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**THE ACS COMMITTEE ON PROFESSIONAL TRAINING
THE ACS COMMITTEE ON MINORITY AFFAIRS**

Workshop on Increasing Participation of Native American Undergraduate Students in Chemistry

FINAL REPORT

**ACS Committee on Professional Training
and
ACS Committee on Minority Affairs**

Workshop on Increasing Participation of Native American Undergraduate Students in Chemistry

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*A special thank you is extended to Ron Estler at Fort Lewis College
for his leadership in planning this workshop.*

Workshop on Increasing Academic Participation Of Native American Undergraduate Students in Chemistry

Executive Summary

Over the past four years, the American Chemical Society (ACS) has hosted a series of three workshops focusing on increasing minority participation in chemistry. Participants in these workshops sought to identify issues faced by minority students in the African American, Native American and Hispanic populations and develop strategies to attract underrepresented minorities to careers in chemistry and to help them attain academic success.

This workshop was organized by the ACS Committee on Professional Training (CPT) and the ACS Committee on Minority Affairs (CMA) and brought together a diverse group of participants involved in the education of Native American undergraduate students at tribal colleges and universities and four-year degree programs across the United States. Increasing the participation of Native Americans in chemistry is an important yet challenging goal. The perspectives of Native American chemists help to advance the frontiers of knowledge and address issues facing our society at large and within tribal communities. According to the National Science Foundation, in 2005 only 65 Native American students were awarded bachelor's degrees in chemistry in the United States. With such a low number of Native American chemistry degree recipients, even small gains in the number of chemistry graduates each year would be significant.

Many factors contribute to the low rate of participation by Native American students. Faculty and mentors may be unfamiliar with Native culture and may misinterpret student actions. Because of the diversity of tribal cultures, there is no generalized Native American experience. Chemistry courses and laboratory experiences must be engaging and responsive to the cultural traditions and values of Native American students to be effective. This workshop focused on identifying barriers to attracting and retaining Native American students and developing successful strategies for ACS to implement.

Participants identified significant barriers to the recruitment and retention of Native American undergraduate students: poor visibility of chemistry in Native communities and lack of knowledge about chemistry careers, few Native American role models, the need for effective mentoring and engaging research experiences, financial difficulties, poor academic preparation, and a lackluster chemistry curriculum. Because of the low numbers of Native American chemists currently being produced, much of the discussion focused on introductory and general chemistry courses and their potential to attract students into the field.

The following recommendations provide a framework for ACS in its efforts to advance the education and participation of Native American undergraduate students in chemistry. These recommendations are described in detail in the text of the report and are summarized here.

Recommendations for the ACS Committee on Professional Training

- Establish a Native American chemistry clearinghouse for culturally appropriate educational resources and effective practices.
- Organize a symposium at a national ACS meeting featuring effective practices in the teaching of chemistry from Native perspectives and highlighting the beauty of chemistry.
- Utilize the CPT newsletter to highlight effective practices in teaching, research and mentoring Native American students.
- Establish a database of chemistry faculty at Native American-serving institutions.
- Conduct a survey on chemistry education practices at Native American-serving institutions.
- Promote awareness of the importance of diversity as part of the five-year review process for ACS approved programs.

Recommendations for the ACS Committee on Minority Affairs

- Establish a more prominent Native American presence within ACS committees.
- Highlight successful careers of Native American chemists at all stages.
- Establish a mechanism to identify ACS members willing to teach, assist with grant writing, and serve as mentors to Native American-serving institutions.
- Build an electronic community focused on Native American issues in chemistry.

Recommendation for the ACS Graduate Education Advisory Board

- Encourage Native American-serving institutions to participate in the Academic Employment Initiative.

Recommendations for the Society Committee on Education

- Identify and disseminate educational materials to facilitate teaching of introductory chemistry within a culturally appropriate context for Native American students.
- Identify and disseminate electronic resources for chemistry-relevant math skill development as a companion to introductory and general chemistry courses.
- Develop and disseminate resources to help faculty and teaching assistants become more effective mentors of Native American chemistry students.
- Facilitate connections between faculty at two-year Native American-serving colleges and four-year degree programs that can foster student transitions.

Recommendation for the ACS Committee on International Activities

- Expand existing international programs, especially international Research Experiences for Undergraduate programs, to target Native Americans.

Recommendation for the ACS Division of Chemical Education

- Increase coordination of programming and participation of AISES (American Indian Science and Engineering Society) and SACNAS (Society for the Advancement of Chicanos and Native Americans in Science) at ACS regional meetings.

Recommendation for the ACS President

- Offer a complimentary one-year membership to chemistry faculty at tribal colleges and universities.

Recommendations for the ACS Younger Chemists Committee

- Organize programming at regional and national meetings to attract and engage Native American students.
- Identify and develop materials on careers in chemistry for Native American students.
- Create electronic resources, especially high quality videos, highlighting successful Native American chemists at various stages of their careers.

History and Objectives of the Workshop

The American Chemical Society (ACS), along with the profession of chemistry more broadly, has become increasingly concerned with its relative lack of diversity. In 2002, the Task Force on Minorities in Academe was appointed by the ACS Board of Directors to consider ways to increase the number of minority faculty in chemistry at institutions of higher education, especially the top 50 research universities. This Task Force adopted the following vision statement to guide its work:

“The American Chemical Society recognizes the need to develop fully the academic potential of all the nation’s citizens. The ACS will, therefore, develop and implement programs that will increase the participation of underrepresented minorities in the chemical academic community to a level that reflects their representation in the country’s population.”

The ACS Task Force, chaired by the late Dr. Stanley C. Israel (Texas State University) and co-chaired by Dr. Joseph S. Francisco (Purdue University), considered its charge in the broader context of crucial decision-making junctures along the educational and professional pathway that leads to a successful academic career and defined the following objectives for its work:

- Increase the number of underrepresented minority undergraduate students choosing to pursue graduate work in chemistry;
- Increase the number of underrepresented minority graduate students choosing an academic career; and
- Increase the number of underrepresented chemistry faculty that become tenured.

The Task Force made 14 recommendations to the ACS Board of Directors that were eventually endorsed and accepted with an implementation timeline of three years. These recommendations fell into six categories as delineated below:

- Develop partnerships to facilitate these goals within, across, and beyond the profession;
- Add value by reshaping boards and other bodies of leadership within the profession to be more inclusive;
- Achieve educational outreach through a series of activities;
- Collect and disseminate better data on the participation of underrepresented minorities in chemistry;
- Enable mentoring; and
- Establish financial incentives to facilitate the participation of underrepresented minorities in higher education in chemistry.

The appointment and work of the ACS Board Task Force on Minorities in Academe paralleled exactly in time discussions within a subcommittee of the Committee on Professional Training (CPT) on the underrepresentation of minority-serving institutions. Two members of CPT, Dr. Jeanne E. Pemberton (University of Arizona) and Dr. Carlos Gutiérrez (California State University-Los Angeles) had been appointed as members of the Task Force on Minorities in Academe and served as conduits for expressing CPT’s concerns about lagging minority student participation in chemistry at the undergraduate and graduate levels and the underrepresentation of minority-serving institutions (MSIs) on the list of ACS-approved undergraduate programs in chemistry.

One recommendation from the Task Force on Minorities in Academe was for CPT to host a workshop with representatives from MSIs to understand the incentives and barriers to ACS approval at these institutions and to increase participation of underrepresented minorities in chemistry. The ACS Board of Directors endorsed this recommendation, mandated that CPT hold such a workshop, and provided partial funding for this purpose. The charge to host a workshop was perfectly consistent with past CPT practice for communicating with various segments of the undergraduate chemistry community and with the strategy that CPT had devised for moving forward on increasing the number of MSIs with ACS-approved chemistry programs.

After further discussion, CPT decided that a single workshop would be insufficient to address the diverse challenges faced by MSIs serving different student populations. To allow more focused discussions, a series of three workshops were held with the African American, Native American, and Hispanic academic communities.

This report is the result of the workshop specifically focused on institutions with large populations of Native American undergraduate students, including tribal colleges and universities and other Native American-serving institutions. The institutions represented a wide range of institutional profiles from small tribal college programs offering no baccalaureate degree in chemistry to research-intensive institutions offering graduate programs. The specific goals for this workshop were:

- To better understand the challenges associated with recruiting and retaining Native American undergraduate students in chemistry;
- To devise strategies for identifying and disseminating practices that work in developing strong chemistry programs that are inclusive of this minority group;
- To identify mechanisms through which CPT can enhance the success of existing and developing undergraduate chemistry programs educating significant populations of Native American undergraduate students, both through the ACS undergraduate program approval process as well as through other CPT activities; and
- To articulate specific actions that ACS, including the ACS Board of Directors, governance groups, and staff, can undertake to facilitate and promote the inclusion of Native Americans in chemistry.

Through this workshop, CPT specifically sought to *initiate a dialogue* with tribal colleges and universities and other Native American-serving institutions as steps to engender greater participation of Native American undergraduates in chemistry and, where appropriate, to increase participation of such institutions in the ACS approval process. Participants at this workshop were recruited from a cross-section of chemistry and science departments from institutions throughout the United States: Boston University, Colorado State University, Fort Lewis College, Haskell Indian Nations University, Humboldt State University, Macalester College, Montana State University, Mount Holyoke College, Northern Arizona University, Oglala Lakota College, Princeton University, Sinte Gleska University, University of Alaska-Fairbanks, University of Arizona, University of California-Riverside, University of Minnesota-Twin Cities, University of Montana, University of North Carolina at Pembroke, and University of South Dakota. A complete list of workshop participants and their affiliations is contained in Appendix A.

Identifying the Challenges

Pre-workshop Questionnaire Results

To better identify the pertinent issues for discussion during the workshop, a pre-workshop questionnaire was distributed to and collected from the participants. The participants were asked to provide institutional information about the size, degrees offered, specific Native American support structures, and current Native American undergraduate student participation in chemistry. In addition, the participants were asked to list their perceived top five factors impeding a greater participation in chemistry from this underrepresented group. Three factors were mentioned most often and equally in frequency. They were:

- A poor academic preparation or experience in K-12, especially in math;
- No employment opportunities where they want to live (often, the reservation); and
- No role models (faculty and/or student).

Additional factors identified as impeding the increased participation of Native Americans in chemistry included:

- Negative pressures from family and peers when returning home for visits, the challenges of not appearing superior to the tribal elders, and a general lack of encouragement from family and/or community;
- Financial difficulties (tuition, textbooks, and living expenses, sometimes resulting from a lack of awareness of the true and total costs associated with higher education);
- Negative institutional signals (no invitation to “join” the chemistry community, no encouragement from faculty and non-Native students, and a general ignorance of cultural differences on the part of faculty); and
- Lack of general knowledge, along with misperceptions, about the field of chemistry (chemistry is perceived as “too abstract”, presentations often lack any cultural connections, and the introductory curriculum is “discouraging”).

Several participants additionally noted, simply, “Native American students do not think that they can succeed.”

The participants were also asked to identify topics that they would like to see addressed within the workshop. These broadly fell into the following categories:

- Innovative techniques to engage Native American students in chemistry and math (“thinking outside of the box”);
- Culturally related ideas/techniques for teaching science/chemistry to this population; and
- Strategies for working with different tribes, which have different customs and cultures.

These items along with the other data culled from the questionnaire were presented by the workshop organizers as part of the first evening’s opening activities, which included an overview presentation by ACS President, Dr. Bruce Bursten.

Keynote Presentation

In the presentation “Building Capacity for Chemistry at Tribal Colleges,” [Mike Fredenberg](#) highlighted many of the challenges faced by faculty and students at tribal colleges and universities, based on his perspective as a faculty member for eight years at Oglala Lakota College and as an NSF program officer for the Tribal Colleges and Universities Program (TCUP). The goals of TCUP are to build capacity for STEM education at tribal colleges and universities including faculty, equipment, buildings and IT infrastructure.

The presentation emphasized the magnitude of the challenges faced by ACS: from 1996-2005 only 514 baccalaureate degrees in chemistry were awarded to American Indian/Alaskan students. With 562 tribes recognized by the Bureau of Indian Affairs, on average fewer than one student per tribe obtained a bachelor’s degree in chemistry over this 10-year period. Mr. Fredenberg highlighted three successful TCUP projects and offered the following observations:

- Simply giving students money did not work; paid internships for undergraduate research were more successful.
- Place-based research was important for engaging students.
- Students benefited from engaged faculty members and strong support structures.

Because few of the tribal colleges and universities have chemistry bachelor's degree programs, they are not currently significant producers of students with this degree; many offer a two-year degree. At many tribal colleges and universities, faculty teaching chemistry may not be trained as chemists. Mr. Fredenberg also highlighted the factors that were the top reasons, in his view, that Native American students do not choose chemistry and other physical science degrees: poor preparation in math, insufficient high school chemistry experiences, and a lack of relevance.

Addressing the Challenges: Workshop Activities and Findings

The rest of the workshop consisted of four sessions. Three sessions began with several short introductory presentations and/or panel discussions to motivate discussions that occurred in subsequent breakout groups. The final session was conducted as a full group discussion of the recommendations to make to various ACS offices and programs. The full workshop agenda appears in Appendix B. Volunteers from each breakout group served as leaders and reporters, and a CPT or ACS staff member was assigned to each group as a scribe for note-taking. Breakout group compositions are listed in Appendix C.

Session 1: Challenges and Strategies in Education of Native American Undergraduates in Chemistry

This session provided examples of the challenges faced by the chemistry profession and strategies for increasing the representation of Native Americans. Challenges associated with retaining Native American undergraduate students were discussed, highlighting support programs, linkages between institutions, and successful strategies in the instruction of chemistry to this underrepresented group.

Discussion Panel

Mary Berry, University of South Dakota
Subdoh Singh, Sinte Gleska University
Lucinda Begay, University of Arizona
Jacquelyn Bolman, Humboldt State University

In the presentation “Educating Native American Students in Chemistry: Programs that Work”, *Dr. Mary Berry* (University of South Dakota) and *Dr. Subodh Singh* (Sinte Gleska University) described the involvement of Native American students and Tribal College faculty in the NSF-supported Northern Plains Undergraduate Research Center (NPURC) based at the University of South Dakota. The NPURC promotes the involvement of undergraduate students in research early in their academic careers through introduction to research workshops and research opportunities. The program also provides symposia and lecture opportunities that stimulate faculty/student interactions. Funds are provided to support faculty in conducting summer research with undergraduate students on their own campuses. Dr. Singh also summarized his community outreach efforts on the Rosebud Reservation and the importance of involving students and their families.

Ms. Lucinda Begay (University of Arizona) described her experiences as a graduate teaching assistant in a general chemistry laboratory section for Native American students. This unique laboratory experience not only provides an educational context for students in which they are not in the minority, it also offers them a strong role model in their Native American teaching assistant. The result is significantly improved retention. Building on her experiences both as a student and as a teaching assistant, Ms. Begay provided a list of suggestions for effective instruction of Native American students, including:

- Be culturally aware (know students' tribes, where they come from);
- Let students know why chemistry is important, and connect it to life on the reservation;
- Teach using visual approaches;
- Challenge and encourage students;
- Be sensitive and respectful;
- Encourage students to work in groups;
- Be a good example (patient, kind, understanding, and happy).

The final presentation in this panel discussion was by *Dr. Jacquelyn Bolman*, Director of the Indian Natural Resources, Sciences and Engineering Program (INRSEP) at Humboldt State University. INRSEP is unique in the California State University System as the only program focused on Native American students in science and engineering. Dr. Bolman highlighted the importance of active recruiting to attract Native American students into STEM careers and indicated that intergenerational recruiting (recruiting the family, not just the student) is often needed. In her experience, teaching science through the Western lens is not successful. Native American cultures have always relied on science because of their close connections to the natural world and their role as stewards of the environment. Successful instruction in chemistry requires making culturally relevant connections that build on the Native American relationship to the land and highlights ways students can use their degree.

After the panel presentation, the participants addressed the following questions in breakout groups. Because of the small numbers of Native American students who choose chemistry as a degree path, these questions were designed to specifically address the introductory and general chemistry experiences.

- How could the success of the Native American undergraduate students enrolled in introductory chemistry be improved?
- How can introductory chemistry courses be more engaging and relevant to Native American students?
- How can communication between tribal colleges and four-year programs be improved to facilitate student success?

The discussion of the preparation of Native American students focused both on easing their transition to higher education and on ways to connect with their families and communities. Summer orientation for beginning students and successful transition strategies for transfer students can help ensure long-term student success. Math deficiencies should be identified using assessment tests and remedial math instruction provided prior to or concurrent with enrollment in general chemistry. Providing role models and peer mentors and building critical mass, through strategies such as Native American laboratory sections, can help encourage student success. The importance of family, community, and tribal connections was stressed. Involving families in the recruitment process and providing summer orientation materials for families, as well as students, could increase success.

Introductory and general chemistry courses should highlight the central role of chemistry in science and ways in which chemistry relates to daily life, particularly the Native American experience. This could be facilitated through the development of culturally relevant curricular materials, such as online resources and videos, for non-Native American faculty at majority-serving institutions. It was suggested that, because of the prominence of cycles in nature and in Native American culture, describing chemistry in terms of cycles could help engage students. Another approach suggested was reorganization of the general chemistry course to first present applications, and then discuss the theoretical principles needed to understand each application. For students who find themselves in trouble early in the first term, opportunities to transfer into rescue courses could help to keep them

in chemistry and on track in their educational program. The use of peer mentors, using Native American mentors where possible, and early engagement in research are other approaches that can interest students in chemistry. It was also suggested that a freshmen seminar, such as “Exploring Chemistry and Native Stories,” could supplement a traditional general chemistry course.

Communication at all levels can help to increase the success of transfer students. Alignment of curricula may require discussions between State and Tribal governments. Strategies for facilitating interactions between tribal colleges and nearby colleges and universities, for example through faculty exchange programs and research collaborations, were suggested. At majority-serving institutions, a dedicated office or staff person can help establish linkages with tribal colleges and facilitate faculty communication. It was also noted that at many tribal colleges, infrastructure and technology limitations can hinder communications.

Session 2: Models that Work: Effective Strategies for Attracting and Retaining Native American Undergraduates in Chemistry

This session focused on the institutional role in promoting student success and resources for educators. Challenges associated with recruiting and retaining Native American undergraduates were discussed at both the departmental and institutional level. Participants also considered effective strategies for recruiting and retaining Native American students in chemistry.

Keynote Presentation

During a working lunch, *Dr. Jani Ingram* (Northern Arizona University) presented a keynote address in which she described strategies for successful engagement of Native American undergraduates through research experiences. Her research projects are directly relevant to Native American students; for example, environmental uranium exposure and water quality are important environmental issues on the Navajo reservation and provide challenging analytical chemistry research problems. The Native American Cancer Research Partnership (NACRP), funded by the National Cancer Institute, connects Northern Arizona University and the Arizona Cancer Center of the University of Arizona to provide biomedical research opportunities. Dr. Ingram also pointed out that cultural awareness is important in research, especially in the handling of human samples.

Discussion Panel

Royce Engstrom, University of Montana

Paul Flowers, University of North Carolina at Pembroke

Sheila Browne, Mount Holyoke College

The University of Montana has a rich history and tradition of involvement with Native Americans. Located on the Lewis and Clark Trail, the campus is on a former summer camp location for the Salish tribe. *Dr. Royce Engstrom*, provost of the University of Montana, described their efforts to encourage Native American students to pursue undergraduate and graduate degrees in science. A cornerstone of this effort is the Native American Research Laboratories (NARL), funded by the Alfred P. Sloan Foundation. NARL provides American Indian undergraduate and graduate students with hands-on, community-oriented interdisciplinary research opportunities in basic and biomedical sciences. Students also have the opportunity to participate in an international research experience and several have traveled to Costa Rica and Norway.

Dr. Paul Flowers, University of North Carolina at Pembroke (UNCP), described his institution's effort to train Native American students in chemistry. UNCP is also an institution with a long history in educating Native Americans. The school was founded in 1887 as a Normal School to train American Indian public school teachers. Native American students constitute 18% of the student body and 27% of the chemistry majors. The chemistry faculty takes a "learning is personal" approach and is fully engaged with students in the classroom and the laboratory. A number of federal agencies support undergraduate research, including the National Institutes of Health (Minority Access to Research Careers and Research Initiative for Scientific Enhancement), the National Science Foundation (Louis Stokes Alliance for Minority Participation), and the National Aeronautics and Space Administration.

Dr. Sheila Browne, Mount Holyoke College, described the importance of mentoring for student success. Mount Holyoke College was established as the first of the Seven Sisters—the female equivalent of the once predominantly male Ivy League. The connections between this women's college and the Cherokee Nation began in 1850 when two Cherokee tribal leaders visited the college to examine it as an example for the school they wanted to establish in Oklahoma. Dr. Browne stressed the importance of extending an invitation to students to "join" chemistry, especially students from disadvantaged backgrounds. Mentors can encourage struggling students by sharing their own stories of difficult times. Mentors have to believe in students until they can believe in themselves. Dr. Browne also reminded the participants that students learn how to become mentors by watching, so role models are important.

Building on the descriptions of successful chemistry programs shared in the keynote presentation and panel discussions, the participants addressed the following questions in their breakout group discussions, focusing on the institutional perspective.

- What are the barriers and challenges to recruiting Native American undergraduate students to chemistry?
- What are successful strategies for recruiting Native American undergraduate students to chemistry?
- What are the barriers and challenges to retaining Native American undergraduate students in chemistry?
- What are successful strategies for retaining Native American undergraduate students in chemistry?

Not surprisingly, several aspects of the discussion of barriers and successful strategies for attracting students into chemistry paralleled those of the first breakout session. Inadequate preparation in math and science can be a problem for entering freshmen or tribal college transfer students, and as a result, they are less likely to choose a major like chemistry. Outreach can build linkages between academic institutions and tribal communities, which are important for recruiting students. For example, students in the American Indian Science and Engineering Society (AISES) or the Society for the Advancement of Chicano and Native Americans in Science (SACNAS) chapters can serve as outreach ambassadors to high schools. This also addresses the lack of Native American role models in chemistry, a factor that hinders recruitment of students to the field.

It was suggested that tribal college and university students could be invited to visit nearby academic institutions and offered summer research positions to get them interested in chemistry and that assistance from the chemistry community could help build chemistry curricula and infrastructure at these institutions. As in the previous breakout discussion, the need to build relationships with families and community can be an important aspect of recruiting students to chemistry. Recruiting students into chemistry also requires that chemistry be perceived as an attractive career. Students do not see chemistry-related opportunities in the communities where they want to live. By communicating the relevance of a chemistry background to communities and tribal governments, this limitation may be overcome. This requires effective communication and the establishment of long-term relationships.

The participants discussed a number of factors, including the need for colleges and universities to take the point of view that Native Americans can succeed. Faculty must find ways to overcome student trepidation and lower barriers for students to ask questions and seek help. Native American students may feel isolated in a chemistry major that has few native students. Peer mentoring and clustering students, for example by providing Native American lab sections or discussion groups at large majority institutions, can help retain students. Academic

institutions should work to increase the number of role models. It was noted that including members of underrepresented groups in the pool of candidates invited to interview for faculty positions is not likely to effect change in the near term, because the pool of Native American chemistry Ph.D.s is so small. Development of high quality videos that highlight the careers of active Native American chemists could help to increase awareness of this professional choice.

Discussions of barriers and successful strategies to retaining students in chemistry centered on cultural differences, mentoring and role models. Cultural and social differences with regard to time, deadlines, and attendance at office hours may lower the success of Native American students. Students may also find it difficult to discuss their academic challenges. This was characterized as the “It’s going great” response from a failing student. Training for faculty, staff, and teaching assistants can help them to be more culturally aware. The development of online training materials could facilitate this process.

Many students also face financial difficulties that make continuing their education difficult; this is especially true for students with poor academic preparation who often require several remedial courses. Development of well-defined academic pathways can help to keep students on track.

Session 3: Strategies for Increasing Participation of Native American Undergraduates in Chemistry: The Student View

This session focused on the challenges associated with recruiting and retaining Native American undergraduates from the student perspective. Each student presented their unique story and experience and included some suggestions to the chemistry community. Since each student had obtained a bachelor’s degree in chemistry and is currently in graduate school, both undergraduate and graduate program issues were discussed.

Discussion Panel

Chris Moss, graduate student, Colorado State University

Lucinda Begay, graduate student, University of Arizona

Shanadeen Begay, graduate student, Boston University

Mr. Chris Moss introduced himself as a 7/32 Native American student from Oklahoma. He attended a junior college and received an Associate’s degree in biology before transferring to Fort Lewis College where he received his bachelor’s degree. Mr. Moss is currently a graduate student at Colorado State University where he is working toward a Ph.D. degree in chemistry with a focus on chemical education. In his presentation, Mr. Moss stressed that for Native Americans, there is diversity in diversity. For example, Native American students from 105 different tribes are enrolled at Fort Lewis College. While there are some similarities among these students, each tribe has its own particular culture. There is no truly common American Indian experience. Mr. Moss suggested that undergraduate research and other student activities can be effective for recruiting and retaining students in chemistry, but cautioned that professors need to get to know the individual student well before advising them. When asked about the most significant challenge he faced as a student, Mr. Moss indicated that while he was a student at Fort Lewis College, there were three deaths in his family, and that it was very difficult to keep focused while being so far away.

Ms. Lucinda Begay, a member of the Navajo tribe in Arizona, introduced herself to the participants in Navajo. Ms. Begay was raised by her grandmother and grew up on the reservation. As a child, she learned to respect her grandmother’s authority, and was taught about the word selfishness. She learned not to exalt herself, but to approach others, especially elders, in a humble way. Ms. Begay obtained her bachelor’s degree at the University of Arizona and worked in industry for three years before returning to the University of Arizona for graduate

work. Ms. Begay described her relationship with a tribal Councilor whom she has known for a long time. She indicated that her tribal leaders were interested and have helped her communicate what she has learned. When asked about the most significant challenge she faced as a student, Ms. Begay indicated that the deaths of her grandmother and father were difficult. She also described herself as a private person, who didn't want to be the focus of attention. Determining who she is, and not who others think she should be, is another challenge.

Ms. Shanadeen Begay also introduced herself in Navajo and explained to the participants the importance of clans in introducing oneself. Ms. Begay attended Northern Arizona University where she earned bachelor's degrees in computer science and chemistry, with a minor in mathematics. She became interested in math at an early age and was pushed into calculus in the fifth grade by a very influential teacher. She described math as the purest form of language, one that transcends different cultures. Ms. Begay is a graduate student at Boston University, where she participated in the Research Experiences for Undergraduates (REU) program, and she did part of her Ph.D. research abroad at Cambridge University. Because Boston University does not have a large Native American student population, she has organized a coalition of indigenous students at Amherst, Harvard, University of Massachusetts–Boston, and Boston University. Ms. Begay spoke of her respect for her mother and grandmother as wisdom keepers. Although her education may have made her less able to return home to live, her family support has been very valuable in her studies.

Following the student panel presentations, the participants addressed the same questions from session two in their breakout group discussions, this time focusing on the student perspective.

Many of the barriers to recruitment identified previously were reiterated in this discussion. The fact that students do not see chemists growing up is a barrier to choosing this career path. Having freshman students participate in career fairs can help them see the directions in which their degree can lead. Chemists need to better articulate the value of a chemistry degree for careers in policy and education, not just research.

Many students have a lack of confidence in their preparation. This might be overcome by summer “mini-college” programs on campuses that help students feel better prepared to do chemistry.

Engaging and relevant introductory and general chemistry laboratory experiences can attract students into chemistry. Native American students may need to be invited to become active in research. Exciting research experiences are important for getting students interested in chemistry, especially those that have an artistic/aesthetic component, or are connected to nature or tribal concerns. Many Native students prefer interdisciplinary work because of the focus on understanding how things are connected.

Issues related to retention included a lack of support services and a feeling of isolation. Frequent interactions with a caring mentor are very important for retaining students, and mentors may be peers or faculty members. Encouraging new students to connect with AISES and SACNAS chapters can help with the transition to college. Students can benefit from more directed advising and should be provided with a campus resource guide, indicating what services are available and how they can benefit students. Family days on campus and involvement of family in student orientation may help. Students could be encouraged to visit tribal communities, and ACS could provide chemistry materials for distribution. Another approach suggested was engaging Native American Elders by bringing them to campus to discuss cultural issues and provide advice.

Financial issues often make it difficult for Native American students to complete their degrees. Although many students qualify for financial aid, these funds often do not arrive at the beginning of the academic term, and students may need short-term loans to buy books. Financial challenges may discourage students from applying to graduate programs because of the expense of taking GRE exams and graduate school application fees. Another financial issue that can hinder retention is that federal financial aid has a unit cap and students with poor academic preparation may exceed this limit because of required remedial coursework.

During this discussion, the group also addressed ways in which cultural mismatch can affect the retention of students in chemistry. Traits seen as passive in Western culture may be valued by Native Americans. For example, speaking last is valued by many Native cultures, because what is said at the end of a discussion is viewed as having been given more thought. Also many Native American students prefer collaborative activities and can benefit from instructional approaches that foster teamwork in the classroom and laboratory.

Session 4: Development of Proposed Strategic Plan for ACS and Timeline

This session consisted of a discussion of the major issues raised during the workshop along with recommendations for ACS. All participants engaged in this discussion and addressed the questions below. For the purposes of this discussion, short term was considered to be 1-3 years.

- What specific actions might ACS undertake in the short term to increase the participation of Native American undergraduate students in chemistry?
- What specific actions might ACS undertake in the longer term to increase the participation of Native American undergraduate students in chemistry?
- What other groups or organizations should ACS partner with to develop resources, activities and policies to increase the participation of Native American undergraduate students in chemistry?

Because of the low numbers of Native American chemists currently being produced, even small gains in the number of chemistry graduates each year would be significant. One factor contributing to the low number of chemistry graduates is the poor visibility of chemists and chemistry in Native American communities.

Recommended short-term actions included creation of materials to enhance the visibility of Native American chemists, such as video or internet biographies. Materials are needed that explain the value of a chemistry degree and what careers are open to chemists. Involvement of Native Americans in the ACS speakers service would increase visibility within the chemistry community. It was suggested the ACS establish a Native American network or focused interest group as part of the ACS Network. More visibility should be given to the issues of attracting and retaining Native Americans in chemistry through a symposium at a national meeting. A *Chemical & Engineering News* article about these issues could also help to raise awareness. The organization and sponsorship of a follow-up workshop, perhaps associated with an ACS national meeting, was suggested as important for providing continuity to the gains achieved at this workshop.

Longer term actions should include efforts to assist faculty teaching chemistry at tribal colleges. This could be in the form of help with instruction, grant writing, mentoring or equipment. Tribal college and university faculty members are not likely to be ACS members and should be offered a one-year complimentary membership to introduce them to the Society. Distribution of ACS materials, such as *In Chemistry* magazine, to tribal colleges could stimulate interest among students in chemistry careers.

Because of the value of research experiences in general and especially international experiences, ACS should work to expand the numbers of these experiences and to ensure inclusion of Native American students in these programs. New instructional materials are needed to make introductory and general chemistry courses and laboratory experiences more engaging and culturally relevant. Materials, such as case studies, are also needed to train chemists to be more effective mentors and improve understanding of Native American culture. It would be helpful to create a manual on effective practices of recruitment and retention of Native American undergraduate students, written by Native American faculty. ACS should establish a clearinghouse through which these materials can be easily accessed.

At all organizational levels, ACS should promote stronger relationships and coordination with AISES and SACNAS. For example, ACS local sections might sponsor students to attend SACNAS meetings and ask them to include the ACS logo on their posters. At higher levels, meetings and programs could be coordinated. There was also a discussion of the need for NSF to more seriously consider the outcomes of broader impacts during the review of renewal proposals and how ACS could play a role in communicating that message.

Participants considered the workshop to be a significant step towards the long-term goal of developing the academic potential of all the nation's citizens. The workshop presentations, discussions, and recommendations highlighted that increasing academic participation and success among Native American undergraduate students is a multifaceted challenge. Given the importance of the goal and the nature of the needs to be addressed, ACS should play a key role in providing resources and engaging the chemistry community.

References and Resources

“The Status of Native Americans in Science and Engineering”, Eleanor L. Babco, Commission on Professionals in Science and Technology, March, 15, 2005.

“Federal Panel Seeks Cause of Minority Students’ Poor Science Performance”, Peter Schmidt, *The Chronicle of Higher Education*, 9/15/2008

<http://www.collegefund.org/news/factsheets.html> “Facts: Educating the Mind and Spirit”, American Indian College Fund, accessed 12/11/2008.

<http://www.as.wvu.edu/~equity/native.html> “Strategies for Teaching Science to Native Americans”, West Virginia University, accessed 12/11/2008.

APPENDIX A

Workshop Participants	Affiliation
Lucinda Begay	University of Arizona
Shanadeen Begay	Boston University
Mary Berry	University of South Dakota
Jacquelyn Bolman	Humboldt State University
Sheila Browne	Mount Holyoke College
Bruce Bursten, ACS President	University of Tennessee-Knoxville
Mary Cloninger	Montana State University
Mark Distefano	University of Minnesota-Twin Cities
Omnia El-Hakim	Colorado State University
Royce Engstrom	The University of Montana
Ron Estler, CPT	Fort Lewis College
Paul Flowers	The University of North Carolina at Pembroke
Mike Fredenberg, NSF	Oglala Lakota College
Jani Ingram	Northern Arizona University
Cindy Larive, CPT	University of California, Riverside
Chris Moss	Colorado State University
Cathy Nelson	American Chemical Society
Dennis O'Malley	Haskell Indian Nations University
Jeanne Pemberton, CPT	University of Arizona
Brian Rasley	University of Alaska, Fairbanks
Subodh Singh	Sinte Gleska University
Eric Sorensen	Princeton University
Jodi Wesemann	American Chemical Society

APPENDIX B

AGENDA

Friday, Sept. 12

6:00 – 7:00 PM	Registration and social hour
7:00 – 7:45 PM	Dinner
7:45 – 8:15 PM	Welcoming Remarks by the organizers and by Bruce Bursten, ACS President: What is current ACS role? What is the motivation for this Workshop?
8:15 – 8:30 PM	What Issues were Identified in the Pre-Workshop Questionnaire? Ron Estler

Saturday, Sept. 13

7:30 – 8:00 AM	Continental Breakfast
8:00 – 8:30 AM	Keynote: Michael Fredenberg, “Building Capacity for Chemistry at Tribal Colleges”, National Science Foundation and Oglala Lakota College
8:30 – 8:45 AM	Looking Ahead: Small Group Discussion on Important Issues Identified from the Survey or Other Areas Not Represented on Agenda
8:45 – 9:00 AM	Reports on New Issues from Pre-Workshop Questionnaire and Small Group Discussion

Session 1:

Challenges & Strategies in Education of Native American Undergraduates in Chemistry

9:00 – 10:00 AM	Panel 1: Educating Native American Students in Chemistry: Programs that Work Mary Berry, Subodh Singh, Jacquelyn Bolman, Lucinda Begay
10:00 – 10:15 AM	Break
10:15 – 11:00 AM	Breakout Session 1: Challenges and Strategies in Education of Native American Undergraduates in Chemistry: Most Significant Issues for Chemistry & ACS Role
11:00 – 11:45 AM	Reports from Breakout Groups & Full Group Discussion
11:45 – 1:00 PM	Luncheon Speaker: Prof. Jani Ingram, Department of Chemistry, Northern Arizona University

Session 2: Models that Work: Effective Strategies for Attracting and Retaining Native American Undergraduates in Chemistry

1:00 – 2:00 PM Panel 2: Student Recruitment and Retention: Strategies that Work
Paul Flowers, Sheila Browne, Royce Engstrom

2:00 - 2:45 PM Breakout Session 2: Challenges and Strategies in Attracting and Retaining Native American Undergraduates in Chemistry: Best Approaches for Chemistry & ACS Role

2:45 – 3:00 PM Reports from Breakout Groups

3:00 – 3:15 PM Break

Session 3: Strategies for Increasing Participation of Native American Undergraduates in Chemistry: The Student View

3:15 – 4:15 PM Panel 3: The Student View
Lucinda Begay, Shanadeen Begay, Chris Moss

4:15 – 5:15 PM Breakout Session 3: Strategies in Attracting and Retaining Native American Undergraduates in Chemistry: Revisited Considering the Student View

5:15 – 5:30 PM Wrap-up and Preparation for Second Day

7:00 PM Dinner

Summary of Key findings: Comments by Organizers and Participants

Sunday, Sept. 14

7:30 – 8:30 AM Breakfast

8:30 – 9:20 AM Reports from Breakout Groups, Session 3

Session 4: Development of Proposed Strategic Plan for ACS and Timeline

9:20 – 9:30 AM Overview of Strategic Plan Development

9:30 – 10:15 AM Breakout Session 4: Recommendations for Targeted ACS Action

10:15 – 10:30 AM Break

10:30 – 11:45 AM Reports from Breakout Groups and Full Group Discussion: Development of Proposed Strategic Plan for ACS and Timeline

11:45 – 12:00 Noon Final Remarks & Adjourn

APPENDIX C

Workshop Breakout Session Groups September 13-14, 2008

Breakout Session 1: SATURDAY MORNING

Group 1	Group 2	Group 3	Group 4
L. Begay	Bolman	S. Begay	Bursten
Berry	Cloninger	Browne	El-Hakim
Distefano	Fredenberg	Flowers	Ingram
Engstrom	Moss	Nelson (S)	Sorensen
Larive (S)	Pemberton (S)	Rasley	Wesemann (S)
O'Malley		Singh	

Breakout Session 2: SATURDAY AFTERNOON

Group 1	Group 2	Group 3	Group 4
Bolman	L. Begay	El-Hakim	S. Begay
Cloninger	Berry	Ingram	Engstrom
Fredenberg	Browne	Moss	Flowers
Larive (S)	Bursten	Nelson (S)	Rasley
Singh	Distefano	O'Malley	Wesemann (S)
	Pemberton (S)	Sorensen	

Breakout Session 3: SATURDAY AFTERNOON

Group 1	Group 2	Group 3	Group 4
S. Begay	Engstrom	L. Begay	Bolman
El-Hakim	Ingram	Berry	Browne
Flowers	Pemberton (S)	Bursten	Cloninger
Larive (S)	Rasley	Distefano	Moss
Sorensen	Singh	Fredenberg	O'Malley
		Nelson (S)	Wesemann (S)

Breakout Session 4: SUNDAY MORNING

Group 1	Group 2	Group 3	Group 4
Browne	S. Begay	Bolman	L. Begay
Cloninger	Distefano	Engstrom	Berry
Ingram	El-Hakim	Nelson (S)	Fredenberg
Larive (S)	Flowers	O'Malley	Singh
Moss	Pemberton (S)		Wesemann (S)
Rasley			
(S) = Scribe			



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