Could you outline the objectives of your study, and provide a brief overview of the different activities and phases of the investigation?

MB: The objectives are to study native language use in relation to learning environmental science topics in the Yellowstone and Altai mountain systems. Native American university and college students will survey and interview members of indigenous communities in these mountain systems to determine how native language is used in personal, social, cultural and educational contexts. The results will be shared via online resources in multiple languages including English, Russian, Native Altai, and Yellowstone tribal language.

What is the background to this study? How was the partnership between the indigenous Yellowstone and Altai communities created?

MB: This National Science Foundation (NSF)-funded project is based on previous NSF funded a research planning workshop with faculty from Montana State University, Gorno-Altaisk State University and the University of New Hampshire. We engaged Altaian/Russian Federation governments, non-governmental natural resource organisations and native community members from several villages in the Altai Republic and reservations in the Yellowstone region. The very idea for this new project was based on the collaboration of many stakeholders in the Yellowstone and Altai mountain systems.

Why was environmental science selected as the focus for this project?

MB: There are unique characteristics of Yellowstone and Altai that are both ecological, such as sensitive mountain systems representing a variety of biomes, and cultural, such as the lives of indigenous people within a dominant culture. Global climate change is a reality and sustainability is a great concern on both sides. Natural resource management on both systems is also evolving towards ecological and social interactions. Furthermore, these guiding principles align with the results of our past research planning workshop experiences.

Why does the project specifically target undergraduate and graduate students who are women and/or Native American?

CRS: Many people know that women and native peoples are underrepresented within the science professions. While underrepresentation is largely due to decades of discrimination, there are more subtle underlying factors as well. This project focuses on awareness that conventional, Eurocentric views of science, and of learning science, are potentially limited. By encouraging participation of women and Native Americans, we work to confront and expand those views, foster creativity and innovation, and elevate the importance of respect for holistic understandings of community. For example, within many indigenous communities, women and men have distinct roles, learn different content in different ways, and may even speak...
different dialects of indigenous language. This project seeks to honour the complexity of community- and place-based learning.

How have you succeeded in accessing communities that are traditionally isolated and insular?

CRS: Various members of the research team have accessed rural and tribal communities in different ways. The indigenous members of our team have initiated research in their home communities, which is very different from the work of the non-native researchers who have been asked by indigenous leaders, colleagues or friends to support or conduct existing or emerging scholarly work in these communities. Regardless of the path, guidance from a cultural insider who is a member of the community has proven essential. Early networking within the community is also important, and introductions to leaders, elders and educators contribute to the sharing of histories, places and ideas. In many cases, this networking is informal and even spontaneous, while in others it is more formalised. As part of Institutional Review Board approval, Montana State University requires a formal letter of support from the tribal government and other reservation-based partners. Most importantly, we strive to develop a sense of access as relational and continuous. We work to establish a long-term relationship with the communities.

Does anyone involved have plans to extend or develop the lines of this investigation further into the future?

MB: All of the undergraduate and graduate students involved in this project will have the opportunity to complete their own personal small-scale research project especially with a focus on their own native people. Students will be encouraged to pursue the topic of their interest in future work, in addition to the research team project. The research team is committed beyond the grant cycle to working on these and related topics with the communities in both the Altai and the Greater Yellowstone ecosystem – our work is really just beginning.

The science of learning science

To help address the underrepresentation of indigenous people in STEM, a research partnership between Montana State University, USA and Gorno Altaisk State University, Russia is exploring informal science learning from personal, place-based and cultural perspectives.

INDIGENOUS POPULATIONS ARE often underrepresented in STEM careers, and in the US and Russia, there is currently a focus on expanding access to such groups to become successful in these areas. Science education research has traditionally focused on classroom, laboratory and field experiences, which are all associated with organisational and professional contexts. However, the importance of understanding and using indigenous language in both formal and informal settings to promote science learning amongst native audiences is now increasingly recognised and considered an effective way to expand success in STEM.

YELLOWSTONE AND ALTAI MOUNTAIN SYSTEMS

At Montana State University (MSU), a National Science Foundation (NSF)-funded project is currently underway to study science learning and plan education activities within indigenous communities in two distinct but similar mountain systems – the Yellowstone mountain region in the US and the mountains of the Altai Republic in Russia. In the US, there is a focused effort to revive Native American languages to help maintain the cultural integrity of tribal nations. The Altai Republic is a fairly recent addition to the Russian Federation and efforts are being made to assimilate Native populations into mainstream Russian culture; in the Altai Republic, indigenous people commonly use native language in their daily lives and learn the Russian language in government schools.

A partnership between the two regions has developed over the past five years, and a steady interaction of people from Yellowstone and Altai has been encouraged by the Foundation for Sustainable Development in Altai. During this time, scientists, resource managers, community leaders, business owners and conservationists have travelled into the Altai and Yellowstone mountain systems to share their expertise and learn from each other’s experiences.

LEARNING OUTSIDE THE CLASSROOM

Led by Dr Michael Brody, the project explores the problems and limitations that may arise from learning environmental science in informal and formal settings. “We recognise that most learning takes place outside of classrooms. We also know that learning is a lifelong endeavour beginning at birth and continuing throughout our entire lives,” Brody explains. “This project explores environmental science learning outside of professional, organisational settings. We believe that science learning takes place in personal contexts such as walking through a meadow, social contexts such as hiking with friends and cultural contexts like community gatherings.”

Over the next three years, a team of Native American students will study research...
Outcomes from the project will contribute significantly to improving understanding of informal and formal science learning, natural and cultural resource management and social and ecological sustainability.

methodologies and learn culturally responsive methods of data acquisition. The students will survey and interview members of their tribe and other native language speakers to ascertain the use of native language related to natural and ecological settings. The team will also travel to the Altai Republic where they will spend two to three months completing similar surveys and interviews with indigenous Altai people. They will participate in two separate workshops in the Ongudaisky and Kosh-Agachsky regions that will focus on native people’s values, interests and concerns related to informal learning settings and how these will influence future research and education activities. They will then collate their results and create an online resource, focusing on what specific language is used and how meaning might be similar or different between the two language systems.

COLLABORATIVE AND MULTIDISCIPLINARY

The project is a collaboration between MSU and the Gorno Altaisk State University (GASU) in Russia and engages educators and environmental scientists as well as experts in Native American and Altai language, history and ecology. Specialists from different fields will contribute to the project from both the American and Russian sides. The GASU team is led by Dr Natalia Yurkova and includes: Dr Surna Sarbasheva, who is native and teaches the Altai language and literature to university students; Professor Maria Sukhova, who works with native people to learn how global warming and its consequences influence their traditional land use; and Dr Alexander Ebel, a specialist in the Altaian history and culture, with experience of working with and teaching native people in informal ways, involving them in different archaeological research projects.

At MSU, the team includes: Dr Shane Doyle, a member of the Crow Tribe who has worked with tribal colleges within the Montana Indian reservations; Dr Christine Rogers Stanton, Assistant Professor in Education and co-Principal Investigator of the NSF grant; Dr Art Bangert, Associate Professor of Educational Leadership whose primary research interest is focused on online learning; and Dr Cliff Montagne from the faculty of land resources and environmental science.

Yurkova believes that this multidisciplinary approach is critical when considering the cultural, social and personal aspects of learning science: “In order to conduct this type of research with native people it is essential to work with tribal and community members in productive ways, which requires a deep understanding of the different aspects of their lives by the research team members,” notes Yurkova. According to Stanton: “Our research draws from participatory, community-based and decolonising research paradigms”. Several members of the project have travelled to the Altai region many times over the years, listening to the needs and interests of the participating communities, sharing ideas and methodologies and forming connections. Stanton adds: “Access is not simply about initial contact and work. We find ways to continue projects in the communities where we have developed initial relationships to create meaningful and appropriate products that meet their needs and expectations, and we spend considerable time simply listening”. This collaborative approach provides a holistic view of science learning and will unite diverse intellectual resources and research efforts within unique ecological and social systems.

PEOPLE, PLACE AND CULTURE

Brody and his team are proposing a unique ecological framework for understanding learning. Their approach will take into account human development and learning from a range of interdisciplinary perspectives, as well as the diversity of life experiences in a global society; considering learning originating from the individual’s experiences across many institutional contexts and social settings.

Notably, the project will investigate the value of native language in environmental science, learning from three different perspectives: people, place and culture. The people-centred perspective studies psychological phenomena relevant to informal science learning such as interests, motivation, knowledge, skills, dispositions, identity, prior knowledge, expert-novice understanding and metacognition. This allows the research team to consider two distinct theories of learning, one from each mountain system. The Altai educators, for instance, are influenced by a traditional Russian approach of ethnocultural teaching and learning, which integrates local and regional ethnicity and cultural factors in the interdisciplinary learning of school subjects. On the US side, science educators are familiar with the theory of pedagogical content knowledge: specialised knowledge within a domain that makes the teaching and learning
that can only describe the natural phenomena to them. In fact, there are unique meanings communicate in ways that are most familiar to them. Montana

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of science subjects more meaningful and effective. “Combining these two perspectives in a context of ecological learning gives us ethnocultural pedagogical content knowledge, a notion originating from the Altai education and research community and assimilated with our own research interests on the US side, that we are interested in developing further,” elucidates Brody. “This is a truly unique cross-cultural collaboration of disparate yet complimentary learning theories.”

The place-centred perspective looks at what happens across and within particular places such as physical features, biological communities, available resources, and local activities associated with specific places that influence learning and decision making.

From the culture-centred perspective, the integration of knowledge from experiences across settings and time will be considered, with an aim of maximising the ecological connections among learning experiences. In this part of the study, the team will focus on the learners as part of contextual participation structures such as after school programmes, museums, kitchen gardens, family excursions, traditional ceremonies, parks, trails and related informal learning experiences.

**TRANSFERRABLE APPROACHES**

Results from the project’s workshops so far indicate that native language use in both Yellowstone and Altai mountain systems is critical to maintaining cultural identity and is of great concern to indigenous people. “In personal, social and cultural contexts, indigenous people think, speak and communicate in ways that are most familiar to them. In fact, there are unique meanings embedded in native language, for example, that can only describe the natural phenomena being observed and discussed,” Brody notes.

Although the team’s results are specific to native populations in the Yellowstone and Altai mountain systems, Brody believes they will provide a potential methodological approach to investigating native language use and science learning in other indigenous populations. Whilst each situation under investigation is likely to be unique, by comparing the similarities and differences between language groups and developing a pattern of culturally appropriate and effective data acquisition methods, the team will help inform a responsive research methodology. “If ethnocultural pedagogical content knowledge actually appears within the use of native language and informal science learning, we believe that the learning concepts, principles and methodologies we generate will be transferrable across disparate groups of underrepresented audiences in science education,” Brody enthuses.

Ultimately, outcomes from the project will contribute significantly to improving understanding of informal and formal science learning, natural and cultural resource management, and social and ecological sustainability. By understanding how, why and where learning takes place, US and international research and education agendas can be extended. As the team members proceed with their research, they will assess their results annually, eventually combining them into native language resources for learning that will be encyclopaedic in nature and used in science education programmes in the future. “We are interested in providing support for underrepresented populations to be successful in STEM,” adds Brody. “There is very little available to help educators and learners bridge the subject of science with native language and indigenous knowledge. Our research project will create a resource for educators to use in working with native people, which we hope will be available in 2016.”

**OBJECTIVES**

To provide Native American students opportunities to learn cross-cultural research skills that may motivate them to pursue further STEM coursework, research projects and ultimately STEM-related careers. A likely sustainable outcome from this project would be that faculty and student participants will continue their research related to native language learning of environmental concepts and, in turn, mentor others who are interested in pursuing similar lines of STEM research, related coursework and careers.

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**KEY COLLABORATORS**

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**INTELLIGENCE**

US-RUSSIA: INFORMAL SCIENCE LEARNING IN ECOLOGICAL CONTEXTS: PERSONAL, PLACE-BASED & CULTURAL VIEWS OF LEARNING IN CONTRASTING MOUNTAIN SYSTEMS

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