuable feedback on their learning (and more-valuable feedback on K's & T's instruction). **RECOMMENDATION:** My only suggestion is to try to have this exchange on the same session that the quiz is administered so that this feedback is instant and more valuable to students and instructors. This instant review was practiced in Session III. K & T wrote more extensive evaluative comments on quiz and homework assignments (another '99 recommendation). **RECOMMENDATION:** The instructors gave me a key to each of their quizzes as they administered them (Good!) but they should try to give me quiz & homework scores as soon as possible instead of waiting for two days after the final session. Instructors were flexible in their evaluation of the quizzes. For instance, on an answer to a quiz item assessing knowledge of methodology that a student "debated", T emailed that student allowing her answer.

Students gave you excellent (GPA 3.8) for your formative assessment practices (There was no category to evaluate & compare formative assessment practices in '99).

SUMMATIVE ASSESSMENT

The average on the exam that included K & T's questions was 94%. Their questions showed the most variety of all the instructors (Short answer questions, true/ false, multiple choice) which indicates that a lot of thought was invested in original question design (Many questions were "carry-overs" from '99, which is fine as long as the questions continue to reflect the experiences and directly address student objectives).

K & T submitted extensive performance reviews of each student. Each instructor included a comment on superior ratings (on the first page) and a comment for every noted outstanding attribute (on the second page of the form). This information is probably the most valuable feedback to the student for her/her/his/her continued development as a technician-in training.

OVERALL COMMENT

In '99, Students gave K & T superlative end-of-teaching session ratings on your organization, credibility, & control and your enthusiasm & motivation (GPA's of 4.0, 4.1 and 4.0). In 2000, the students gave overall marks of 4.1, 4.0 and 4.1, respectively (In order to obtain a greater-than 4.0 perfect score, a number of students would have to assign an A+. Students genuinely liked both instructors and praised each of their complementary teaching styles. In semester-end comments, the word "fun" came up as it did in '99. Students described K & T as personable, enthusiastic, animated and concerned about their job prospects. There was also consensus that having the sessions at [REDACTED] added an extra dimension of applicability to their training. In '99 K & T's overall GPA as instructors was 3.3; in 2000, it was 3.5. These 3 sessions were more effective than the first year's already-effective sessions, which typifies the efforts of dedicated instructors who reflect on evaluative feedback and take action to continue to progress as trainers.