THE VALUE OF MENTORING

"The notion of mentoring is ancient… In modern times the concept of mentoring has found application in virtually every forum of learning. In academics, mentor is often used synonymously with faculty advisor. A fundamental difference between mentoring and advising is more than advising; mentoring is a personal, as well as, professional relationship…In a broad sense, a mentor is someone who takes a special interest in helping another person develop into a successful professional." (Advisory, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering; National Academy Press; 1997)

Connecting students to the world of science and technology that exists beyond the academic classroom holds great potential for helping the students decide on and pursue a career pathway. Whether that path leads to a career in research, teaching, business, or a related scientific or technical field, the advanced scientific laboratories of the U.S. Department of Energy can enhance the knowledge and skills of undergraduates. This is accomplished by linking students to the research projects, facilities, instruments, and people found in these laboratories.

"In a broad sense, a mentor is someone who takes a special interest in helping another person develop into a successful professional.

If research and technology development are the essence of science and engineering, and a laboratory experience allows a student to see the process of science and engineering first-hand, then students in these disciplines can benefit from mentoring by laboratory scientists, engineers and technologists. Mentors are the essential guides and supporters of this learning experience, which differs from the science experience that most students have in a regular classroom setting.

For example, the DOE Community College Institute (CCI) of Science and Technology places community college students in internships in science, engineering and technology where they work directly with researchers. Luis Aceves, a Latino-American community college student from California participated in the CCI program at the Pacific Northwest National Laboratory (PNNL) in summer 2002. He is the first in his family to go on to college. He quit work in his father's business in order to become a full-time student. Luis's experience at PNNL was his first research experience. His mentor, Michael Alexander, knew from experience that the initial stage of any student in his/her first research experience is "bewilderment." The technologies and the protocols of actual scientific research were foreign to Luis, who actually stated, "What the heck did I get myself into?" Michael foresaw this reaction and explained to Luis that he was not concerned so much about what he knew but with what Luis could learn during the ten-week research experience. Michael designed a project for Luis that employed Luis' immediate skills. Michael provided insights on how the technology worked in the research project and how a variety of disciplines are required for the research project to be successfully completed. Luis was provided technical manuals, virtual training courses, and classes that helped him learn the processes for conducting his summer research project. Michael introduced Luis to laboratory staff members who could offer

assistance and answer questions relating to his research project and who provided a network of professionals with whom Luis could interact. For his part, Luis had this to say about his relationship with Michael:

> "My summer here was an awesome and very educational experience. I am thankful that he gave me the resources and trust to work on a part of his research I am most thankful that he chose me to be one of his fellows and for the opportunity to work with him. He made me feel every bit as important as the project itself. Michael was most interested in what I learned from the experience and in giving me ideas opportunities are in my future as a scientist. He made me feel like a professional colleague and gave me confidence in expressing my ideas on the experiments we conducted."

Although mentoring is not the scientist's or engineer's primary responsibility, each staff member who agrees to enter into a mentoring relationship does so based on a common goal: to advance the educational and personal growth of the student. Students benefit from multiple mentors who represent diverse talents, ages, and personalities. While college and university faculty provide the core of the mentoring an undergraduate receives during her/his baccalaureate years, the opportunity to participate in a well-planned research project at a DOE National Laboratory can help the student better understand the practice of science and technology and add value to their education regardless of the career path they finally choose.

"...most careers are seldom a straight path to an imagined goal, but rather a series of "branching decision points"

Thus, the laboratory staff member can become an important mentor to the student as well. In this role, the scientist or engineer can help the student 1) gain an appreciation for the many different careers in science and engineering, 2) realize that most careers are seldom a straight path to an imagined goal, but rather a series of "branching decision points" requiring an increasing degrees of flexibility and versatility, 3) develop important work habits and skills (e.g., communication, leadership, teamwork, and thinking skills), and 4) appreciate the special features, as well as the advantages and disadvantages, of a career in science and engineering. (NAP – 1997)

Young-Me Chung, a participant in DOE's Science Undergraduate Laboratory Internship (SULI) Program had this to say about her mentor, Anna Gutowska:

> "The human condition being what it is, the perfect mentor simply does not exist. However, Dr. Anna Gutowska comes very close. I greatly appreciated my mentor's ability to balance lending me her support and expertise with challenging and entrusting me to accurately conduct lab work on my own and report the results with thoughtful analysis. Anna did not hold my hand, but if I tripped, she was ready to catch my arm before I fell flat on my face. She did not assign to me lab duties to perform blindly, but we discussed together the experimental approaches I would take and the principles behind them. She took my suggestions, questions, results, abstract drafts, and paper drafts seriously. Accordingly, I felt comfortable taking her feedback seriously.
>
> Anna maintained a professional manner and a high level of expertise in her field of research, both in theory and in the lab. At the same time, Anna was a very warm and open person. Her

enthusiasm was contagious (copolymers suddenly hold fascinations for me they never held prior to this summer!) and her communication skills were amazing. English is not her first language, yet she has explained to me numerous technical matters with effective idiomatic language, humor, and clarity, be it a dense paragraph in one of the background papers she gave to me on my first day at the lab or the manifold steps to a synthesis. Moreover, she was a careful listener, giving me her full attention, a fact I appreciate very much when having to explain not-so-good news such as trouble-shooting stubborn equipment or quirky experimental results."

In its educational toolkit on mentoring (Putting the Pieces Together – 2002), the Pacific Northwest National Laboratory describes mentoring as a shared relationship in which both the mentor and student benefit. For the student, the relationship is developmental; for the mentor the relationship creates opportunities to influence the growth and success of the student. For example:

- The student learns strategies on how to function and succeed in the workplace, while the mentor clarifies roles, responsibilities and expectations for the student.
- The student becomes aware of career and professional opportunities, while the mentor develops a sense of pride in seeing the student learn about, focus on, and accomplish goals.
- The student receives guidance in dealing with challenges and problems, while the mentor evaluates and acknowledges the student's potential.
- The student gains a sounding board for exploring career, educational, and professional options, while the mentor provides key guidance, answers critical questions, and acts as a role model.
- The student gains a valuable friend and confidant, while the mentor engages in personal "coaching" that lets the student know that "he/she can do it."

The National Academies' handbook on mentoring (NAP-1997) highlights some of the outcomes of a quality mentor/student relationship. Many of these can be realized through an educational appointment at a DOE National Laboratory. For example, the student:

- Enhances her/his knowledge and skills through introduction to cutting-edge science and technology,
- Accumulates laboratory and field research skills through "work-based" training that may eventually influence the hiring decisions of prospective employers, including DOE and its laboratories,
- Masters laboratory techniques, learns to think critically, practices problem solving strategies, and experiences the importance of patience and perseverance in the unpredictable context of research,
- Takes a big step on the path to becoming a part of the "next generation of scientists and engineers."

The mentor:

- Shares life experiences, wisdom, as well as technical expertise,
- Develops his/her own professional and interpersonal skills,
- Experiences the personal satisfaction found in teaching,
- Receives recognition in the academic and scientific community for their mentoring efforts, and
- Grows personally from exposure to a new ideas and perspectives of a diverse set of students who participate in these DOE undergraduate programs.

Perhaps nowhere in the portfolio of undergraduate programs sponsored by the Office of Workforce Development for Teachers and Scientists is the need for effective mentors greater than the Pre-Service Teacher (PST) Program. For the past three summers, PST has provided summer research internships, for undergraduate students who plan

on teaching. For many, if not all of these students, working in research is a new and often intimidating experience. A thoughtful and prepared mentor can make a difference. Sherene Carter, a student at Idaho State University, had this to say about the impact of her mentor, Deanna Auberry:

> "Intimidated by the description of my lab research this summer, I was a little frightened to get in the lab. I had very little lab experience, and yet wanted to look like I knew what I was doing. Well, I didn't. But when I met my mentor I knew that everything would be okay. Deanna was the hippest and coolest of mentors. She let me know that mistakes were not the end of the world; she expected them, but as time went on, I would get more comfortable in the lab.
>
> As the summer went on, I realized that science is a slow process. A simple experiment that should take one or two days can end up taking 3 weeks! I witnessed that first hand. It's was also important to be creative. Deanna taught me the art of improvising with the equipment that is available to you. With the lack of money, it is not always possible to order every little convenience. You have to make do.
>
> I enjoyed and valued the lab experience I gained this summer. I have indeed become comfortable in the lab and more confident of my skills. I look forward to setting up labs for my future students and helping them to have more lab experience than I did when I was their age. This program has been a blessing in my life for more reasons than one. I hope to be able to encourage other Idaho State students to apply next year!"

These student vignettes describe the powerful impacts of a DOE research experience with an effective mentor. I encourage student and scientist alike to experience the mentor/student relationship by participating in a DOE undergraduate program. To be successful, mentors and students must make the effort to know, accept, and respect the goals and interests of one another. In the end, they can establish an environment in which the student's accomplishments and the mentor's satisfaction are only limited by the extent of their scientific talents and their commitment to one another.

Jeffrey Estes
Pacific Northwest National Laboratory

Committee on Science, Engineering and Public Policy. 1997.
Advisory, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering. Washington, D.C.: National Academy Press

Science & Engineering Education Programs. 2002
Mentor Tool Kit: "Putting the Pieces Together."
Richland, WA: Pacific Northwest National Laboratory