

**(A) NEED FOR PROJECT:** *Raising Educational Achievement through Cultural Heritage* (REACH) proposes to improve Alaska Native student knowledge of Inupiat and Yup'ik ways of knowing about climate, and increase student Science, Technology, Engineering and Math (STEM) competency. REACH provides three full years of services to 15 schools in the Bering Strait School District (BSSD). Nearly half of these schools are identified as Tier I, "Persistently Lowest Achieving Schools," and only two BSSD schools met Adequate Yearly Progress for 2010-2011 (AKDEED, 2011). Annual professional development (PD) in the form of two separate weeklong summer institutes and yearlong in-service training will help prepare teachers to deliver effective culturally relevant STEM instruction in this high-poverty, rural district. More than 240 curricular resources will be developed to help transfer PD training to classroom instruction. Provision of renewable supplies will help sustain instruction for future teachers.

The academic achievement gap between indigenous BSSD students and the statewide average is significant. Alaska students are tested in science in grades 4, 8 and 10. In math and language arts, grades 3-10 are tested. Only 20% of BSSD 4th graders are meeting state science standards, compared with 49% statewide. In math, BSSD students fare somewhat better, yet still lag significantly behind, with 45% of BSSD students in grades 3-10 meeting state standards, compared to 69% statewide. Similar disparities exist in language arts (AKDEED, 2011).

The BSSD covers an area of 80,000 square miles—an area larger than the state of Nebraska. Residents of this vast region represent two distinct cultural and linguistic groups: Inupiat and Yup'ik. For the majority of BSSD residents, English is their second language. Villages have limited services (plumbing, sewer systems, roads, or clinics) and range in population from 145 to 752. There are no roads in the district that connect villages or provide access to urban centers. Small planes offer the only year-round access into the region (weather permitting).

Social factors contributing to BSSD's low academic achievement include geographic isolation, poverty, and lack of higher education or career role models. The escalating cost of fuel oil—\$5.31 to \$7.53 per gallon in Western Alaska—used for basic needs (DCCED, 2012) has reduced funds for travel, increasing a sense of isolation for students and teachers.

October 2011 BSSD enrollment data indicates there are 1,606 students in the district. Of these, **98% are Alaska Native**. The district has 158 full-time-equivalent teachers, and only 2% are Native, creating a cultural disparity between students and teachers. School student populations range from 33 (Little Diomedé) to 245 (Savoonga). With a high level of English Language Learners (especially in primary grades), it is not surprising to find **54% of BSSD students are Limited English Proficient** (AKEED, 2011). Due to small populations, most teachers teach multiple grade levels and disciplines in the same classroom. Few schools have special education or accelerated learning programs, so teachers also must adapt to the unique learning needs of each student. High costs and limited funds have increased school dependence on outdated textbooks focused on topics of little relevance to rural Alaskan culture or place.

Factors contributing to low academic achievement in BSSD and targeted by REACH include:

**A high teacher turnover rate of 35%**, compared to 13% statewide (ISER, 2006). This lack of continuity prevents students from establishing lasting, supportive relationships with their teachers, who could become mentors and role models. It also increases the burden of training and administrative services for the district. The teachers who remain in the district long-term are those with connections to the communities they serve (primarily Alaska Native teachers).

BSSD employs a **high number of inexperienced teachers**. Based on personnel records, 63% of BSSD teachers have less than five years teaching experience; 48% have less than two years. Most teachers are from outside Alaska and are unprepared for the unique circumstances

existing in Native villages. Low teacher experience results in low student achievement (NCES, 2001). BSSD schools suffer from a **lack of current, place-based, relevant curricula**, which contributes to poor student achievement and low parental and Elder involvement in school.

REACH uses the topic of climate change as a focal point for culturally responsive PD. It interweaves indigenous and western knowledge systems to strengthen the ability of non-Native teachers to use methodologies proven effective with Native students. Climate literacy is one of the most crucial issues facing humanity (NRC, 2007), and is critical for Native residents, whose cultures, languages and subsistence lifestyles are inseparably tied to the land. This is especially true in the Arctic, where climate changes are significant, accelerating, and unlike any in recorded history (NRC, 2004). Average arctic temperatures have increased at twice the rate of the rest of the world (ACIA, 2005), are affecting the survival of arctic animals and plants (NSIDC, 2007), and have resulted in changes in generational wisdom about thriving and surviving (Duran, 2007).

Despite its cultural and environmental importance, climate science is missing from most Alaska public school curricula (NOAA, 2007). Research underscores the importance of increasing school emphasis in content areas that facilitate global awareness and civic responsibility, and foster critical thinking. Climate studies provide a natural forum for helping students develop problem-solving skills to explore the interconnected physical, geographic, and social dimensions of research. Climate is a theme that integrates subjects across disciplines, and cross-curricular integration is shown to improve student achievement, and to increase student ability to apply learning to the world (Meichtry & Smith, 2007).

With roots in indigenous culture while living in western society, Native students are uniquely poised to assume future leadership roles in climate research and policymaking careers. Native culture trains students to understand Earth's interconnected systems first, and then to view

individual parts of the system as they relate to the whole. By contrast, western schooling focuses on the individual parts first. Conclusions about a whole picture are drawn only after amassing large quantities of data. In REACH, both methods intersect and complement each other. REACH focuses on helping Alaska Native students recognize Native Elders as scientists who have studied climate for millennia. The project contrasts instrument-collected quantitative data on climate with oral history gathered qualitative data on climate.

Tribal leaders and researchers alike recognize the need for indigenous expertise in understanding climate change and addressing its effects (AGU, 2007; NASA, 2006; Nunavut, 2001). Acknowledging that expertise from the global community will be needed to adapt to a changing planet (NASA, 2006), scientists often seek indigenous input in western research. Despite this, Native Americans are the least represented of all minorities in geosciences; less than .001% of the US indigenous population is pursuing Earth system science degrees (NSF, 2007). Teachers desperately need geophysical training: 90% of US secondary students are taught Earth/physical science by a teacher lacking certification (NCES, 2007). In rural Alaska, the situation is worse because small staffs teach multiple subjects (ISER, 2006). In REACH, climate scientists and Elders collaborate to create PD shown to increase indigenous student achievement. PD results in university credits teachers can use toward earning highly qualified status or certification.

**(B) QUALITY OF PROJECT DESIGN:** REACH proposes to improve student and teacher STEM competency with culturally relevant teacher training and curricular resources for K-6 students and teachers in BSSD. REACH seeks to mitigate the factors contributing to low academic achievement in BSSD by delivering a rigorous PD program augmented by ongoing mentorship and support from master teachers, scientists, and Native Elders knowledgeable about regional climate changes. REACH provides immersive indigenous and western training in

summer intensive sessions to 45 BSSD teachers (3 per school) annually. These teachers then help mentor all 79 BSSD K-6 teachers as they participate in yearlong curriculum-based REACH in-service training. In-service training involves interacting with newly designed REACH curricular resources infused with current, place-based STEM content and built-in best-practice methods for teachers of indigenous students. During REACH curriculum-based in-service, BSSD teachers learn about regional climate changes and practice culturally relevant best-practice methods for engaging indigenous students in the study of science and math. Program enactment culminates with stewardship activities that allow students to propose possible solutions to local climate change issues. Students present their stewardship projects at annual Climate Expos held in their communities. Incorporating culturally relevant activities into standard-based curricula increases Native student achievement (Starnes, 2006), as does including Native language terms and values (AK Standards, 1998) and cooperative work relevant to Native life (Stephens, 2001).

Climate change was selected as the topic of instruction because it includes core academics and is highly relevant to Bering Strait residents who are directly impacted by its effects. **REACH goals are to:** (1) improve BSSD student STEM achievement in high-poverty, persistently low-achieving schools; (2) increase the number of effective teachers, training them in culturally relevant STEM instruction proven to increase student achievement; and (3) prepare Native youth to become leaders in developing solutions to climate issues in school and in the real world.

**Changing Climate, Changing Landscapes, Changing Lifestyles:** The conceptual model used to drive teacher training, resource development and student learning begins in Project Year (PY)1 with foundational knowledge about changing weather and climate. During PY2, students apply knowledge while exploring climate change effects on the local landscape, and in PY3 students plan approaches and strategies for adapting to climate change problems in rural Alaska.

Research and experience show that a continuum of service increases a sense of ownership that perpetuates sustained expert involvement (Coenders et al., 2008). Therefore, Native Elders, scientists, and master teachers are involved in the program from inception through classroom enactment. These experts collaborate to provide guidance on teacher training and curriculum development. They also deliver PD instruction and provide year-round mentorship.

**Teacher Professional Development:** REACH experts (Native Elders, scientists, and master teachers) annually offer 45 BSSD teachers two weeks of summer PD (*for 4 credits*) to prepare them to mentor all 79 K-6 BSSD teachers during yearlong in-service training (*for 3 credits*). BSSD teachers attending summer PD earn 7 credits annually from UAF that can be used toward earning highly qualified status in science and math, which certifies teacher effectiveness in these areas. Summer PD is divided into two one-week institutes. Leading climate scientists share current climate research during **Geophysical Institute (GI) Training**, which occurs at UAF. Elders provide teachers with instruction on local climate knowledge during **Culture Camp**, which occurs in Unalakleet (BSSD headquarters). Kawerak, Inc., the Alaska Native regional nonprofit organization serving BSSD, supports the camp by sharing cultural resources from their Eskimo Heritage Program and from their Beringia Museum of Science and Culture.

GI Training is focused on quantitative climate research from a western science perspective, while the Culture Camp focuses on qualitative climate observations and findings from an indigenous knowledge perspective. The project compares and contrasts instrument-collected quantitative data on climate with oral history-gathered qualitative data on climate. Including western and indigenous knowledge is additive to teachers' understanding of climate change and is aligned with the current research practice of collaboration between scientists and indigenous leaders to better understand climate changes (ACIA, 2005; Walsh et al., 2005). A Master Alaska

Native teacher selected by Kawerak, and a Master western science teacher selected by the GI will help scientists and Elders align their summer presentations with Alaska Content Standards and show them how to model evidence-based best practices for providing STEM instruction.

Taken together, the complementary institutes offer a complete and culturally grounded approach to understanding climate change and related challenges in western Alaska and the world. Table I provides examples of how western and indigenous content will be presented during summer PD.

<b>(Table I) Project Year 1 Theme: Changing Weather &amp; Climate (Foundational Studies)</b>		
Unit	Quantitative GI Training Activities	Qualitative Culture Camp Activities
Temperature Changes	<ul style="list-style-type: none"> <li>• building/using temperature gauges</li> <li>• scientific terms related to climate</li> </ul>	<ul style="list-style-type: none"> <li>• traditional weather prediction</li> <li>• indigenous terms related to climate</li> </ul>
Precipitation Changes	<ul style="list-style-type: none"> <li>• measuring impacts of snow albedo</li> <li>• modeling precipitation changes</li> </ul>	<ul style="list-style-type: none"> <li>• precipitation change observations</li> <li>• precipitation collection &amp; uses</li> </ul>
Seasonal Shifts	<ul style="list-style-type: none"> <li>• graphing seasonal changes</li> <li>• projecting Alaska's seasonal shifts</li> </ul>	<ul style="list-style-type: none"> <li>• changing wildlife/plant cycles</li> <li>• seasonal subsistence charting</li> </ul>
<b>Project Year 2 Theme: Changing Landscapes (Learning to Apply Knowledge)</b>		
Permafrost Thaw	<ul style="list-style-type: none"> <li>• data from a permafrost borehole</li> <li>• engineering for permafrost areas</li> </ul>	<ul style="list-style-type: none"> <li>• impacts of local permafrost thaw</li> <li>• build or tour a traditional ice cellar</li> </ul>
Coastal Erosion	<ul style="list-style-type: none"> <li>• increased storm and erosion data</li> <li>• mapping/modeling coastal erosion</li> </ul>	<ul style="list-style-type: none"> <li>• discuss storms and local erosion</li> <li>• tour local coastal erosion sites</li> </ul>
Disappearing Lakes	<ul style="list-style-type: none"> <li>• tracking methane seeps from lakes</li> <li>• satellite imagery of lake changes</li> </ul>	<ul style="list-style-type: none"> <li>• local stories of lake gas emission</li> <li>• impacts of lake loss on subsistence</li> </ul>
Shifting Tree Line	<ul style="list-style-type: none"> <li>• modeling tree line shifts &amp; impacts</li> <li>• invasive plant species mapping</li> </ul>	<ul style="list-style-type: none"> <li>• observed tree line shifts and impacts</li> <li>• traditional &amp; new uses of local flora</li> </ul>

Project Year 3 Theme: Changing Lifestyles (Learning Stewardship and Leadership)		
Infra-structure	<ul style="list-style-type: none"> <li>• green energy sources / assessments</li> <li>• coastal erosion counter-measures</li> </ul>	<ul style="list-style-type: none"> <li>• community relocation planning</li> <li>• reengineering the ice cellar</li> </ul>
Travel and Industry	<ul style="list-style-type: none"> <li>• sea ice impacts on shipping routes</li> <li>• carbon outputs of motor vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• new animal migration/hunting paths</li> <li>• traditional &amp; new travel technology</li> </ul>
Subsistence	<ul style="list-style-type: none"> <li>• telemetry tracking of animal range</li> <li>• tracked changes to fish populations</li> </ul>	<ul style="list-style-type: none"> <li>• new hunting/gathering techniques</li> <li>• local subsistence tools then and now</li> </ul>

**The 5-Day GI Training** offers teachers the latest research data on climate change in Alaska. Joining GI researchers will be scientists from two Landscape Conservation Cooperatives. The U.S. Department of the Interior recently established these LCCs to gather climate data, review modeling forecasts, and develop management plans to address climate impacts in or near BSSD (Arctic LCC, 2010). Each morning of instruction scientists provide background information for teachers about the year's climate change theme (see Table I), introduce data collection and analysis tools, provide instruction on the types of data needed to explore the theme, and discuss current scientific conclusions and emerging areas of future study. Many scientists contribute expertise to ensure broad coverage of each theme, and because experience indicates involving a large pool of experts keeps interest high and burnout low (Berry Bertram, 2010). Each afternoon, REACH Master teachers will demonstrate evidence-based best practices for engaging indigenous students in STEM study centered on the morning science presentation. Some of the best-practice methods promoted by REACH include: use of tactile lessons (Brayboy & Castagno, 2007), interactive visual tools (Kawagley, 2006), multiple opportunities for review (Aikenhead, 2001), and relating concepts learned to local issues (Klump & McNeir, 2005). These same best practices are embodied in Elder instruction at the Culture Camp.

**The 5-Day Culture Camp** is held in Unalakleet before the school year begins. The same 45 teachers who attended GI Training also participate in this culturally immersive program, planned and delivered in cooperation with Kawerak, Inc. Kawerak identifies Elders knowledgeable on weather and climate to lead the Culture Camp. As experts in traditional ways of teaching and transferring knowledge, Elders will establish the training agenda, identify important concepts to be taught and instructional techniques to be demonstrated at the camp.

At the Culture Camp, Elders describe the crucial role Native youth must play in finding answers to climate change problems. It is not enough to teach about climate change, its effect on the environment and its lifestyle impacts. Students must be prepared to construct solutions to mitigate the effects of climate change, and become leaders in implementing those solutions. Elders, master teachers and BSSD teachers collaborate to identify culturally appropriate climate change topics, potential stewardship projects, and issues that will foster student leadership.

Each morning of the camp, Elders discuss climate observations and other information passed down through generations by indigenous knowledge bearers, highlight key concepts emphasizing qualitative observation techniques, demonstrate use of natural instruments and circular charts based on seasonal subsistence, and showcase Native language terms for weather phenomena and forecasting. In the afternoon, Master teachers share insights on integrating this information into STEM teaching and evidence-based methods for engaging Native students scholastically.

A one-day **Elder Summit** held at Kawerak's Beringia Museum of Science & Culture in Nome, Alaska, is scheduled to help Elders and Master teachers prepare for the Culture Camp. At the Summit, Elders will catalog the climate information they wish to share with teachers, assign instructional roles and responsibilities, and prepare a list of supplies for hands-on activities.

**Yearlong In-service training** (*for 3 UAF credits*) occurs as teachers transfer summer

institute learning to their classrooms. All 79 K-6 BSSD teachers annually participate in this training (for a three-year total of 237 teachers). Teachers who attended the summer institutes serve as mentors for the rest of the teaching faculty. These mentoring teachers will assist scientists and Elders at BSSD's fall district-wide meeting in leading a one-day **Introductory Workshop** on REACH in-service training. The workshop is a venue for the REACH Management Team to meet all of BSSD's K-6 teachers, and to describe their expected involvement with REACH curricular materials throughout the school year. REACH curriculum will be infused with evidence-based best practices for engaging indigenous students in STEM study and will incorporate current, place-based culturally relevant information on regional climate changes. In their villages, teachers will field-test curricular resources, share reflections with peers, and provide feedback to program staff. REACH curricular resources and kits of supplies for enacting hand-on lessons will be shipped to each teacher. Teacher support from an online network of REACH scientists, Elders, and curricula developers will be continually available.

Peer interaction and teacher feedback occur within Moodle, a secure, online course management system. The Moodle environment is customized for REACH to house course materials and discussion forums. Distance-delivered instruction mitigates geographic and financial barriers that often prevent rural teachers from receiving PD. Re-useable supplies shipped to teachers become school property, ensuring program sustainability beyond grant end.

To annually receive UAF credits for school-year participation, teachers must attend the Introductory Workshop, field-test the full suite of REACH curricular resources, and provide feedback. At the end of the year, one teacher from each of the district's 15 schools will attend a two-day **Culminating Workshop** at UAF. The workshop offers an opportunity for the REACH Management Team and evaluator to hear teacher comments and gather data for reporting.

**Curricular Resources** will be created to transfer teacher training to classroom instruction. Elders, scientists and teacher practitioners will be involved in all stages of curriculum development, field-testing, and refinement. All resources will embed best practices for teaching indigenous students and include Native language terms describing weather and climate. A suite of standards-based, culturally relevant classroom resources based on annual REACH themes will be created each year. Multiple, flexible resources designed to help teachers effectively meet the needs of students with diverse learning styles include: (a) Core hands-on STEM content lessons interweaving indigenous and western climate knowledge; (b) interactive multimedia to help students visualize complex climate processes; and (c) digital Elder and scientist lectures.

Because most BSSD schools have multi-age classrooms, separate resources are designed for three grade ranges: K-2, 3-4, and 5-6. A total of 75-90 resources (lessons, multimedia and lectures) will be created each year (25-30 per grade-range). Lessons will be indexed to Alaska Cultural Standards and Grade Level Expectations (GLEs) to help teachers meet core academic requirements. Lessons, designed to fit into one-hour class periods, will include step-by-step instructions; enrichment activities; student worksheets; cultural and scientific background information and student pre-/post- tests. REACH curriculum transferring PD training directly to the classroom will free teachers from having to write their own STEM lesson plans and connect activities to standards. Providing lesson supplies is critical in rural schools because curricula and instructional support are limited and there are no stores that carry educational supplies.

The curriculum will provide students with the content knowledge and skills they need to engage in hands-on lessons and inquiry-based projects focused on local climate changes. In PY3, students will create **Stewardship Projects** in which they propose and test solutions to local issues. These performance-based projects help students apply scholastic knowledge to local

issues, and are a part of preparing Native students for leadership roles in careers focused on adapting to climate changes. Students will present their Stewardship Projects to local community leaders at **Climate Expos** held in all BSSD schools. Modeled after American Indian Science & Engineering Society (AISES) science fairs, Climate Expos are public events that encourage community engagement and foster discussion about solutions to local problems. Exemplary projects are entered into an online science fair for broader viewing by AISES entrants statewide.

<b>(Table II) Diverse REACH Curricular Resources Available to BSSD Teachers</b>				
<b>Curricular Resource:</b>	<b>PY1</b>	<b>PY2</b>	<b>PY3</b>	<b>Total</b>
Core STEM Content Lessons	30 (10 / level)	30 (10 / level)	30 (10 / level)	90
Interactive Multimedia Activities	30 (10 / level)	15 (5 / level)	15 (5 / level)	60
Digital Elder and Scientist Lectures	30 (10 / level)	15 (5 / level)	15 (5 / level)	60
Stewardship Project Lessons	N/A	15 (5 / level)	N/A	15
Climate Expo Lessons	N/A	N/A	15 (5 / level)	15
<b><i>Totals</i></b>	<b><i>90 (30 / level)</i></b>	<b><i>75 (25 / level)</i></b>	<b><i>75 (25 / level)</i></b>	<b><i>240</i></b>

Two online databases support REACH: the **Indigenous Knowledge Database** and the **Student Network for Observing Weather** (SNOW). The Indigenous Knowledge Database was designed to make Native climate observations accessible to students, teachers, cultural experts and scientists. This resource will be expanded to include resources from Kawerak’s repository of cultural assets. The Alaska Native master teacher will search Kawerak’s archive to identify material for the database and for inclusion in cultural lessons. SNOW was designed by the GI to allow students to act as local weather observers, collecting and recording weather data. Student-collected data are shared with the National Weather Service, helping students build STEM competencies, practice skills used in science careers, and contribute to authentic research.

The REACH website, which hosts all curricular resources, will be divided into four sections:

(1) The **Classroom Lesson** tab will host core STEM content, stewardship project, and climate expo lessons. (2) The **Interactive Learning System** tab will host multimedia activities and digital lectures by Elders and scientists that supplement classroom lessons. (3) The **Climate Resources** tab will include links to Indigenous Knowledge and SNOW databases, satellite imagery, interactive maps, and other data sets provided by REACH affiliated researchers and consortium partners. (4) The **Professional Development Course** section will offer a portal to the secure Moodle environment used for in-service course management. After grant end, this tab will house publicly accessible information about REACH professional development and findings.

**(C) QUALITY OF MANAGEMENT PLAN:** A full-time (school year) **Management Team** (PI *Berry Bertram* [3 mos/yr] & Program Director *Findlay* [6 mos/yr] oversee REACH development and implementation. *Berry Bertram* (Ph.D. Science Education; 20-yr education researcher & PI) leads Advisory Board, Consortium and Development Team meetings to ensure continuous testing and revision during development, ongoing improvement during implementation, and thorough data analysis for summative conclusions. The PI publishes articles and presents at science and indigenous education conferences. She works in tandem with *Findlay* (MBA; 10-yr program manager), who carries out budgetary, supervisory, and other administrative duties, and prepares reports used to document program activities and ensure milestones are met and data analysis and feedback are conducted on time and within budget.

The REACH **Advisory Board** annually meets for a full day to review program resources and give feedback that guides revision. The board includes: UAF Center for Cross-Cultural Studies & Alaska Native Knowledge Network Director *Ray Barnhardt* (Ph.D. Anthropology and Educational Administration; 30-yr researcher), who ensures use of evidence-based, culturally

relevant best practices for Native learners; UAF/GI Research Associate Professor **Gerhard Kramm** (Ph.D. Meteorology; 30-yr researcher), who provides data and reviews science content; Cultural Heritage & Education Institute Director **Robert Charlie** (Native Chief, 25-yrs guiding Native programs), who assures cultural integrity and recruits Elder participants; and Education Researcher and former NSF Program Director **Emma Walton** (Ed.D. Curriculum & Administration; M.Ed. Science Teaching), who advises on implementation and methodology.

The **REACH Consortium** is made up of 3 Native organizations (**Kawerak, Inc**; **Cultural Heritage & Education Institute**; and **AK Native Knowledge Network**), 3 research organizations (**UAF/GI**; **Northwestern Interior Forest LCC**; and **Western AK LCC**), and 1 LEA (**Bering Strait School District**). The consortium ensures REACH curriculum and associated PD are created and implemented according to clear timelines and milestones for task accomplishment. Consortium members independently conduct a content review, then meet by teleconference to ensure all program elements are place-based, accurately reflecting Native culture and STEM content. These partners also share in program dissemination and contribute to sustainability.

The **REACH Development Team** follows a systematic process for developing the 240 curricular resources that interweave Native and western perspectives for BSSD (see Table II). These resources will help transfer REACH PD training into sustainable classroom instruction. Input from consortium partners will ensure all REACH curricular resources are aligned with the latest research findings and culturally relevant place-based climate issues. They also will ensure that all REACH resources address Alaska cultural standards and GLEs for math and science.

The team relies on a model proven successful for indigenous education (Berry Bertram, 2010). This model includes the following **seven phases** that facilitate development, review, feedback, and improvement: (1) planning and conceptualization; (2) drafting curricular

resources; (3) initial curricular resource review and revision; (4) curricular resource kit assembly and testing; (5) curricular resource school-year field-testing and revision by practitioners; (6) publishing and dissemination; and (7) avenues ensuring continual improvement.

The REACH team members involved in each phase are identified below, along with their time commitments, qualifications and responsibilities.

**(1) Planning & Conceptualization:** The full REACH Development Team meets annually to conceptualize curricular resources that offer teachers flexible options for transferring PD training into classroom instruction. Two climate experts will share content and identify data sources: Yup'ik Elder *Oscar Alexie* ([2 wks/yr] BA Interdisciplinary Studies; 10-yr Yup'ik Language Institute coordinator) and Scientist *Peter Webley* (Ph.D. Atmospheric Science; 9-yr researcher). Five educators will identify related STEM content strands, formulate lesson ideas, select applicable cultural standards and GLEs, and develop step-by-step instructions to help teachers enact REACH evidence-based best-practice methods: GI master teacher *Gary Cooper* ([2 mos/yr] BA Life Science; 30-yr rural AK STEM teacher); curriculum developers *Lori Schoening* ([6 mos/yr] BA Education; M.Ed. in progress), *Sam Norlin* ([6 mos/yr] MS Biology; BS Environmental Science; Highly Qualified in Math, Biology, Chemistry, Earth Science), an **Alaska Native Master Teacher** ([1 mo/yr] to be selected by Kawerak); and an **Alaska Native Pre-service Teacher** ([6 mos/yr] UAF Education Student to be hired). This team will map outlined curriculum to verify thorough coverage of annual themes at targeted grade levels. Technology expert *Eric Muehling* ([2 mos/yr] MA Visual Communication; 25-yr instructor/multimedia developer) creates multimedia activities to augment classroom instruction.

**(2) Curriculum Drafting:** Webley collects and prepares data and remote sensing imagery, works with Cooper to incorporate data and imagery into technology-rich lessons, Schoening,

Norlin draft lessons blending Native and western perspectives (with input from the Alaska Native master and pre-service teachers). Muehling develops multimedia and Moodle interface.

(3) **Initial Review/Revision:** Findlay oversees Elder and scientist review of drafted lessons, related data sets, and multimedia. Curriculum developers incorporate feedback into lessons. Muehling incorporates feedback into multimedia and online resources.

(4) **Kit Assembly and Product Testing:** Curriculum developers work with the Native pre-service teacher to assemble kits containing all supplies necessary for classroom instruction. Muehling places online resources on the REACH website and tests web-based materials for consistent performance on multiple computer platforms and browsers.

(5) **Field Testing/Revision:** BSSD teachers test REACH curricular resources to discover if they are suited for use in BSSD classrooms and ascertain if REACH instructional objectives are being met. Throughout the year, teachers will complete review checklists to provide feedback that informs revision. Curriculum developers revise activities based on teacher feedback.

(6) **Publishing:** Publication designer *Lynda McGilvary* ([2 mos/yr] 15-yr publisher/graphic design) develops graphics, performs lesson layout and posts lessons on the REACH website.

(7) **Continual Improvement:** Continual review and refinement of REACH resources is achieved in three ways: (a) each supply kit sent to BSSD schools contains a postpaid feedback card to be completed by teachers and mailed to the GI; (b) curriculum implementation, review and feedback are all credit requirements of REACH PD; and (c) 15 lead teachers (one per BSSD school) attend the Culminating Workshop to provide feedback on REACH resources.

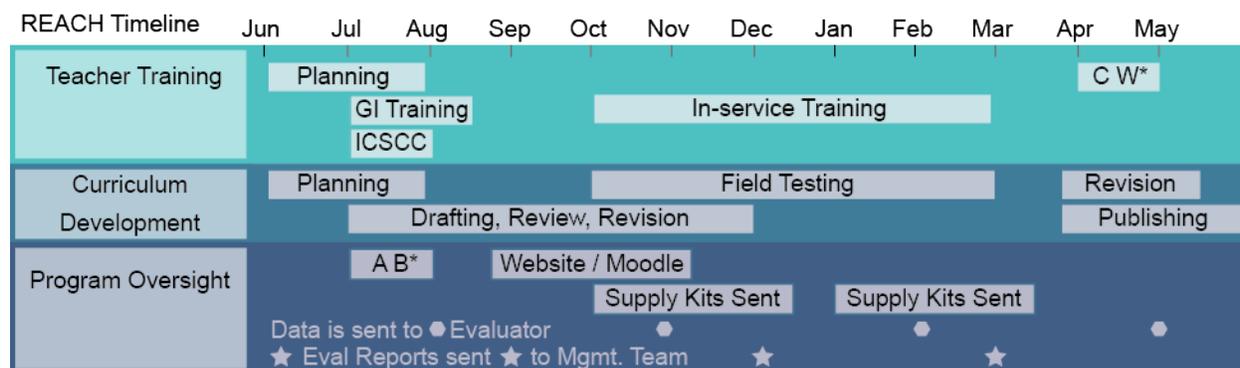
The Management Team works with consortium partners and master teachers to create PD that will be sustained by curricular resource enactment. Berry Bertram serves as PD course instructor. Consortium members designate STEM and cultural experts to provide lectures and

participate in PD. These experts also provide data and other resources for program use.

**External Evaluator Doug Crevensten** ([1.25 mos/yr] 40-yr teacher; 12-yr evaluator) designs evaluation instruments to gauge progress toward meeting REACH goals and objectives. He reviews all program activities, collects and analyzes data, provides feedback contributing to program revision and improvement, and produces annual and final evaluation reports.

While content themes for development and instruction change each year, major program activities and milestones occur all three years of the program according to an iterative schedule.

A **timeline showing major program activities and milestones** is provided below.



\* A B: Advisory Board Meeting; C W: Culminating Workshop

Not represented on the REACH Timeline are the PY3 culminating activities (Stewardship Projects and local Climate Expos). Lessons guiding student work on Stewardship Projects are developed in PY2 and enacted in PY3. Lessons preparing students for local Climate Expos are drafted in the fall of PY3 and enacted during the spring semester prior to local Climate Expos.

**(D) ADEQUACY OF RESOURCES:** REACH will serve 945 students and 79 teachers per year at an average annual cost of [REDACTED] per student. REACH offers in-depth PD to improve BSSD teacher effectiveness augmented by an extensive suite of flexible curricular resources that help K-6 teachers sustain culturally relevant STEM curriculum in their classrooms. All resources developed and field tested through REACH will be made accessible at no cost from the program website, ensuring broadened dissemination after grant end. The budget includes supplies for

BSSD schools, stipends for participating Native Elders, and stipends for an Alaska Native master teacher to participate in PD and offer cultural input into associated curricular resources. An Alaska Native pre-service teacher will assist the Native master teacher. This pairing is designed to provide mentorship for a Native pre-service teacher soon to join Alaska's teaching workforce.

REACH costs are reasonable when compared to a similar Nenana City Schools program (S356A110042). Resources and services provided by the Nenana program are similar to REACH, however REACH offers more extensive PD training and technology-based resources. The Nenana program operates at a higher annual cost of [REDACTED] per student. Some factors to consider when comparing these programs: REACH serves 15 high-poverty remote communities only accessible by small plane (airfare ~\$750), while the Nenana program serves one community on the road system 50 miles from Fairbanks. Not only is travel in and out of BSSD costly and time consuming, all supplies must be shipped by air, further increasing program costs. REACH per student costs are lower because valuable resources are leveraged to realize significant savings. For instance, consortium partners provide STEM expertise at no cost, since their involvement satisfies outreach requirements of their organizations. This significant cost savings reduces program expense and increases the value of services and products provided.

The UAF **Geophysical Institute** has adequate resources to perform the proposed effort. Established by an Act of Congress in 1946, the GI has built an international reputation for studying Earth and its physical environment at high latitudes, and for training students in related disciplines. The GI has 80 faculty members, 80 graduate students and 130 staff members. For over 15 years, the GI has successfully provided Alaska Native education programs throughout Alaska. The GI commits to providing classrooms, conference rooms/auditorium, office space and equipment. It authorizes its researchers to contribute content and data to the program, review

curricular resources, participate in PD activities, and serve on the Advisory Board. To ensure program sustainability, the GI will maintain the REACH website after grant end.

Also supporting REACH by providing scientific content, authentic data and cultural resources are the **Western Alaska** and **Northwestern Interior Forest Landscape Conservation Cooperatives (LCCs)**. These LCCs are part of a nationwide network of federal, state and local governmental agencies, Native tribes, nongovernmental organizations, and academic institutions concerned with assessing and mitigating climate changes in identified regions. Collaborative efforts make it possible to share expertise and personnel. In addition to sharing data, both LCCs have committed to offering mentoring by multi-agency partners to support BSSD teachers.

The REACH Alaska Native regional non-profit organization partner is **Kawerak, Inc.** Kawerak was incorporated under State Law in 1973 to provide services to Alaska's Bering Strait region. It seeks to improve the region's social, economic, educational, cultural and political conditions. Kawerak has committed to select the Alaska Native master teacher who will develop cultural lessons based on Kawerak's Eskimo Heritage Program resources. The Eskimo Heritage Program is a repository of photos, traditional music, and videos depicting the history and cultural activities of its Native people. Kawerak also operates the Beringia Museum of Science and Culture. The museum will provide a gathering place for REACH's Elder Summit.

UAF's **Alaska Native Knowledge Network (ANKN)** serves as a resource for compiling and exchanging information related to Alaska Native knowledge systems. The **Cultural Heritage & Education Institute (CHEI)** shares cultural knowledge, educates youth and adults on Native and non-Native cultures, and restores cultural sites and history. ANKN Director Barnhardt and CHEI Director Charlie will serve on the REACH Advisory Board. ANKN and CHEI also will recruit Elders to participate in REACH PD activities, share oral histories with teachers and

students, visit BSSD classrooms, and disseminate REACH products and findings at regional, state and national indigenous conferences; and link to REACH products from their websites.

The **Bering Strait School District** commits to integrating REACH summer intensive and year-long in-service teacher training into its annual PD plan, and to make REACH curricular resources an integral part of the district's K-6 math and science program. BSSD also has agreed to disseminate information about REACH at statewide and national education conferences.

The REACH program budget includes **salaries and wages** for program management, PD planning and delivery, curriculum development, multimedia/Moodle and website development, graphic design and publishing. Salaries and wages are adequate and reasonable based on the quantity and variety of educational services and resources to be developed (teacher PD annually resulting in 7 UAF credits that can be used toward attaining highly qualified status; 240 lessons, multimedia activities, digital lectures and supplies to sustain STEM training for future teachers).

**Travel** is budgeted for participants to travel to Advisory Board (Fairbanks) and Kawerak (Nome) meetings; the Elder Summit (Nome); GI Training (Fairbanks); Culture Camp (Unalakleet); the Introductory Workshop (Unalakleet); the Culminating Workshop (Fairbanks); and for the Alaska Native master and pre-service teachers to present at Bilingual Multicultural Education Equity Conferences (Anchorage). Travel costs within the state of Alaska are relatively high, but essential to this project due to the remoteness of the communities served and significant need for high-quality professional development in the district. Holding the Introductory Workshop in Unalakleet during mandatory district-wide teacher training reduces travel costs for the project. Advisory Board meetings take place in Fairbanks, where three of the four board members are based. When possible, telephone or online communication is used to limit travel.

**Supplies** are budgeted for summer institute activities, classroom supply kits, stewardship

projects, and computers for Elder use. Summer institute supplies include printed manuals, resource books and other material (i.e., notebooks, pens, etc.). Classroom supply kits are provided to all participating teachers to ensure schools can implement REACH instruction. BSSD villages do not have stores where educational supplies can be purchased, and schools in the district have limited funds for classroom resources. Supply kits contain re-useable items that bolster school resources and ensure program sustainability. Stewardship project supplies are provided in PY3 based on materials requested by teachers for student-designed projects. Stewardship projects are shared with the local community and exemplary projects are placed on the REACH website for broadened viewing. Five computers will be purchased for Elders participating in the Culture Camp. Elders will use computers to review curricular resources (including multimedia), communicate with program staff, and contribute data and observations to the Indigenous Knowledge Database.

**Contractual services** included in the budget provide for **lunches** for 7 participants at the annual Advisory Board meeting; **ground transportation, lodging and meals** for 51 people involved in GI Training, **meals** for the 51 people involved in the Culture Camp, **lodging** and **meals** for the 15 lead teachers attending the Culminating Workshop, and **evaluation services**. To save money, teachers will stay at the UAF Dorms during GI Training, and at the school in Unalakleet for the Culture Camp. Dorms are not available for the 15 teachers attending the Culminating Workshop, so they will stay at a local hotel.

**Other Expenses** include **honoraria** for Elders and the Kawerak-selected Alaska Native master teacher, **Express mail** service, and **UAF credit fees** for PD. Elders will be compensated for each 8-hour day they contribute to the program. The Alaska Native master teacher will be compensated for activities and meetings associated with PD coordination and instruction, and

curriculum development. Express Mail is used to mail student pre-/post-tests to the GI for assessment and evaluation and to ship supply kits to BSSD schools. UAF credits are budgeted to ensure all BSSD teachers can participate in PD, regardless of their economic standing.

**(E) QUALITY OF PROJECT EVALUATION:** External Evaluator *Crevensten* conducts REACH formative and summative evaluation. He works with the Management Team to acquire and analyze data related to project goals, objectives and performance measures. He oversees all data collection activities and develops quarterly reports including quantitative and qualitative data and recommendations for program revisions, modifications or new capacity-building strategies. Quarterly reports are shared with the Management Team and Advisory Board, who review results and collectively make program modifications. Annual evaluation reports summarize each year’s grant activities, impacts, and results. A final report is written at grant end.

During **formative evaluation**, the evaluator provides ongoing feedback to the Management Team on progress toward REACH objectives and offers advice on emerging issues. Driving questions are: Were project activities successfully implemented with fidelity? If not, why?

**Summative evaluation** addresses attainment of performance measures for each project objective. Driving questions in summative evaluation are: Were the intended outcomes attained? Were program performance measures met within the prescribed timeframe? If not, why?

Goal 1: Improve BSSD student STEM achievement in persistently low-achieving schools	
Objectives:	Summative Performance Measures:
1.1: Improve Alaska Native student performance on elementary STEM	(A) <i>Collect State student achievement data:</i> annual percentage of grade 3-6 students scoring proficient on Alaska Standards Based Assessments for Math/Science (GPRA measure 1.3). (B) Grade K-6 students show significant improvement between pre-/post-test scores

assessments.	of climate knowledge (from indigenous and western perspectives).
1.2: Provide accurate, culturally relevant standard-based STEM curriculum.	(A) Elder curriculum reviews indicate accurate portrayal of indigenous science/language. (B) Scientist reviews of curriculum indicate scientific accuracy. (C) REACH core content, process, & presentation lesson plans identify appropriate AK Cultural Standards and GLEs.

Summaries of district-wide and school-specific SBA scores are published on the Alaska Department of Education and Early Development website each January. During formative evaluation, current SBA scores of student participating in REACH will be compared to those from the previous year. At grant end, PY3 scores will be compared to pre-program scores for summative evaluation of overall program impact. The Management Team will supply the Evaluator with identity-shielded student scores on pre-/post assessments of climate knowledge, Elder and scientist review forms, and lesson plans upon completion.

Student pre- and post-test scores will be analyzed using the Wilcoxon Signed Rank test to determine significant improvement. Data will be disaggregated to ensure students in BSSD’s 7 persistently lowest achieving schools show improvement comparable to their peers in the rest of the district. Document review of Elder and scientist review forms & lesson plans will determine if revision is needed (formative) and to what extent this objective was met (summative).

Goal 2: increase the number of BSSD teachers providing culturally relevant STEM instruction.	
Objectives:	Performance Measures:
2.1: Increase Teacher STEM content knowledge.	(A) Teachers show significant improvement in scores between pre- & post-tests of climate knowledge after the summer institutes. (B) REACH online Discussion Forums include content-rich questions and answers.

2.2: Improve Teacher pedagogy for instructing AK Native students & STEM self-efficacy	Teacher pre-/post-surveys show: (A) improved understanding of best practices for instructing Native students; and (B) increased confidence in instructing about climate change. (C) More than 80% of participating teachers achieve passing grades in REACH PD. (D) Case studies conducted by evaluator indicate effective pedagogy and self-efficacy.
2.3: Provide culturally relevant STEM curriculum that is effective for Native students.	1.1 Performance measures, plus: 240 REACH curricular resources: (A) include western and indigenous climate knowledge; and (B) embed best practices for instructing Native students. (C) Teacher surveys show that lessons, multimedia, lectures and Stewardships Projects are effective for increasing Native student STEM engagement and achievement.

The Management Team will supply the evaluator with identity-shielded teacher pre-/post-test and survey data and PD course grades. Teacher climate knowledge pre-/post-test scores will be analyzed for significance using the same methods employed for the student test. Descriptive statistics will be used to analyze teacher surveys, combined with content and frequency distribution analyses of teacher training materials to correlate survey findings to the training events.

The technology expert will provide the Evaluator with a login to view REACH online discussion forums in which Elders and scientists offer mentoring support to BSSD teachers. The evaluator will use qualitative content analysis to determine the extent to which teacher – mentor discussions were rich and informative. The evaluator will randomly select two BSSD teachers attending the Culminating Workshop with whom to conduct case study interviews. Interviews will be transcribed and content analysis will be used to understand case study results.

Frequency distribution analysis of lesson plans will reveal how often key words related to western and indigenous climate knowledge and best practices arise. Document review with

descriptive statistics will provide a picture of the extent to which resources meet this objective.

Goal 3: Prepare Native youth to be leaders in finding solutions to climate issues.	
Objective:	Performance Measures:
3.1: Train Native youth to propose solutions to local climate changes.	(A) Stewardship & Climate Expo lessons offer instruction in oral presentation, inquiry-based learning, critical thinking and leadership skills identified by program partners. (B) Stewardship projects occur at all 15 schools. (C) Climate Expos are held at all 15 schools in PY3.

The Management Team supplies the Evaluator with Stewardship & Climate Expo lessons for document review. Lead teachers attending the PY3 Culminating Workshop share Stewardship Project and Climate Expo results with the Evaluator. Lead teacher reports are compiled and evaluated using descriptive statistics to determine the extent to which the project was successful in training BSSD youth to become leaders in finding solutions to climate change problems.

**COMPETITIVE PREFERENCE PRIORITY POINTS:** REACH addresses three areas of competitive preference: **Priority 1** (consortia with Alaska Native Regional Nonprofit Organizations); **Priority 2** (improving the effectiveness of teachers in persistently lowest-achieving schools by offering PD that contributes to teacher attainment of highly qualified math and science certification, by creating curricular resources that encapsulate REACH PD and make sustained classroom enactment of REACH teacher training possible for current and future teachers; and by collecting State data showing that REACH teacher training fostered increased student achievement); and **Priority 3** (turning around persistently lowest-achieving schools by providing services that increase student achievement, foster community involvement in academia, build mentoring communities that support rural teachers in isolated areas, and prepare Alaska Native students to assume leadership roles in educational activities and future careers).