

PROJECT SUMMARY

Overview:

This conference proposal is for a two-and-a-half day professional development event that will bring together high school teachers, community college biology faculty, and American Sign Language (ASL) interpreters to improve biology education for deaf and hard-of-hearing (deaf/hh) students. The conference will address the compelling need for a diverse workforce in the United States by specifically targeting the educational needs of a group of students with unique learning and communication characteristics. Through a focus on Universal Design for Learning (UDL) principles and literacy-building case-based learning pedagogy, the conference will improve learning not only for deaf and hard-of-hearing students but for all students in the biology classroom. This kind of opportunity for discipline-specific professional development for high school teachers, community college faculty, and interpreters that addresses the unique needs of deaf/hh students has never been offered, to our knowledge. This unprecedented conference will provide participants with:

- * Training in the use of case-based pedagogies and their potential for enhancing literacy and world knowledge for students within the context of learning biology
- * Multiple ways to implement principles of UDL in biology classrooms
- * Best practices for teaching biology to deaf/hh students
- * Information about technician careers requiring a biology foundation
- * A community of biology instructors of students who are deaf/hh
- * A stronger biology content knowledge

The projected outcomes of this conference are the collection and dissemination of best practices for teaching biology to deaf/hh students using UDL principles, case-based pedagogies, and literacy improvement practices. The conference is designed to support sharing effective educational resources within and beyond the conference community, continued collaboration of participants, and promoting connections to the broader community of biology educators. Findings from the conference will be presented in a white paper so that best practices and the needs of the deaf/hh community with regards to biology education are more broadly understood. The conference will be offered by the NSF Advanced Technology Education (ATE) national center, DeafTEC: Technological Education Center for Deaf and Hard-of-Hearing Students, and BioQUEST.

Intellectual Merit:

The conference increases educators' abilities to incorporate UDL principles and effective pedagogies to teach biology to deaf/hh students and other students with literacy challenges, such as second language learners. This conference combines the knowledge and experience of educators, interpreters, UDL experts, and professional developers to address the challenges in biology education of students who are deaf/hh. Effective professional development lies in the growth of a supportive community of peers, and this conference provides an opportunity for this community to grow and share ideas about effective educational practices at the conference and beyond, using the platforms provided by DeafTEC and BioQUEST.

Broader Impacts:

This conference has the potential to improve the experience and success in introductory biology courses of students who struggle with literacy, which in turn could influence decisions to enter a related technician education program. Increasing the diversity of students pursuing STEM careers both diversifies the workforce and increases students' economic success, as science and technology careers can be considered good paying positions. Additionally, conference participants will be encouraged to join the larger BioQUEST community and share their knowledge of universal design for learning, case-based pedagogies, and teaching students with disabilities.

PROJECT DESCRIPTION

A. Statement of Need

The NSF Advanced Technology Education (ATE) national center, DeafTEC: Technological Education Center for Deaf and Hard-of-Hearing Students, and BioQUEST propose a two-and-a-half day professional development conference, *Opening the Pathway to Technician Careers: A Conference for Biology Teachers of Deaf Students* that will bring together high school teachers, community college biology faculty, and American Sign Language (ASL) interpreters to improve biology education for deaf and hard-of-hearing (deaf/hh) students.

The conference will address the compelling need for a diverse workforce in the United States by specifically targeting the educational needs of a group of students with unique learning and communication characteristics. Through a focus on Universal Design for Learning (UDL) principles and literacy-building case-based learning pedagogy, the conference will improve learning not only for deaf/hh students but for all students in the biology classroom.

Recent national reports such as *Vision and Change* and *A New Biology for the 21st Century* call for biology courses to be current and relevant, however, the constant, fast pace of change in this field makes this challenging. Biology courses impact large numbers of students because high school or introductory college biology courses are often the only exposure non-science majors have to science. In technician education, biology serves as a gateway course for students interested in technical fields such as agricultural technology, biotechnology, and environmental sciences where the deaf/hh population is underrepresented (Walter, 2010). Improving biology education practices for deaf/hh students has the potential to increase their participation by engaging them at the introductory biology level and lowering barriers to technical career education tracks.

Deafness, unlike other disabilities, often creates communication barriers resulting in significant and unique learning needs that may not be present in other disability populations. Some students are fluent in ASL, others are fluent in English, and some are bilingual in both ASL and English. The variable literacy skills of deaf/hh students are a result of their early language experiences. As a result, they often struggle with literacy in either or both English and American Sign Language (ASL) and may not have fluency in language upon entering the education system (Dostal *et al.*, 2017). This language variance can significantly impede their academic success.

Deaf/hh students may also often demonstrate considerably less world knowledge than their hearing peers (Convertino, Borgna, Marschark, & Durkin, 2014). This can be attributed to the limited access that they have to incidental learning; the learning that takes place through informal interactions such as listening to conversations of others or hearing something on the TV or radio. Hearing students can apply what they learn through incidental learning to the classroom while deaf/hh students miss out greatly on this wealth of incidental information and scaffolding opportunities. (Hopper, 2011)

Science courses, and in particular biology courses, require students to learn a large amount of new terminology (Yager, 1983). For students already struggling with literacy, these increased vocabulary requirements may be a significant barrier. Add to this the lack of science background of most sign language interpreters, and the language barrier intensifies.

To promote and strengthen student literacy skills and world knowledge within the context of learning biology, this conference will focus on the use of case-based learning pedagogies (Waterman, 1998, Herreid, 1997). Pedagogical approaches that engage students in scientific practices and thinking and empower them to ask and answer questions that are of interest to them can help address gaps in knowledge (Peterson and Jungck, 1988). The use of case-based learning pedagogies involves engagement in scientific investigation and the development of analytical thinking focused on real-world problems (Stanley and Waterman, 2000; Waterman and Stanley, 2008). These pedagogies also build collaborative learning skills, communication skills, and promote active learning (Herreid, 1994; Herreid *et al.*, 2011; Thistlewaite *et al.*, 2012, Stanley *et al.*, 2012). Relevant case studies in agricultural technology, biotechnology, and environmental sciences will be introduced at the conference, and where ever possible

will highlight the work of deaf/hh scientists. The conference will also include presentations and discussions about technician careers that require a foundation in biology.

Cases will be developed using the Universal Design for Learning (UDL) framework, principles, and guidelines. The UDL framework (Meyer, Rose, & Gordon, 2014; Rose & Meyer, 2002) focuses on creating instructional goals, methods, materials, and assessments that consider learner variability. The UDL principles and guidelines (CAST, 2011; Rose & Gravel, 2010) were created so that instructional designers and teachers could systematically anticipate this variability and reduce or eliminate barriers to learning. A UDL approach has been established as effective in promoting positive, engaging learning experiences in informal science settings (Rappolt-Schlichtmann & Daley, 2013; Reich, Price, Rubin, & Steiner, 2010). The three principles that underlie the framework of UDL are: using multiple means of representation, employing multiple means of expression and action, and offering multiple means of engagement (Rose & Meyer, 2002). These principles rest on research from the learning sciences and have been incorporated into federal policy as a scientifically valid approach to educational practice to enable all learners to be successful. The Higher Education Opportunity Act of 2008 established the statutory definition for UDL, and the U.S. Department of Education's National Educational Technology Plan (2010) refers to UDL ubiquitously as a framework that reduces barriers and maximizes learning opportunities for all students.

ASL interpreters will be invited to participate in the conference as they play a critical role in the success of deaf/hh students in mainstreamed classrooms, but often have limited content knowledge in the STEM discipline they are interpreting. Interpreters need to be able to understand the vocabulary and jargon of a discipline in order to provide an accurate interpretation and need to be able to identify a specific sign to convey the meaning of the specific English word or concept. In biology, terms often have different meanings from their common English uses (e.g. theory, fitness) and misrepresentation of these terms can lead to confusion and misunderstanding. A lack of established ASL lexicon for STEM vocabulary adds to the challenge for interpreters (Graham, et al., 2012) who often have to fingerspell complex vocabulary. In biology, many terms are long (e.g. photosynthesis, electrochemical gradient) or difficult to spell (e.g. Latin species names such as *Oryctolagus cuniculus*, the common European rabbit). To save time, it is not uncommon for an interpreter to "make up" a sign which can lead to inconsistent signing between courses and create confusion for students (Madhusoodanan, 2016). There are few opportunities for interpreters to engage in professional development related to providing services in STEM disciplines (Grooms, 2015) and none that we know of for biology. Interpreters participating in this event will strengthen their basic biology knowledge, learn from biology instructors about conveying challenging biology concepts, and exchange best practices with other interpreters.

It is expected that a significant number of high school teachers and community college faculty attending the conference will be deaf or hard of hearing themselves. Historically, participation of deaf/hh instructors in biology conferences has been rare as many professional discipline meetings are not fully accessible for such attendees. Barriers may include: rooms that are dimmed to compensate for poor projection, making it difficult for the deaf attendee to read lips or see the interpreter; videos that are not captioned, making the material inaccessible for the deaf attendee; and inability to get conference materials in advance so the deaf attendee and interpreter can become familiar with the information. Although interpreting is normally provided for formal presentations, it is often hard to find interpreters with the appropriate background to decipher the technical information in order to provide accurate translation. Interpreting services can be expensive and are often not provided for the critical informal networking that happens after hours. To engage in this networking, deaf/hh attendees may need to communicate by writing on paper or typing on a tablet or computer. Not being able to easily interact with other attendees often results in deaf/hh attendees feeling isolated (Cooke, Graham, 2012) and as a result, they tend not to participate fully, or not at all. The proposed conference will offer a fully accessible professional development experience for all attendees.

This kind of opportunity for discipline-specific professional development for high school teachers, community college faculty, and interpreters that addresses the unique needs of deaf/hh students has never been offered, to our knowledge. This unprecedented conference will provide participants with:

- Training in the use of case-based pedagogies and their potential for enhancing literacy and world knowledge for students within the context of learning biology
- Multiple ways to implement UDL principles in biology classrooms
- Best practices for teaching biology to deaf/hh students
- Information about technician careers requiring a biology foundation
- A community of biology instructors of students who are deaf/hh
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The projected outcomes of this conference are the collection and dissemination of best practices for teaching biology to deaf/hh students using UDL principles, case-based pedagogies, and literacy improvement practices. The conference is designed to support sharing effective educational resources within and beyond the conference community, continued collaboration of participants, and promoting connections to the broader community of biology educators. Findings from the conference will be presented in a white paper so that best practices and the needs of the deaf/hh community with regards to biology education are more broadly understood.

B. Intellectual Merit & Broader Impacts

Intellectual Merit. The conference increases educators' abilities to incorporate UDL principles and effective pedagogies to teach biology to deaf/hh students and other students with literacy challenges, such as second language learners. This conference combines the knowledge and experience of educators, interpreters, UDL experts, and professional developers to address the challenges in biology education of students who are deaf/hh. Effective professional development lies in the growth of a supportive community of peers, and this conference provides an opportunity for this community to grow and share ideas about effective educational practices at the conference and beyond, using the platforms provided by DeafTEC and BioQUEST.

Broader Impacts. This conference has the potential to improve the experience and success in introductory biology courses of students who struggle with literacy, which in turn could influence decisions to enter a related technician education program. Increasing the diversity of students pursuing STEM careers both diversifies the workforce and increases students' economic success, as science and technology careers can be considered good paying positions. The argument for increased diversity in the workforce is not simply a social justice issue or an attempt to meet growing workforce needs. In fact, diversity in the workforce has been demonstrated to increase the creativity and problem solving capability of industry (Hong and Page, 2004, Sommers 2006). Additionally, conference participants will be encouraged to join the larger BioQUEST community and share their knowledge of universal design for learning, case-based pedagogies, and teaching students with disabilities. Universal design and working with diverse students are themes in the annual BioQUEST Summer workshop, and experienced faculty have much to share with their peers.

C. Recent Meetings on the Same Subject

Although a number of conferences focusing on deaf education have been convened over the past five years, we are unaware of any conference dedicated specifically to educating deaf/hh students in biology. Below is a sampling of conferences related to deaf education with only one related to teaching a specific discipline, mathematics, to deaf/hh students.

- *Promoting Student Success in Mathematics Working with Deaf and Hard-of-Hearing Students.* Held on April 18, 2017 in San Antonio, TX. This was a DeafTEC supported conference on best practices in secondary and post-secondary mathematics instruction.
- *Best Practice in Mainstream Education of Deaf and Hard-of-hearing Conference.* Held in June 2016 at Rochester Institute of Technology, Rochester, NY, with a second conference scheduled for July 2018. This is a biennial deaf education conference consisting of keynote presentations and poster sessions for teachers from around North America to share their strategies and methods for teaching deaf/hh students in K-12 settings.

- *National Deaf Education Conference*. Held in July 2016 in Phoenix, AZ, August 2017 in Indianapolis, IN and scheduled for July 2018 in Hartford, CT. This is a National Association of the Deaf hosted annual conference focused on educator collaboration to improve teaching practices for deaf/hh students in primary and secondary education
- *Annual International Association of College Educators – Deaf & Hard of Hearing Conference*. This is an annual conference since 1974 offered in varied location. This Deaf Education conference is held by a professional society, focused on educational training for instructors of deaf/hh students.
- *Convention of American Instructors of the Deaf National Conference*. This is a biennial conference since 1858 offered in varied locations. This Deaf Education conference is held by a professional society, offering professional development and community for educators of deaf/hh students.
- *AHEAD Conference and pepnet 2 Training Institute*. Held on July 2014 in Sacramento, CA and July 2016 in Indianapolis, IN. The Association on Higher Educational on Disability (AHEAD) annual conference held twice with a special interested component for professionals working with deaf/hh students in post-secondary education.
- *Workshop for Emerging Deaf and Hard of Hearing Scientists*. Held on May 17-18, 2012 in Washington, D.C. This workshop aimed to increase the representation of deaf/hh individuals in STEM.

D. Conference Chairperson and Organizing Team

The conference is a joint offering between the NSF ATE National Center, DeafTEC, at the Rochester Institute of Technology's (RIT) National Technical Institute for the Deaf (NTID), and BioQUEST, a non-profit science education group providing professional development for biology faculty. The conference will also partner with the NSF funded project, Quantitative Undergraduate Biology Education (QUBES); the ATE funded, Austin Community College Bio-Link Regional Advanced Technological Education Center for Biotechnology and Life Sciences; CAST and the NTID Regional STEM Center - Southeast. Information about these organizations is given below. The organizing committee consists of representatives from each of these organizations. Biosketches of the members are provided.

- Co-Chair, Kristin Jenkins Director, BioQUEST, QUBES Leadership Team
- Sam Catherine Johnston Director of Postsecondary & Workforce Development, CAST
- Denise Kavin, Co-PI, DeafTEC, Executive Director, NTID Regional STEM Center-Southeast, Rochester Institute of Technology
- Co-Chair, Donna Lange, Center Director and PI, *DeafTEC: Technological Education Center for Deaf and Hard-of-Hearing Students*, Rochester Institute of Technology
- Hayley Orndorf, Project Manager, QUBESHub, Project Support Specialist, BioQUEST
- Margaret Waterman, Professor *emerita*, Biology Department and Department of Middle & Secondary Education, Southeast Missouri State University

Organizations

DeafTEC: Technological Education Center for Deaf and Hard-of-Hearing Students is an NSF ATE National Center of Excellence (DUE #1104229 and 1501756). The goal of the Center is to successfully integrate more deaf/hh individuals into the workplace in highly-skilled technician jobs in which these individuals are currently under-represented and underutilized. DeafTEC is housed at the National Technical Institute for the Deaf (NTID), the first and only two-year technical college in the United States for deaf/hh students. NTID was established on the campus of Rochester Institute of Technology (RIT), a prominent four-year technical university in Rochester, NY, in 1965 to reverse the long history of under-employment and unemployment among our nation's deaf/hh citizens. As one of the

nine colleges of RIT, NTID enrolls more than 1,200 deaf/hh students from all 50 states and 20 countries that live, work, and study as part of the same college community as 16,000 RIT hearing students.

BioQUEST is a community of educators who are committed to biology education that reflects scientific practices. BioQUEST has been combining cutting edge content and evidence based pedagogical approaches for over 30 years. Practical skills emphasized in national education policy including quantitative skills and 21st Century skills such as communication, information literacy and cultural awareness are core components of BioQUEST professional development conferences. BioQUEST provides a “community of transformation” - taking participants beyond a community that encourages good practice to a community that literally transforms practice and allows participants to explore beyond the existing boundaries and norms to generate cultural change (Kezar and Gehrke, 2015). BioQUEST’s work has been funded over the years by the Howard Hughes Medical Institute, the Annenberg Foundation, and the NSF. BioQUEST received the Bruce Albert’s Award in Science Education in 2010.

Quantitative Undergraduate Biology Education and Synthesis (QUBES) is an NSF funded virtual center designed to accelerate systemic change by providing support and resources to instructors teaching quantitative skills to life science students. The QUBES team has built a consortium of over 70 institutions, NSF projects, and professional societies which are leveraged to connect initiatives across disciplines and subdisciplines. The team engages in synthesizing best practices for teaching quantitative biology and identifies spaces of urgent research or action need. QUBES includes an online virtual infrastructure to support inclusive collaboration, qubeshub.org. QUBESHub is a scientific collaboration platform built on the HubZero infrastructure. It has been developed to support QUBES project activities including faculty mentoring networks, access to educational computing and simulation resources, and the development of robust user communities around quantitative biology partner projects. The Hub environment provides a suite of tools for managing membership, content, and communications while integrating partner projects into the broader QUBES community and thus promoting discoverability, annotation, and sharing of resources.

CAST is a research and development non-profit that uses educational technology coupled with expertise in the learning sciences to ensure all learners can and do reach their full potential, be they learning in the K-12 classroom, a community college, or on the job. Pioneered at CAST, our primary lever for change is the UDL framework for designing instructional practices, tools, and curricula that better meets the needs of all learners. Research and development on UDL is supported by multiple federal agencies, state departments of education, and national foundations. CAST has spent 30 years engaged in transforming K-12 and postsecondary classrooms so that they fully include learners with disabilities and afford them the same opportunities as their typically developing peers.

The NTID Regional STEM Center - Southeast was established in November 2016 in partnership with the Alabama Institute for the Deaf and Blind, to expand the geographic reach of activities and services supported by NTID, with the goal of improving access to postsecondary STEM education and employment for secondary deaf and hard-of-hearing students.

Austin Community College (AC2) Bio-Link Regional Advanced Technological Education Center for Biotechnology and Life Sciences (DUE #1501207) is a four year ATE center grant that will establish a distributed statewide leadership network focused on educational and industry based solutions using Communities of Practices as a methodology to effectively establish networks supporting growth in Biotechnology industries in Texas and Kentucky.

E. Information on the Location and Probable Date(s) of the Meeting and the Method of Announcement or Invitation.

Location. The *Opening the Pathway to Technician Careers: A Conference for Biology Teachers of Deaf Students* will be held at RIT/NTID. The NTID and DeafTEC staff have experience offering on site workshops and conferences. All conference sessions will occur on the RIT/NTID campus. The conference will have access to one large auditorium and multiple conference rooms of varying size for sessions and small group work. RIT/NTID has sufficient capacity, multi-media services, and access services to host a conference of this size.

Date. March 14-16, 2019 during RIT spring break or summer, 2019

Invitation. DeafTEC has an extensive network from which participants will be invited to apply, ensuring an enthusiastic and diverse group of attendees. Biology faculty and interpreters will be invited from DeafTEC current and past community college partners including but not limited to: Austin Community College, Florida State College at Jacksonville, St. Petersburg College, Pierce College, Ohlone College and Harper College along with faculty from NTID, Southwest Collegiate Institute for the Deaf - Howard College and the ATE community. High School teachers will be invited from the 27 DeafTEC high school partners and from the nine states served by the NTID Regional STEM Center - Southeast.

Participants will be personally invited by DeafTEC PIs, Donna Lange and Denise Kavin approximately six months before the date of the conference. Applications will be evaluated to prioritize biology faculty at high school and community college who are working with deaf/hh students on a regular basis. Faculty who are not biology specialists or work with deaf/hh students occasionally will be considered as space allows. Conference participation will be limited to 45 participants with a goal of 20 high school teachers, 15 community college faculty, and 10 interpreters. All conference and travel expenses will be covered by the grant, and participants will have the option to receive CEUs for the event.

F. Organization and Management

The goal of the conference is to improve the biology education for deaf /hh students. This will be accomplished through the use of evidence based pedagogical approaches, universal design for learning principles, providing up to date biology content knowledge, and fostering a community of instructors through the objectives:

- Objective 1: Develop participants' case-based pedagogical skills to promote and strengthen students' literacy skills and world knowledge within the context of learning biology
- Objective 2: Improve participants' understanding and use of the UDL principles in a biology classroom
- Objective 3: Increase participants' understanding of the challenges and barriers students face in a biology classroom and best practices for addressing them.
- Objective 4: Broaden participants' knowledge of biology-related technician careers
- Objective 5: Build a community of biology instructors of students who are deaf/hh
- Objective 6: Strengthen participants' biology content knowledge

Objective 1: Develop participants' case-based pedagogical skills & Objective 6: Strengthen participants' biology content knowledge

To promote and strengthen student literacy skills within the context of learning biology, five resources will be used to guide content choices, pedagogy, and activities of the conference: Vision and Change; case-based learning pedagogies, Universal Design for Learning, the Next Generation Science Standards (NGSS) and the Common Core Standards for Language Arts.

The case-based pedagogies to be used were developed by Stanley and Waterman (2003, 2010) and will structure the participants' experiences in the conference. They will work on three cases that will expose their students to content relevant to technician education in areas such as biotechnology, environmental science, and agricultural technologies. Participants will experience how this case-based pedagogy itself offers many opportunities for deaf/hh students to learn and practice literacy skills such as reading, writing, signing, visualizing, speaking, creating presentations, and communicating as members of small groups, while at the same time learning about technology-related science and its applications.

The cases will also demonstrate the "low floor, high ceiling" learning environment, a concept that builds on Papert's ideas about programming with children in Logo (Papert, 1980) and is used in mathematics education (McClure *et al.*, 2011). This type of learning environment offers accessible entry points for learners, regardless of their current background, while simultaneously offering the opportunity

to extend learning as far as the learner wants to go. This approach is ideal for engaging students (or conference participants) with a wide range of backgrounds and preparation. In case-based learning, the case launch points are very accessible, regardless of students' prior knowledge and skills. Subsequent activities build on students' existing knowledge, development of scientific knowledge and practices, and communication and literacy skills. Cases are not capped or limited, providing opportunities for more advanced students to continue to be challenged.

The 2014 National Research Council report on literacy in science links the NGSS scientific practices (e.g., experimenting, hypothesizing, designing, collecting data, reasoning with evidence, modeling) with their potential as activities for developing literacy skills (as laid out in the Common Core Standards for Language Arts). Vision and Change (AAAS, 2011) and the NGSS (NGSS Lead States, 2013) both speak to the same issues of the modern content of biology and scientific practices of biology, but for different educational levels. We will use the scientific practices during the course of the case-based learning activities in this conference to speak to the needs of high school teachers, community college faculty, and interpreters. This will model both how to use these practices for developing knowledge of science, technology and literacy as well as providing examples of curriculum materials that teach science and literacy together.

The case-based pedagogies to be used (Stanley and Waterman, 2003), like other variants of case study (Herreid, 2007) and case or problem based learning pedagogies (Barrows, 1996), is centered on the use of authentic "real world" problems as the anchor for learning. The report *A New Biology for the 21st Century* (NRC 2009) recommends that significant real world issues, such as sustainability, food production, human health, and environmental change be major foci in biology courses, and this applied real world focus, aligns well with technician education. For this conference, the organizing committee will work with faculty at NTID and from the Science Case Net community to develop cases on genetics and biotechnology of genetically modified organisms, environmental science technologies, and evolution in the context of agricultural technology that will highlight contributions by deaf/hh scientists as appropriate. These cases will feature current developments in biology, applications of recent developments and provide participants with information on new trends in biology research.

Learning with case-based pedagogies involves three stages which are grounded in common activities of scientists: Problem Posing, Problem Solving, and Peer Persuasion (Peterson and Jungck, 1988). Learners in small groups use a scaffolding sheet (the Case Analysis Sheet (Waterman and Stanley 2010) to analyze the case and pose their own questions (including scientific questions). The question asking phase includes techniques from Rothstein and Santana (2011). Ideas, questions and potential resources are shared in small and large groups. In accordance with UDL principles, the case can be presented in several ways: as text, online, with images or videos, as well as read aloud and interpreted in ASL.

Subsequently, learners investigate one or more of their questions using a variety of resources to address the problem. These activities engage students in scientific practices, increase content knowledge and quantitative skills, and provide practice in group work, communication and literacy. The fact that multiple activities are available for learners to work with fits with the UDL principle of providing multiple representations of information. Students may be researching background information in books, maps, or on the internet. They may conduct interviews or watch videos. Within the investigations themselves, learners may choose to be recorders, investigators, theorists, or data analysts. The investigations are mostly open ended allowing learners to choose the variables to be investigated.

Finally, just as scientists present at meetings, the groups present their evidence-based answers to others in the class as a way to persuade their peers about the value of their approaches and conclusions based on their data. The UDL practice of providing multiple means of expression and action is used in this phase. Learners can, for example, write, draw, prepare charts and tables, prepare an oral or signed presentation, or create a video to show their results and their reasoning.

The use of case-based learning strategies supports technical career training by developing learners with flexible and useful knowledge (i.e., it is integrated with practice, can be applied to different contexts) (Hmelo-Silver, 2004). Undergraduate students learned as much with cases as those learning with

traditional instruction, but in follow up studies, medical students who learned with cases retained more information (Hmelo-Silver, 2004). In a review of biology students learning with cases, Lundeberg (2008) notes several benefits for all students. First, they gained more knowledge than did traditionally instructed students. Second, students learning with cases outperformed students in traditional classes on skills used in scientific investigations. Because case scenarios are realistic and conceptually complex, students learned to assess problems from multiple perspectives. Finally, students learning with cases developed global awareness and ethical stances more robustly than did students in traditional instruction. In a national study of faculty using cases, Yadav and his colleagues (2007) found that faculty who use case studies believe their students develop both stronger analytical cognitive abilities and a deeper understanding of the topic of the case.

Objective 2: Improve participants' understanding and use of the UDL principles in a biology classroom

Before participants divide into groups to work on cases, we will have an overview of the principles of UDL and case-based pedagogy. The cases for the conference will be designed following the framework and principles of UDL and will showcase and provide practical examples on how to bring UDL into cases. CAST has examples of how to do this from an open educational resources project with the National STEM consortium and projects to build STEM career exploration and engagement in opportunity youth between the ages of 16 and 24 that are disconnected b from both school and the workforce. UDL principles will be used and emphasized throughout all activities as described above. Pedagogy and UDL experts will highlight the use of UDL and opportunities will be provided for participants to reflect on the use of UDL that they might adopt in their classrooms.

Objective 3: Increase participants' understanding of the challenges and barriers students face in a biology classroom and best practices for addressing them

Throughout the conference, faculty, teachers, and interpreters will have an unparalleled opportunity to discuss the challenges and barriers they have seen deaf/hh students face in biology classrooms and best practices that help students overcome them. This will be encouraged as participants work on cases and develop biology curriculum suitable for their instructional settings and students. Before the conference participants will be asked to prepare posters related to best practices they have already implemented that will be shown at a poster session at the end of Day 1.

To shed light on the student experience through high school and post-secondary education, a panel of deaf/hh students will share their stories on Day 2 focusing on their experiences in the biology classroom. Panelists will be asked not only to share challenges, but also approaches that helped them succeed. This will be a lunch presentation and participants will have an opportunity to ask questions.

Objective 4: Broaden participants' awareness of technician careers that require a foundation in biology

Teachers can be sources of support and information for students as they transition from school-to-work or school-to-school. High school students rank the influences of teachers on their career expectation and choice right behind that of family and friends (Paa & McWhirter, 2000). To ensure that participants have an awareness and understanding of technician careers requiring a foundation in biology, a career awareness presentation will be made during lunch on Day 2. The conference organizers will work with ATE centers and projects related to agricultural technologies, biotechnology, environmental sciences and others as appropriate to collect information on various technician careers for the presentation. Dr. Linnea Fletcher, Executive Director of the AC2 Bio-Link ATE Regional Center has agreed to help us with preparing the presentation or perhaps even give the presentation if possible. We will follow the technician careers presentation with a panel of representatives from industry who will discuss career opportunities, trends, and advances in their fields as well as hiring and working with deaf/hh individuals.

In addition, deaf/hh students involved in undergraduate biology and lab science research at RIT/NTID will be asked to participate in the poster session with conference attendees at the end of Day 2.

This will be arranged through the office of the NTID Associate Dean for Teaching & Scholarship Excellence who runs the NTID Annual Student Research Fair.

Objective 5: Build a community of biology instructors of students who are deaf/hh

The greatest impact a conference such as this can have is in the launch of a community who will continue to share ideas and information. BioQUEST has fostered this type of community growth for many years, and the QUBESHub is designed to support this kind of community. Before, during, and following the conference the QUBESHub will be used to share and archive information, promote conversation and serve as a base for the community. Through the QUBESHub, the community from this conference will learn about other events of interest, including Science Case Net projects and resources. Following the conference, QUBESHub will be used to offer a series of webinars exploring case-based pedagogies and UDL further.

Organization

The overall structure of the conference follows the BioQUEST two phase faculty development model (Waterman and Stanley 2005). In Phase 1, participants engage as learners with biology content and new pedagogies. In Phase 2, participants form small groups to adapt the concepts and methods they have experienced as they generate a piece of biology curriculum suitable for the specifics of their instructional settings and students.

Meet and Greet. Participants will be expected to arrive the day before the conference in time to attend a meet and greet at the hotel in the early evening followed by a dinner. This will save time the next morning with introductions, foster relationships, and begin the community building.

Day 1 will begin with a keynote presenter, Barbara Spiecker, a PhD student at Oregon State University studying the responses of seaweed to climate change. Ms. Spiecker will talk about her research and also share her previous experiences as an undergraduate deaf/hh biology student and current experiences teaching Intro to Biology. Following this, Margaret Waterman and Sam Johnston will introduce the concept of cases in a brief session to illustrate the case analysis pedagogy along with an overview of UDL principles. Participants will then work with three different biology cases in sessions offered throughout the day. The cases session presenters will run their session three times, so each participant will experience all three cases in a small group format. Sessions will be interactive, participatory workshops on using cases and investigations in the classroom. The three cases will be built around topics in genetics and biotechnology of genetically modified organisms, environmental science technologies and evolution in the context of agricultural technology.

During the three sessions, participants will experience case-based pedagogy and using science practices as a way to structure literacy-building activities. In each session participants will read the cases and do the Problem Posing work of case analysis. Session leaders will engage the participants in Problem Solving with one or more planned investigative activities. Various methods of Peer Persuasion will be used in the different sessions as small groups report what they found out in their investigations.

Lunch on Day 1 will include the technician education career awareness presentation and industry panel. Day 1 will conclude with the informal poster session for conference participants and RIT/NTID deaf/hh students. This will be a valuable networking opportunity and will aid participants in forming project working groups on Day 2.

Day 2 will begin with a keynote presentation from Dr. Derek Braun, director of the Molecular Genetics Laboratory, at Gallaudet University. Dr. Braun will present about his research and experiences as a deaf biologist. Day 2 will then focus on small groups working with and adapting the resources presented on Day 1 for use with their own students. Small groups of 2-5 participants will form based on their project interests. Groups will work to adapt and design case studies and activities aligned with UDL principles for their classrooms. This process, from group formation through material development, is facilitated by the BioQUEST and NTID staff. Participants should leave the meeting with resources they can immediately implement into their courses, and following the conference groups may continue to meet virtually to complete their materials using the online collaborative space on QUBESHub. Groups will

spend most of Day 2 working on their projects and developing short presentations to share with the full group on Day 3.

Lunch on Day 2 will include a deaf student panel discussing the successes and challenges they experienced in biology classes. Day 2 will conclude with a discussion on teaching STEM content in ASL and strategies for addressing the lack of established and standardized ASL signs for STEM vocabulary and concepts. This will be led by Dr. Chris Kurz, a professor in NTID's Master of Science program in Secondary Education of Students who are Deaf or Hard of Hearing.

Day 3 will focus on small group project presentations, establishing next steps and evaluation. Participants will be encouraged to continue to work together on QUBESHub after the conference. BioQUEST staff will facilitate groups technically and organizationally to make the best use of the QUBESHub workspace. In addition, pedagogical support from the BioQUEST staff will be available to all groups upon request. One to three webinars will be offered throughout the following semester with presentations from case and UDL experts.

As the first conference of its kind, the meeting will conclude with an open, group discussion about how to continue to grow this community and build connections to the broader biology education community, specifically the QUBES and BioQUEST communities. The discussion will also determine if the interest in and value of this meeting warrants an annual or biannual meeting to better support the biology instructors of deaf/hh students. The community will be encouraged to participate in the annual BioQUEST Summer workshop where their Universal Design experience will be a valuable contribution to the BioQUEST community of biology educators. Evaluation activities will be conducted immediately following the group discussion.

Day 1		Day 2		Day 3	
8:00 am	Breakfast	8:00 am	Breakfast	8:00 am	Breakfast
8:30 am	Welcome & Introductions	9:00 am	Logistics	9:00 am	Logistics
9:00 am	Keynote: Barbara Spiecker, Oregon State University	9:15 am	Keynote: Dr. Derek Braun, Gallaudet University	9:15 am	Small group presentations
10:00 am	Break	10:30 am	Break, small groups form	11:00 am	Full group discussion
10:15 am	Introduction to Cases & Overview of UDL	11:00 am	Small group work	12:00 pm	Conclusion and evaluation
11:15 am	Session 1	12:30 pm	Lunch & Deaf Student Panel		
12:45 pm	Lunch & Technician Career presentation, Industry Panel	1:30 pm	Group work time		
2:00 pm	Session 2	3:15 pm	Break		
3:30 pm	Break	3:30 pm	Group work time		
4:00 pm	Session 3	6:00 pm	Dinner		
5:30 pm	Dinner	7:00-8:30 pm	Discussion of ASL STEM signs, Dr. Chris Kurz, NTID		
7:00-8:30 pm	Poster session				

Planning

The conference planning committee will meet on a regular basis beginning nine months prior to the event, via a virtual meeting service to finalize conference dates, speakers and structure. NTID staff will manage logistics such as room reservations, interpreters and catering on-site, as well as leading advertising and recruitment efforts.

The BioQUEST staff will work with case developers to design cases related to biology in technician education programs, highlighting contributions made by deaf scientists as appropriate and incorporating Universal Design practices. BioQUEST staff will also develop the conference website using the QUBESHub platform.

Management Team Roles and Responsibilities		
Kristin Jenkins	Principal Investigator	Convene committee meetings and organize conference committee activities, oversee the development of conference website and cases, develop white paper
Donna Lange	Principal Investigator	Oversee conference logistics at NTID, oversee the recruitment and selection of participants, coordinate evaluation activities and develop white paper
Sam Catherine Johnston	Consultant	Ensure UDL framework and principles are incorporated into all workshop content and activities, develop and give UDL presentation and white paper
Denise Kavin	Co- Principal Investigator	Recruit and select participants, assist with conference logistics and develop white paper
Hayley Orndorf	Other personnel, BioQUEST	Assist in organization of conference committee activities, develop and manage conference website, coordinate post-conference activities
Margaret Waterman	Senior Personnel, BioQUEST	Select and train faculty to present cases, develop case studies, give presentations and work with participants on their cases throughout the conference

Dissemination

The conference website will be hosted on QUBESHub and will be used prior to, during, and after the meeting to share information, resources and build community. The conference schedule, presentations, resources, and participant products will be available on this site. In addition to hosting conference resources, the website will allow participants to share and explore resources. Participants will have access to materials post-conference and the option to seek support from pedagogical experts through the site's community tools. QUBESHub will host between one and three webinars by pedagogical experts based on community interest as follow up to the conference. Participants will have the option to publish their products or modifications of conference resources on QUBESHub's resource sharing platform. A significant portion of the materials and results of discussions about case-based pedagogy and UDL approaches will be curated and made public on QUBESHub, and the DeafTEC websites as shared resources, articles or blog posts.

A conference white paper will also be disseminated on QUBESHub, DeafTEC, and ATE Central websites as well as shared with NSF. This report will outline the proceedings and outcomes of the conference. This report will include the best practices for teaching deaf/hh students in biology and applying UDL in biology classrooms that emerged out of the conference. The goal will be to publish a variation of this report in a journal such as CBE- Life Sciences Education or the Journal of Deaf Studies and Deaf Education. The outcomes will also be shared with the BioQUEST, QUBES and Science Case Net community as a presentation during the annual Summer Workshop, and with the broader ATE community through presentations and/or exhibits at related national conferences including the ATE PI conference.

Evaluation

The evaluation of the conference will assess gains in participant knowledge regarding case-pedagogy, UDL, and biology content, and examine the actions taken by conference attendees. These short-term and medium-term outcomes are shown in the logic model below. Short-term outcomes will be evaluated immediately after the formal workshop concludes on Day 3. The perceptions of participants will be collected through a focus group discussion related to the successes and failures of the conference and through a survey that will assess the effectiveness of each activity. Medium-term outcomes will be assessed through an online survey approximately six months after the conference to evaluate the extent to which instructors have integrated case-based learning strategies and UDL principles into their teaching, and the impact of those strategies. Data will also be collected regarding the instructors' participation in webinars, the use of resources, and involvement in the online community. An online survey will also be used to evaluate the extent to which the interpreters have been able to provide more effective services for students in biology courses. Evaluation will be conducted by DeafTEC evaluator, Peggie Weeks, and will be considered part of her DeafTEC evaluation activities.

Logic Model for Biology Teaching Conference for Teachers of the Deaf			
Situation	Inputs	Activities	Outputs
<ul style="list-style-type: none"> ● Biology is a gateway course to several technician fields ● Deaf/hh students struggle with literacy skills and have limited world knowledge ● No biology-specific professional development for teachers of deaf/students ● Deaf/hh educators rarely participant in discipline-specific professional development ● Interpreters have limited technical content knowledge ● Industry seeks a diverse technician workforce 	<ul style="list-style-type: none"> ● Conference committee planning time ● Attendee participation time ● UDL principles ● Case-based learning pedagogy ● Existing BioQUEST two phase faculty development model ● ATE Funding 	<ul style="list-style-type: none"> ● Training on case-based learning pedagogy and implementing UDL principles ● Keynote presentations ● Technician careers presentation ● Industry panel ● Student panel ● Group work ● Poster sessions ● ASL STEM discussion ● Open discussion 	<ul style="list-style-type: none"> ● 45 attendees ● Biology curriculum modules for classroom implementation ● Collection of best practices for teaching biology for deaf/hh students using UDL principles and case-based pedagogies ● A community of biology instructors of students who are deaf/hh ● Conference white paper
Biology Teaching Conference for Teachers of the Deaf Outcomes			
Knowledge (short-term)	Actions (medium-term)	Conditions (long-term)	
Participants: <ul style="list-style-type: none"> ● Developed case-based pedagogical skills to promote and strengthen students' literacy skills and world knowledge ● Have an improved understanding on how to apply UDL principles in a biology classroom ● Increased their biology content knowledge ● Are aware of biology-related technician careers ● Better understanding of the challenges/barriers students face in a biology classroom and best practices for addressing them. 	<ul style="list-style-type: none"> ● HS and CC instructors: <ul style="list-style-type: none"> - Use case-based pedagogy - Apply UDL principles in the classroom - Use best practices for teaching deaf/hh students - Discuss biology-related technician careers with their students - Continue to work together on QUBESHub after the conference - Participate in the annual BioQUEST Summer workshop - Participate in QUBESHub webinars ● Interpreters provide more accurate translation of biology concepts ● Conference outcomes are shared through a white paper, publications, conference presentations, and websites 	<ul style="list-style-type: none"> ● Deaf/hh students are successful in biology courses and pursue related technician education programs ● Deaf/hh student enter technician workforce ● The BioQUEST community of biology educators is larger and more diverse 	

Logic model format for a national conference developed by Chase and Kuehn (2010).

G. Results of Prior NSF Support

DeafTEC: Technological Education Center for Deaf and Hard-of-Hearing Students. DUE #1104229 PIs D. Lange, G. Long, M. Pelz, \$4,459,327, 2011-2015 and DUE #151756 PIs D. Lange, D. Kavin, M. Pelz, \$3,999,807, 2015-2019. DeafTEC is an ATE National Center in its sixth of eight years of funding. The Center's long-term goal is to successfully integrate more deaf/hh individuals into the workplace in highly skilled technician jobs where they are currently underrepresented and underutilized. DeafTEC has focused on capacity building and creation of an infrastructure through: (1) Regional partnerships to cooperatively promote best practices in educating and employing deaf/hh individuals (2) A comprehensive website that serves as a clearinghouse for information related to technical education and technician careers for deaf/hh students, their parents, teachers, and employers (2) An expansion of the STEM national dual credit program, Project Fast Forward.

The regional partnership train-the-trainer model has trained 206 partners (85 high school teachers, 73 community 43 employers) from CA, FL, TX and IL to offer four different DeafTEC workshops within their regions. To date partners have offered 143 workshops to 2,043 participants (819 high school teachers, 564 college faculty, 283 employees and 377 others) on best practices for teaching deaf/hh students in STEM classes, supporting math instruction, incorporating more writing in STEM classes, and creating an inclusive workplace. In follow-up surveys on their "Plans for Change" educators reported that DeafTEC's practical strategies were easy to implement and benefited not just deaf/hh students, but all students. They also reported that they felt more connected with deaf students, and more confident in meeting the needs of all students. Employers reported that they now communicate more effectively with deaf colleagues, that deaf and hard-of-hearing employees are more engaged with colleagues, and that hearing individuals had taken the opportunity to learn more about Deaf culture.

High school and community college regional partners have also offered STEM camps and activities to over 1,400 deaf/hh students and industry partners have offered career awareness activities and have hired deaf/hh students in co-op and permanent positions.

Information from focus groups with student veterans with hearing loss resulted in Top Ten Things Student Veterans Would Like Faculty to Know. This document helps faculty understand military culture and the veteran transition experience and provides teaching strategies that improve access to learning for all student veterans.

The DeafTEC website contains sections on (1) Teaching & Learning – best Practices for Teaching as well as all of our teaching-related content; (2) STEM Employment – videos of deaf/hh STEM professionals, information on the importance of STEM and on career information for students and employers; (2) Projects and Programs – a STEM ASL Video dictionary, information about the DeafTEC workshops and the Project Fast Forward dual credit program; (3) Online Learning - a five-module *Working Together Deaf and Hearing People* online workshop for employers; (4) About DeafTEC - includes information about the Center, our partners, staff, and NVC.

Project Fast Forward (PFF). This national dual credit program was established in 2007 by a three-year grant from the NSF ATE program (DUE # 0602761) and is now an integral part of DeafTEC. The goal of PFF is to build a pathway for deaf/hh students to transition from high school to college in areas of STEM education. During DeafTEC funding we have: (1) Increased the number of partner high schools from 15 to 27; (2) Offered summer professional development to 65 high school teachers to prepare them to teach dual credit courses in their high schools, with many teachers returning to learn content for a second and third course for a total of 99 teacher "trainings"; (3) Offered summer professional development to 28 guidance counselors who work with students taking dual credit courses; (4) Increased NTID dual credit course offerings from 5 to 10 (5) Increased course registrations from 489 to 1,045; (6) Increased the number of unique students taking dual credit courses from 421 to 808 (237 students taking more than one course); (7) Increased the number of course sections taught in high schools from 77 to 196. Since the inception of the program, 77% of students have received passing grades and 1,812 RIT credits have been awarded.

Intellectual Merit: A larger percentage of deaf/hh college students attend 2-year schools compared to hearing students, and a higher percentage are enrolled in STEM majors; however, fewer deaf/hh students earn an associate degree compared to their hearing peers (Walter, 2010). Deaf/hh students also tend to have lower career self-efficacy and less career maturity than their hearing peers (Punch, Hyde & Creed, 2004, 2005, 2006). Military veterans of college age are also underrepresented in community college given the incidence of hearing loss among that population. To address these concerns, DeafTEC will use an innovative partnership approach that will provide deaf/hh students access to career and educational resources specifically designed to meet the challenges that these students face in school and on the job.

Broader Impacts: DeafTEC will broaden the participation in technician careers among deaf/hh individuals by providing them, as well as their teachers, counselors, employers, and co-workers, with the resources that will help them succeed both in the classroom and on the job. Integrating more deaf/hh individuals into the workplace, particularly in highly skilled technician careers, will create a more diverse workforce, and encourage tolerance of individuals currently underrepresented in these highly technical fields. However, DeafTEC's impact will be even broader than that. The Center's emphasis on universal design, developmental math and writing across the STEM curriculum can benefit all students in need of additional resources and support. The partnerships established among high schools, community colleges, and employers in DeafTEC's four different regions can also serve as a model that can be replicated in other regions as well as with other groups of underserved students.

Collaborative Research: BIO IUSE Ideas Lab: Supporting Faculty in Quantitative Undergraduate Biology Education and Synthesis (QUBES). PIs S Donovan, MD LaMar, J Wojdak, C Diaz Eaton, K Jenkins. NSF 1446269, 1446258, 1446284; \$3,216,883; 9/15/14 -8/31/19.

Summary of Results: The overarching mission of the QUBES project is to improve quantitative biology education for all students. QUBES services are patterned on the NSF synthesis centers model (e.g., NIMBioS), which are community driven but also provide leadership in the identification of trends and practices. The QUBES organization has focused on the growth of the community through partnerships and collaborations, the development of effective geographically distributed faculty mentoring networks, and the development of the virtual QUBESHub infrastructure for collaboration.

QUBES Partners are external groups that provide resources to the QUBES community and include professional societies, NSF-funded projects, synthesis centers, curriculum developers, and textbook authors. QUBES enhances our >75 partners' ability to reach and collaborate with their target audiences. Curriculum development partners like Data Nuggets use our web portal to share their resources more broadly, while partners like the Ecological Society of America have used our virtual group workspaces to allow faculty to remix and reshape existing educational materials. Organizational partners such as the National Ecological Observatory Network use QUBES to introduce faculty to their library of educational modules and get important user feedback. NSF-funded RCN-UBE groups use our cyberinfrastructure to host their communities' interactions (Eaton et al., 2016).

QUBES has developed Faculty Mentoring Networks (FMNs), a long-term, low-intensity, virtual and hybrid, community-based professional development model, to increase faculty engagement in scholarly teaching practices. We have found that FMN participants find value in the experience and are more comfortable with quantitative biology education as a result. Participants also place greater value on sharing, and are more likely to share curriculum materials publicly (unpublished results). Over 325 faculty have participated in FMNs and the number continues to increase rapidly. Using the NSF-funded HubZero content management system, we have developed QUBESHub to foster community around quantitative biology education. QUBESHub is not just a curriculum repository, but also a space for virtual collaboration to improve quantitative biology education. For example, QUBESHub offers (1) website design for education projects, (2) built-in community tools, such as forums, announcements, file-sharing, and projects, (3) a customized publication platform to disseminate education resources, and (4) access to in-browser software for educational use (e.g. Jupyter Notebooks, ImageJ, Mesquite, R-Shiny).

Intellectual Merit: The QUBES organization supports increased teaching of quantitative skills in undergraduate biology through building community, supporting dissemination of established resources,

and providing professional development. This addresses the Vision and Change call to improve students' quantitative skills, and prepares future biologists to deal with the rapid growth of quantitative tools in biology.

Broader Impacts: Quantitative skills frequently present a barrier to biology students, especially underrepresented students. Improving faculty's ability to teach quantitative skills helps all students succeed, and disproportionately impacts underrepresented students.

Publications and Products: Five publications have stemmed from QUBES thus far (Donovan et al., 2015; Eaton et al., 2016; Eaton et al., in revision; Eaton et al., in revision; Dahlquist et al, in revision).

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DATA MANAGEMENT PLAN

This plan describes the approach the leadership team will take to define the type of data generated by the conference, ensure integrity of the data, and allow distribution of data in a way that conforms to university and NSF privacy and protection policies.

1) Types of Data

The data to be collected during the project will be: (a) survey results and (b) qualitative responses from observations and focus groups.

Deliverables will include resources for the DeafTEC, BioQUEST, and ATE communities which will be posted on the publicly available DeafTEC, QUBESHub, and ATE Central websites. In addition, (c) data will be created as results of analyses of collected data.

2) Data and metadata standards

The data will be recorded via typical practices used in the human resource/institutional research arena. All data will be stored in electronic or digital format. Quantitative data will be stored in Excel. Qualitative data will be stored in a number of formats, including Excel, Word, Adobe Acrobat, etc.

3) Policies for access and sharing and provisions for appropriate protection/privacy

- Written agreements with the primary content providers will be drafted and finalized to ensure their privacy, confidentiality, security, and intellectual property is protected to the level that the provider deems necessary.
- Consultants will be asked to sign non-disclosure, proprietary materials agreements to protect the content providers' privacy, confidentiality, security, and intellectual property rights.
- Results of the findings will be disseminated to a larger audience through conference presentations and publications.

4) Policies and provisions for re-use, re-distribution

Restrictions will be placed on the raw data collected during the project to ensure protection of privacy and confidentiality. A permission restriction to be placed on re-use or re-distribution data is the disclaimer that any and all such data must credit RIT/NTID, BioQUEST, and the National Science Foundation.

5) Plans for archiving and preservation of access

Sensitive data will be stored on a RIT secure server, and all identifiers will be removed for analysis. Data will only be reported in aggregated form. Only selected staff will have access to confidential research data. Once the research is completed the data may be saved for further mining or analysis. Data will not be released with personally identifiable characteristics. Project staff will also work with ATE Central to archive conference resources and findings.