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**NORTH AMERICAN NATIVE RESEARCH
AND EDUCATION FOUNDATION, INC.**

AMERICAN INDIANS IN STEM



The Montana American Indian in Math and Science (MT-AIMS) program is requesting funding through the Education Innovation and Research competition to support an Early Phase grant. This project is a partnership between the North American Native Research and Education Foundation (NANREF) and the University of Montana (UM) to serve Native American students from 6th – 10th grade, our identified high need student population. The project Demonstrates a Rationale and will utilize Field Initiated Innovations in improving and expanding STEM learning and engagement (Absolute Priorities 1 and 2). MT-AIMS will develop a STEM learning program targeting Montana’s Native American youth that will increase their competency and persistence in STEM fields. The long-term vision of the AIMS program is to provide linked STEM programming to Native American students across the country, from sixth grade through their freshman year in college, and continued support through pursuit of a Ph.D. This project will implement the first, early phase of development towards this vision by creating learning experiences for students in grades 6 through 10 in Montana. The project will address the significant gap in participation of Native Americans in STEM fields by increasing the number of Native students who are prepared to succeed in STEM at the university level.

A. Project Design

A1: Goals, Objectives, and Performance Measures

The goals for the MT-AIMS EIR *Early Phase project* are the following:

Table 1: Goals, Objectives, and Performance Measures	
<u>Goal 1:</u> Develop a longitudinal program for Montana American Indian (AI) students from 6 th through 10 th grade	
<i>Objective 1.1:</i> Develop and Implement MT-AIMS Gatherings , a 12 day summer module for middle school students (grades 6-8)	
<i>Performance Measure (PM) 1.1a:</i> 42 student participants from two MT reservations will partake in MT-AIMS Gatherings in Year 1.	<i>Performance Measure (PM) 1.1b:</i> 54 student participants from all MT reservations will partake in MT-AIMS Gatherings by Year 5.
<i>Objective 1.2:</i> Develop and Implement MT-AIMS Journeys , a 6-day summer module for middle school students who have completed AIMS <i>Gatherings</i> (grades 7-8)	

<i>PM 1.2a:</i> 20 students will return for MT-AIMS Journeys for one week in Year 1	<i>PM 1.2b:</i> 54 returning students will partake in MT-AIMS Journeys by Year 5
<i>Objective 1.3:</i> Develop and Implement MT-AIMS Pathways , a 12-day summer module designed for 9 th and 10 th grade students	
<i>PM 1.3a:</i> 10 high school students will partake in MT-AIMS Pathways in Year 1	<i>PM 1.3b:</i> 54 high school students will partake in MT-AIMS Pathways by Year 5
<i>Objective 1.4:</i> Develop and Implement Academic Year Follow Up with Participants	
<i>PM 1.4a:</i> All participants will be personally visited at least once per quarter	
<u>Goal 2:</u> Increase the competency of AI Middle School students in Math and Science.	
<i>Objective 2.1:</i> 75% of MT-AIMS Gatherings and Journeys participants will complete Algebra 1 by 8th grade.	
<i>PM 2.1a:</i> Tracking student completion of Algebra 1 by 8th grade with a C or better.	
<i>Objective 2.2:</i> 75% of MT-AIMS Gatherings and Journeys students will be Proficient or above Proficient in Math and Science.	
<i>PM 2.2a:</i> Tracking student standardized test scores in Math.	<i>PM 2.2b:</i> Tracking student standardized test scores in Science
<u>Goal 3:</u> Increase the competency of AI High School students in Math and Science.	
<i>Objective 3.1:</i> 75% of MT-AIMS Pathways participants will complete Chemistry, Physics, and Trigonometry by high school graduation.	
<i>PM 3.1a:</i> Tracking student completion of Chemistry, Physics, and Trigonometry by graduation with a C or better.	
<i>Objective 3.2:</i> 75% of MT-AIMS Pathways students will be Proficient or above Proficient in Math and Science.	
<i>PM 3.2a:</i> Tracking student standardized test scores in Math	<i>PM 3.2b:</i> Tracking student standardized test scores in Science
<u>Goal 4:</u> Inform STEM educational community on effective practices for AI students	
<i>Objective 4.1:</i> Examine the effectiveness of building a community among AI students.	
<i>PM 4.1a:</i> 75% of participants interact with other participants throughout the year.	<i>PM 4.1b:</i> Participants with higher interactions will generally have higher GPA and Scores
<i>Objective 4.2:</i> Examine the effectiveness of culturally responsive pedagogy among AI students.	
<i>PM 4.2.a:</i> 75% of participants will respond favorably to activities with infused cultural content (above 3 on a 1-5 Likert scale)	
<i>Objective 4.3:</i> Disseminate results to a national audience – at least 5 articles published and 7 presentations given within 2 years after the grant has ended.	
<i>PM 4.3a:</i> Number of articles published and presentation given in workshops and conferences	
<u>Goal 5:</u> Plan expansion of program to other communities and grade levels.	
<i>Objective 5.1:</i> Identify at least 7 more communities for expansion	
<i>PM 5.1a:</i> Number of Tribal communities contacted	
<i>Objective 5.2:</i> Identify sustainable and replicable measures	
<i>PM 5.1a:</i> Number of grants submitted – at least 6	<i>PM 5.1a:</i> Number of businesses/corporations contacted – at least 10 with University of Montana Foundation assistance

The project will include five program components: *AIMS Gatherings*, *AIMS Journeys*, *AIMS Pathways*, *Academic Year Activities*, and a *Research Component*. The consecutive summer modules – *Gatherings*, *Journeys*, and *Pathways* - will create a community of MT-AIMS students, and build a pathway for academic opportunity and success in STEM. Academic Year Activities will provide follow up for program participants, and link out-of-school informal learning experiences with school-based experiences and help motivate participants to meet math and science performance benchmarks. These program components, along with the research component, are the field-innovation strategies that will be employed for addressing and accommodating the particular needs of Native American students in Montana.

A.2 Addressing the Needs of Native Students

Native Americans are critically underrepresented in our Nation's STEM enterprise. In 2017 in the United States, only 112 American Indians and Alaska Natives (AI/AN) earned a doctorate degree in Science and Engineering (S&E), which is only 0.2% of all doctorates awarded in that year, even though AI/AN individuals make up 1.7% of the US population. This is a *decrease* from the number of doctorates awarded in 1992 where 149 were AI/AN students¹. Gains have been made with African Americans and the Hispanic population during this time, but not among AI/AN students.

Clearly, there is a tremendous need for assistance with our targeted *high need* group, Native students, from primary through graduate school, that will be served through this program. It is not just that progress has been leveling off, but it appears that we are taking a step backward among our Native population in education that is very nearly, if not clearly, at crisis level. This is despite many millions of dollars spent in support of programs that have served a high percentage of AI/AN students for over 30 years. A promising, evidence-based, new strategy is

needed to help our Native students. The MT-AIMS project will focus on increasing STEM engagement for Native Americans through early-phase project development in the state of Montana, which is home to ten federally recognized tribes and seven reservations. Once the project is piloted in Montana, it can be replicated and scaled to other regions as well.

One of the primary obstacles facing Native American students in Montana is fluency in mathematics and basic science, cornerstone disciplines for all STEM subjects. Among American Indian Students in the Montana University System (MUS-does not include tribal colleges), remediation rates in math during 2012-2017 averaged about 43%². Nationally, only 31% of students who are referred to a developmental math sequence complete it, and less than 25% of remedial students at community colleges earn a degree or certificate within 8 years^{2,3}. This is demonstrated by the completion rate of Native students, with only 60% completing their degree(s) within four years, compared to 85% of their non-Native counterparts.

Colleges and universities primarily address this issue through offering more or larger remediation classes; however, the real issue lies within the preparation of students in K-12. There are just over 20,000 American Indian students enrolled in Montana's K-12 public schools which represent 14% of all students in the State. Only 17.7% of American Indian students were proficient in Math in 2017 compared to 45% of white students in Montana's statewide Smarter Balanced Assessment (SBAC). Science scores on the Science Criterion Reference Test (Science CRT) rank low as well with only 33.2% acquiring proficient status compared to 67% for white students². One of the most concerning statistics reported by Montana's Office of Public Instruction is that 57 American Indian students took at least one AP exam in 2016-2017, but only 12 (twelve) tests total scored a 3 or higher *in the entire state*! This compares to the nearly 1,200 non-Native students who passed an AP exam² within the same time period.

To address the issue and reduce the necessity for remediation among Native students, we have designed a comprehensive program consisting of five distinct components, which will incorporate place-based, community-centered practices. Such practices are essential for any program that will meet the needs of Indigenous students⁴.

The first three program components - *AIMS Gatherings*, *AIMS Journeys*, and *AIMS Pathways* - are summer modules. These modules are residential programs geared towards different age and experience groups of Native students. Programming will rely on three different learning frameworks: (1) **STEM Workshop**, involving student-directed learning and focuses on a cumulative group or individual project under the supervision of a mentor; (2) **Exploration Lab**, featuring instructor-led experiential learning on STEM topics related to the overall theme; and (3) **Field Experiences**, consisting of lab tours, site visits, and occasional day excursions. The activities within the three learning frameworks are supplemented with group meals, outings, and relaxed time, all of which are essential in building relationships among participants and mentors, and supporting the learning community that is essential for long-term student success. Central to all of these activities are a morning and evening circle – a time for the group to convene and recognize each person individually, set goals, and consider opportunities.

Summer modules will be based on the UM campus, exposing participants to the university environment and campus life. Native graduate and undergraduate students will serve as mentors/counselors in the program, and as natural role-models. Participants will develop a sense of place in the university environment and their identity as a STEM-learner and member of the MT-AIMS learning community. Indigenous content will be infused into these programs through involvement of tribal members in curriculum development. Montana Natives have a unique sense of place that is based on their surrounding landscape; MT-AIMS will incorporate

this in all summer modules through thematic emphasis on topics and issues related to the natural world and with local cultural or traditional relevance.

Component 1: *AIMS Gatherings* is a 12-day residential program for rising 6-8th graders, which is closely modeled after the ANSEP program's *Middle School Academy*. This will begin in Year 1 and will lay the foundation for other MT-AIMS programs. Students will build their own computers during the first days of the camp, which they will use throughout the 12-day program to engage in program content (see Table 2 for an outline of program content). Upon completion of the course, students will take home the computers, and will be able to keep the computer they built, provided that they have completed Algebra 1 by the end of 8th grade.

Component 2: *AIMS Journeys* is offered for returning *AIMS-Gatherings* students. *AIMS Journeys* is a 6-day learning experience that focuses on a single project in addition to exploring a variety of STEM fields through field trips and lab visits. Camp activities center around the *STEM Workshop* framework, providing hands-on, inquiry-based experiences designed to keep students involved in the learning community and focused on the goal of completing Algebra 1 by 8th grade. The topics for the camp project will be rotated each year so that an incoming 6th grade student who completed *AIMS Gatherings* will experience a different focus for their 7th and 8th grade years before moving on to the *AIMS Pathways* program for high school students.

Component 3: *AIMS-Pathways* is modeled after the *ANSEP Acceleration Academy*. *AIMS Pathways* is a project-based, 12-day summer module, centering on a theme that alternates every year, serving rising 9th and 10th grade students across Montana and beginning in year 2. 54 students in each program is the goal with 1:6 counselor to student ratio and approximately equal number of girls and boys.

Table 2: AIMS Gatherings – grades 6-8. 42 students in Year 1. 54 by year 5.
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Montana American Indian Math and Science

STEM Workshop	Group project focusing on water, analyzing two local rivers; activities include data collection and analysis and introduce hydrology, watersheds, climate, and water quality;
Exploration Lab	Demos and inquiry-based, hands-on learning on fundamental concepts in chemistry, physics and biology; activities are mentored by Native grad and undergrad students;
Field Experiences	Lab tours on the UM campus; half or multi-day excursions to National Bison Range, Flathead Lake Biological Research Station, and Missoula Fire Science Laboratory;
AIMS Journeys – grades 7-8. 20 students in Year 2. 54 by year 5.	
STEM Workshop	Topics alternate on a yearly basis; first cohort will focus on 3-D printing
Field Experiences	Visit research labs and field sites (see Field Experiences for Gatherings)
AIMS Pathways – grades 8-10. 10 students in Year 2. 54 by year 5.	
STEM Workshop	Small group project building alternative-power vehicles to be entered into a competition at the end of the module;
Exploration Lab	Topic rotates annually; first cohort will explore alternative energy through mentored hands-on inquiry-based learning activities;
Field Experiences	Visit research labs and field sites (see Field Experiences for Gatherings)
It is anticipated at least 280 unique students served , most receiving multiple programming. Represents about 6% of the total number of Native American middle school students (4825) in the entire state ² .	

It should be noted that a pilot program of AIMS Gatherings was implemented the summer of 2019 with a small amount of donor funding. Nineteen middle school students from the Blackfeet and Navajo nation completed the two-week program with additional follow up during the academic year. Monthly meetings with students were conducted with grade checks and linking students to tutoring where needed. For the first semester of the 2019-2020 academic year, all AIMS students passed their classes. Follow up meetings continued at the start of the second semester, but were halted as COVID-19 hit these communities hard. Standardized testing was not done in the spring due to remote learning on the reservations. This cohort was poised to come back to experience AIMS Journeys, but were unable due to the tribes not allowing their students to leave the reservation. Other Native communities in Montana were also ready to come as a new cohort of Gatherings students, but also had to cancel due to COVID-19 concerns. Only a small cohort of 8 students attended from the Flathead reservation. The need and momentum

are there, but we are still very much in the early phase of the program, ready to take the next step

Component 4: *Academic Year Activites*, focus on strengthening community and relationships. As is further described in section A.3. of this proposal, this is of utmost importance to Native families, as their connection to their community and the land on which they've grown is binding. MT-AIMS program components combine a series of intensive short-term experiences away from home in the University setting with follow up visits by mentors and program personnel to the students' home schools and communities. The result over time is the creation of a community away from their homes in which these students can thrive, and a bridge back to their home community on the reservation. Building the bridge between MT-AIMS and the home community is a critical part of overall program success.

High school and middle school students who have completed the MT-AIMS programs will be visited at least once a quarter by the program coordinator. The goals of these visits are to foster and build relationships between the AIMS community and both the student and their home community, to assess student progress, and to help the student connect learning experiences across settings. This will also provide an opportunity for the program coordinator to visit with the schools and teachers regarding education strategies, building collaboration and the support network for these students, while developing an understanding for the student's home that can only be gained through firsthand experiences.

Student success in their home-school will be incentivized through monthly stipends. The stipends will be based on satisfactory progress towards the completion of Algebra 1 by 8th grade and progress towards completing chemistry, physics, and trigonometry in high school. For schools that have more than one student in the program, incentives will be implemented that will reward the group if all of them collectively are making satisfactory progress towards their

requirement, such as group dinners or lunches. This will help deepen the sense of community among participants, motivating them to work together to achieve higher standards.

Select high school students will also be afforded the opportunity to travel to a STEM-related event such as the American Indian Science and Engineering Society National Conference or to a NASA center. This event will provide a way for students to self-identify as future scientists or engineers in a real-world setting and is designed to provide another form of motivation for continuing progress in their classes and continue to build community. Students will attend with teachers from their respective schools through an application process that will be submitted to the MT-AIMS program. This opportunity will begin in the 4th year of the program.

Component 5: *Research* will be implemented during the academic year through tracking and surveying of students involved in the program. The *Research* component, detailed in section C, Evaluation, will examine the extent to which building a community of students and using culturally responsive pedagogy impacts student success.

A.3: Up-to-Date Knowledge and Research Practices

Our project aims to increase social and academic preparedness among Native students, advance collaboration with Tribal communities, and improve recruitment and retention of Native students at the University level. MT-AIMS demonstrates a new strategy to address Absolute Priority 1: Demonstrates a Rationale and Absolute Priority 2: Field Initiated Innovations because it: 1) is based on evaluation of a successful model and is therefore likely to improve Native STEM achievement, and 2) will develop, implement, and take to scale an evidence-based, field initiated, and innovative program that will improve achievement and attainment for Native American students, our identified high-need population. A conceptual framework for the effectiveness of the proposed research and activities is based on the following theory of action.

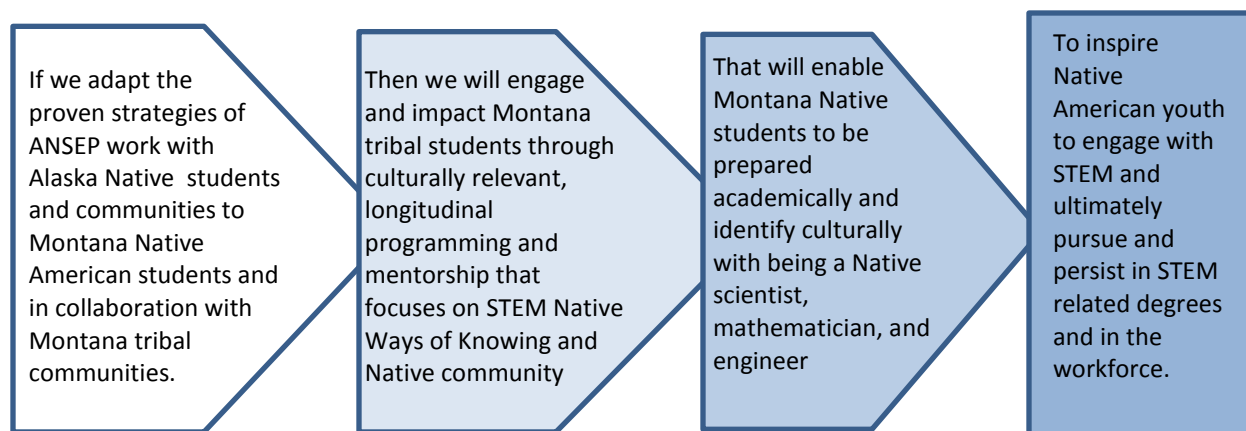


Figure 1: Theory of Action

Community is one of the foundations of tribal identity, and therefore an essential element of the MT-AIMS program. Cajete, in his book *Native Science*⁴, notes that “Relationship is the cornerstone of tribal community, and the nature and expression of community is the foundation of tribal identity. Through community, Indian people come to understand their ‘personhood’ and their connection to the ‘communal soul’ of their people.” Native people have a connection to their tribal and cultural identity through their relationships that go beyond immediate family members and include grandparents, aunts, uncles, cousins, elders, and those of the same clan and related clans. Building and maintaining relationships among Native people is important in the advancement of students in education, knowledge, and personal growth.

Incorporating community and Native Ways of Knowing through Indigenous content into the learning environment are asserted as two of the primary components that make ANSEP successful with Alaska Native students. Research suggests that productive STEM learning opportunities provide hands-on exploratory and place-based learning where youth can investigate the world around them in a supportive environment^{5, 6}. Youth are also more likely to pursue and persist in learning a topic or skill that is relevant and valuable to their own experiences^{7, 8}. A

supportive learning community encourages students to develop their own questions and explore the unknown⁹. These recommendations and findings, along with the demonstrated success of the ANSEP program (summarized in Table 3), suggest that by more deeply incorporating Indigenous values through programming content, approach, and community development, greater impact can be achieved when working with Native students.

MT-AIMS builds upon evidence from the Alaska Native Science and Engineering Program (ANSEP) at the University of Alaska Anchorage. ANSEP has successfully addressed math and science literacy and STEM preparedness by engaging middle and high school Alaska Native students in a series of STEM learning activities and has substantially impacted Math level completion rates of participants to be well above the national average¹⁰ (see Table 3 below).

ANSEP has evolved into a longitudinal education model that provides a continuous string of components beginning with students in sixth grade, continuing on through high school, into engineering and science undergraduate majors, and through graduate school to the PhD. The model represents 20 years of effort and has been developed with the awareness that a fragmented approach focusing on one academic level is not adequate to deal with the scope of the problem and ultimately falls short. ANSEP began in 1995 with only one student and now has over 1,250 middle school, high school, university students and alumni that represent 95 Alaskan communities. The ANSEP program demonstrates practical implementation of many recommendations from the informal learning community of practice, including engaging young learners intellectually, socially, and emotionally, through supportive learning communities and experiences that connect them with their own cultural practices and beyond the boundaries of a school setting. The Urban Institute¹⁰ completed a 246 page evaluation report in 2015 on the ANSEP program.

Table 3: Urban Institute Summary of Significant Findings

1. Since 2010, 479 students have participated in Middle School offerings. Of the 263 that have completed 8 th grade, 203 of them have passed Algebra 1 with a C or higher. The 77% completion rate of Algebra 1 compares to the 49% of Alaska Natives who enroll pass Algebra 1, 69% of White students in Alaska, and 26% of all students nationally complete Algebra 1 by 8 th 5
2. Since 2010, 189 high school students have participated in ANSEP programs. 95% of these students have advanced 1 level or more of math or science each summer.
3. 67% of students served by ANSEP as undergraduates have either graduated (35%, n=177) or are still enrolled (32%, n=207) in STEM disciplines. This compares to a 53% retention rate of Alaska Natives over all disciplines at the University of Alaska Anchorage.
4. Of 67 ANSEP alumni contacted, 66 (98%) were employed and 58 (87%) of those employed in STEM or STEM related fields. This compares to 8.8% employment nationally in STEM fields by Alaska Native/American Indian/Native Hawaiians ⁶ .

The program has only continued to grow since the evaluation, and other programs comparable to ANSEP show similar effects^{5, 11-13}.

A.4: Contribution to Increased Knowledge and Understanding

The MT-AIMS project incorporates and builds on aspects of the ANSEP model and will take it a step farther by researching to what extent the following elements impact an individual student and overall program success: (1) infusion of Indigenous content and values and (2) establishing a community of learners. Results of this research will inform the community of practice for broadening participation of Native students in STEM as well as the evolving program architecture and content for MT-AIMS. The program will be tailored for Montana's Native American youth— geographically dispersed across a large rural state.

This program will serve as an innovative model for other states with large Native populations to prepare Native American students for college-level classes and undergraduate STEM education. MT-AIMS will build knowledge and contribute to the research community on informal learning, building on the findings from ANSEP evaluation and ultimately providing a foundation for whole-scale change in the way that these underrepresented students are educated.

The project will develop and refine an evidence-based model that has the potential to reach many other rural, low-income, first-generation students in states with a similar demographic, ultimately broadening the participation of Native Americans and other groups in STEM fields.

The incorporation of indigenous content and an emphasis on the development of learning communities are promising new strategies for STEM education for Native students in Montana. The majority of Montana's K-12 Native students live in a geographically isolated and extremely rural setting, significantly impacting resources, opportunities, and relevance of STEM learning experiences. They have very few Native STEM role models and often students who are interested in STEM subjects lack a peer group or community who share the same interests. Native students in the Montana public K-12 school system are receiving minimal content that is relevant to their indigenous background and resources on reservations are scarce for the development of targeted STEM curriculum incorporating indigenous content.

In addition, helping students identify in STEM is important as students with positive STEM-based identities perform better academically and are more likely to persist in schooling, earn a degree, and stay in a STEM field (Hartman & Hartman, 2006; Seymour & Hewitt, 1997; Townley et al., 2013). However, it is not sufficient to entirely focus on the development of STEM-based identities alone as such a focus can potentially erase students' histories and valued personal/cultural identities. It is best to integrate STEM-based identities with Native ways of knowing so that STEM does not clash with with personal/cultural identities that may put students in "untenable epistemological positions that work against engagement" in STEM (Bang, Warren, Rosebery, & Medin, 2012, p. 304). This may be particularly significant for students from rural communities. The majority of the work on this topic has focused on African American and Latinx students; students from rural and NA communities are particularly understudied¹⁸⁻²⁰.

Given the overrepresentation of rural individuals and NAs in Montana, our project is poised to make contributions to this important, but understudied, area.

B. Management Plan and Resources

B.3 Key Project Personnel Qualifications

The MT-AIMS project leaders will be Dr. Ed Galindo (PD), Yaqui, who is an affiliate faculty with the University of Idaho and Director of North American Native Research and Education Foundation Inc. (NANREF) and Dr. Aaron Thomas (Co-PD), Navajo, who is an Associate Professor in Chemistry at UM and also the Director of Indigenous Research and STEM Education (UM IRSE). As PD and Co-PD, they will oversee the development and implementation of the project, including program development, recruitment of student participants, hiring of coordinators and mentors, and working with student participants. Drs. Galindo and Thomas have joint experience running programs for middle school students through their time in Idaho implementing *NASA's Summer of Innovation* on tribal reservations and towns with high populations of Hispanic students in Idaho, Wyoming, and Utah. In addition, Dr. Thomas has developed relationships with and conducted programs in Montana on each reservation and schools with Native middle school and high school students.

Project Leadership will receive support from Herb Schroeder, the founder and director of ANSEP. Dr. Galindo, Dr. Thomas, and Dr. Schroeder have worked together for the past 12 years looking to implement and expand ANSEP concepts in other states. Dr. Frederick Peck from the UM mathematics department will also serve as major faculty contributor. Dr. Peck's research is in mathematical education and will be instrumental in linking activities with math proficiency and in the development and implementation of the research portion of the project. Together, Drs. Galindo, Thomas, Schroeder, and Peck make up the Project Leadership Team (PLT) and will

meet quarterly (via video conference and in-person when possible) to oversee all components of the project including design and content of summer modules, academic-year follow-up, and project research. A Program Coordinator (PC) will also be hired as part of the program. This person will be recruited from a Native community and have the qualifications to assist with the research component of the project. In addition, an half-time academic support specialist will be funded to help with logistics and budgeting.

Summer programming will also include counselors whose primary responsibility is the safety of the participants, but also will lead community based programming. Training will be provided to the counselors by Co-PD Thomas and the PC during a one day event prior to the summer activities. In addition, counselors from ANSEP will be a part of the summer programming in Years 1 and 2 to help with development of the programming and training in best practices. Workshop leaders will be used to run STEM based activities during the summers, with a focus on Indigenous content woven into the content. These leaders will be University or tribal college graduate students and faculty who will work closely with the PLT in developing and implementing the activities. Finally, Math, Science, and Writing instructors will be for the Pathways program in helping further develop skills in these disciplines with a Native focus. These instructors will also be trained by the PLT. The counselors, workshop leaders, and instructors will possess appropriate experience and credentials to work with students effectively.

B.2. Costs

Costs associated with the education of Native American students in Montana tend to be higher than other groups. This is primarily due to the rural nature of Montana tribes where the over 4,000 Native middle school students reside over an entire state, instead of in one school district as is the case in larger cities with easier access to more underrepresented students.

However, this presents an opportunity to influence an entire state in terms of its education of Native students and serve as a model for other rural states with Native populations. Further, whereas gains have been made with Latinx and African American groups, there have not been similar gains with Native populations, especially in STEM. In many cases, STEM achievement has regressed over the years, so a new model is needed to reach this unique population.

Montana is extremely large – nearly 150,000 square miles, with Tribal communities dispersed throughout the state. Many of the seven reservations are remotely located and sparsely populated, and only one, the Flathead Reservation, is less than a 200-mile drive from the University of Montana. This rural nature poses a unique challenge for program implementation. While the primary number of students served in AIMS summer modules is likely smaller than STEM programs serving our urban counterparts, MT-AIMS students will receive a concentrated and focused experience and return to their tribal communities and schools with new perspectives. Over the course of the project, the student participants will be part of the MT-AIMS culture of learning and achievement, and bring these values back to their communities and schools, impacting a larger student population across a large rural state.

B.1. Management Plan

Dr. Ed Galindo (PD) and Dr. Aaron Thomas (Co-PD) will oversee the implementation of all project components in collaboration with the Project Leadership Team and in consultation with the External Advisory Team (see section B.4 below). Table 3 outlines project goals, objectives, performance measures, activities, timeline, and responsible personnel.

Table 4: Management Plan

Activities	Start	End	Responsible
GOAL 1: Develop a longitudinal program for Montana American Indian (AI) students from 6th through 10th grade.			
Objective 1.1: Develop and Implement <i>MT-AIMS Gatherings</i> (grades 6-8)			

Activities	Start	End	Responsible
Performance Measure (PM) 1.1a: 42 student participants from two reservations will partake in MT-AIMS Gatherings in Year 1.			
PM 1.1b: 54 students \ from all reservations will partake in MT-AIMS Gatherings by Year 5			
Activity 1.1.1: Hire a program coordinator	1/1/2020	2/1/2020	Project Director (PD)
Activity 1.1.2: Recruit Students	1/15/2021 each year	5/30/2021 each year	PD and Program Coordinator (PC)
Activity 1.1.3: Hire counselors and workshop leaders	1/15/2021 each year	5/30/2021 each year	PD and PC
Activity 1.1.4: Develop culturally relevant program	3/1/2021 each year	5/30/2021 each year	PD, PC, and Workshop Leaders (WL)
Activity 1.1.5: Implement Program	6/1/2021 each year	7/30/2021 each year	PD, PC, WL, and Counselors (C)
Activity 1.1.6: Implement surveys to students, WL, and C.	7/1/2021 each year	8/30/2021 each Year	PD and PC and Evaluation Team (ET)
Objective 1.2: Develop and Implement <i>MT-AIMS Journeys</i> (grades 7-8)			
PM 1.2a: 20 returning students will partake in MT-AIMS Journeys for one week in Year 1			
PM 1.2b: 54 returning students will partake in MT-AIMS Journeys by Year 5			
Activity 1.2.1 - Activity 1.2.6	Same timing as above except starting in Year 2.	Same Personnel responsible as above.	
Objective 1.3: Develop and Implement <i>MT-AIMS Pathways</i> (grades 9-10)			
PM 1.3a: 10 high school students will partake in MT-AIMS Pathways in Year 1			
PM 1.3b: 54 high school students will partake in MT-AIMS Pathways by Year 5			
Activity 1.3.1 - Activity 1.3.6	Same timing as above except starting in Year 2.	Same Personnel responsible as above.	
Objective 1.4: Develop and Implement <i>Academic Year Follow Up</i> with Participants			
PM 1.4a: All participants will be personally visited at least once per quarter			
Activity 1.4.1: Schedule meetings with each student	Oct, Jan, March, and May	Each Year	PD and PC
Activity 1.4.2: Schedule tutoring as needed.			
Activity 1.4.3: Deliver stipends for students passing science, math, and writing classes			
Activity 1.4.4: Have group celebration if all students at location have C or better.			
Goal 2: Increase the competency of AI Middle School students in Math and Science.			
Objective 2.1: 75% of participants will complete Algebra 1 by 8th grade.			
PM 2.1a: Tracking student completion of Algebra 1 by 8th grade with a C or better.			

Activities	Start	End	Responsible
Activity 2.1.1: MT-AIMS Gatherings Program	3/1/2022	9/1/2025	PD and PC
Activity 2.1.2: MT-AIMS Journeys Program for returning students	3/1/2022	9/1/2025	PD and PC
Activity 2.1.3: Survey student participants and make changes and improvements.	7/15/2021	9/1/2025	ET, PD, and PC
Objective 2.2: 75% of participants will be Proficient or above Proficient in Math and Science. PM 2.2a: Tracking student standardized test scores in Math. PM 2.2b: Tracking student standardized test scores in Science.			
Activities 2.2.1 and 2.2.2	Same Timing		Same Personnel
Activity 2.2.3: Collect standardized scores from school districts.	5/30/2021	9/30/2025	PD and PC
Goal 3: Increase the competency of AI High School students in Math and Science.			
Objective 3.1: 75% of MT-AIMS Pathways participants will complete Chemistry, Physics, and Trigonometry by high school graduation. PM 3.1a: Tracking student completion of Chemistry, Physics, and Trigonometry by graduation with a C or better.			
Objective 3.2: 75% of participants will be Proficient or above Proficient in Math and Science. PM 3.2a: Tracking student standardized test scores in Math PM 3.2b: Tracking student standardized test scores in Science			
MT-AIMS Pathways Program	Similar to Goal 2 for high school starting in year 2.		
Goal 4: Inform STEM educational community on effective practices for AI students			
Objective 4.1: Examine the effectiveness of building a community among AI students. PM 4.1a: 75% of participants interact with other participants throughout the year. PM 4.1b: Participants with higher interactions will generally have higher GPA and Scores			
Activity 4.1.1: Survey students on their level of interaction with other students	Continually during student visits		PI, PD, PC
Activity 4.1.2: Link interaction level to GPA and student scores.	End of each academic year		PI, PD, PC
Objective 4.2: Examine the effectiveness of culturally responsive pedagogy. PM 4.2.a: 75% of participants will respond favorably to activities with cultural content			
Activity 4.2.1: Develop rubric to measure cultural content	01/01/21	06/01/21	PI, PD, PC
Activity 4.2.2: Survey student’s response to all activities.	At the end of each summer activity		PI, PD, PC, WL, Counselors
Objective 4.3: Disseminate results to a national audience PM 4.3a: Number of articles published and presentation given in workshops and conferences			
Activity 4.3.1: Publish results What Works Clearinghouse and other Journals.	10/1/2023	9/30/2025	PI, PD, PC, ET, WL

Activities	Start	End	Responsible
Activity 4.3.2: Present findings in national conferences and workshops.	10/1/2023	9/30/2025	PI, PD, PC, ET, WL
Activity 4.3.3: Develop a website to display findings	10/1/2022	9/30/2025	PI, PD, PC, ET, WL
Goal 5: Plan expansion of program to other communities and grade levels.			
Objective 5.1: Identify more communities for expansion PM 5.1a: Number of Tribal communities contacted			
Activity 5.1.1: Visit with tribal communities in nearby states	10/1/2023	9/30/2025	PI, PD, PC
Activity 5.1.2: Draw from ANSEP for 11 th – Graduate school activities.	10/1/2023	9/30/2025	PI, PD, PC
Objective 5.2: Identify sustainable and replicable measures PM 5.1a: Number of grants submitted PM 5.1a: Number of businesses/corporations contacted			
Activity 5.2.1: Identify and submit grants that will sustain and expand program	10/1/2024	9/30/2025	PI, PD, PC
Activity 5.2.2: Contact corporations and donors to support program	10/1/2023	Continual	PI, PD, PC

B.4. Performance Feedback and Continuous Improvement

There will be several mechanisms for performance feedback, including formal external evaluation, a research component, ongoing internal evaluation, and feedback through an advisory team. The research component and external evaluation are detailed in Section D, Evaluation. Specifically, the external evaluation includes an ongoing Process/Fidelity of Implementation Study which will provide periodic feedback on adherence to program activities. Data collected by the research team will be reviewed by evaluation team to provide feedback for continuous improvement through monthly meetings.

Ongoing internal evaluation will include monthly reports from the Project Coordinator with general updates on progress toward completing proposed activities and preliminary and informal feedback from participants. The PLT will review the reports and discuss them during their quarterly meetings to assess whether activities are being implemented as planned or

whether adjustments need to be made. This ongoing feedback will allow the project team to make corrections to the project in order to keep it on track.

Another mechanism for feedback will be through the **External Advisory Team**. The advisory team will provide feedback and support to the PLT on project development and progress as well as engage directly with the public, and specifically with the target audience. The team includes members from K-12 education; postsecondary administration; and statewide programs which stimulate education initiatives in disadvantaged areas. These individuals have been selected based upon their unique insights on K-12 and higher education in STEM and their ability to help further the project with their connections in the state. The advisory team will assist in developing surveys and rubrics for community and Indigenous content. Their role will include: (1) discussing essential components, which the PDs will use to develop draft instruments, (2) and reviewing instruments and providing feedback on the program in a timely manner. To ensure the team provides regular and relevant feedback to the project team, they will meet twice in years one and two and then annually thereafter to provide direction and make recommendations for recruitment, retention, and project delivery.

Name	Position	Description
Travis Anderson	Coordinator, Montana GEAR UP	Works directly with middle and high school students in disadvantaged areas
Angela DesJardins	Director, Montana Space Grant Consortium	Works to further NASA's mission in each state linking students to future STEM opportunities
Pauline Dupuis	Teacher/Instructor	High School and Tribal College Math
Jessie Herbert -Meny	Director, SpectrUM Discovery Science Center	Hands on science center. Also oversees SciNation on the Flathead Reservation.

B.5. Dissemination

The results of MT AIMS will be disseminated in three primary ways –articles, conference presentations, and through direct conversations with neighboring states. Articles will begin through the What Works Clearinghouse as will be discussed in section C. below. In addition,

journal submissions will be sought through other educational journal such as the International Journal of STEM Education, Journal for STEM Education Research, and Journal of Research in Science Teaching. As mentioned earlier, there is a lack of literature on STEM education with Native populations that needs to be expanded, and MT AIMS has a chance to further this field of work. Conference presentations will be given at conferences that focus on Native education such as the American Indian Science and Engineering Society National Conference, the Society for the Advancement of Chicanos and Native Americans National Conference, and the National Indian Education Association National Conference. Other local conferences, such as the Montana Indian Education Association will also be a target for dissemination. Finally, both PD Galindo and co-PD Thomas have extensive experience working in Indian Country and have numerous contacts with those in K-12 education. This is especially true in nearby rural states with large Native populations and situations similar to Montana such as North Dakota, Utah, South Dakota, and Wyoming. Personal conversations and small workshops will be provided to assist these states in starting similar programs for their Native populations. In addition, co-PD Thomas' work within the National Science Foundation EPSCoR community could serve as a mechanism to integrate these programs into their respective EPSCoR statewide awards.

C. Evaluation

The evaluation includes a research plan intended to provide evidence-based findings for replication and ongoing program improvement. Experimental research is subject to test and revision, and the successive iterations that result play a role similar to that of systematic variation in experiment. It is through this iterative process of describing educational settings, teachers, students, and their interactions that learning theories can be developed and tested²¹.

Research Focus 1: building a community of students: *To what extent does*

connectedness influence student academic achievement? The “community of learners” educational model is not a new concept. This model supports learning because it calls for active participation, some degree of social interaction and peer support. Some have found that academic achievement and school behaviors can be significantly influenced by peer groups²². Others have linked student connectedness to academic performance²³. ANSEP and MT-AIMS developers posit that program activities will increase student connectedness by building a community of students which will impact student achievement. Therefore, sense of belonging (a measure of connectedness and the level of community developed among the student participants) will be measured to assess how it affects student success. The survey instrument will be developed and administered prior to program participation and re-administered to students at key points throughout the life of the project. This process will help determine if program activities impact student connectedness and if a community of peers impact academic achievement. ***Methods:***

Pre/Intermittent Connectedness Survey

Research Focus 2: culturally responsive pedagogy: ***To what extent does culturally responsive pedagogy influence student academic achievement?*** The idea of providing a culturally responsive educational experience for Native American students has been around for some time²⁰. Culturally responsive pedagogy involves incorporating local practices and epistemologies *together with* traditional academic disciplines, “what we might call a ‘both/and’ approach rather than an ‘either/or’ approach²⁴. There are three goals: “produce students who can achieve academically, produce students who demonstrate cultural competence, and develop students who can both understand and critique the existing social order²⁵”. We will design our curriculum using the “both/and” approach, with the three goals in mind. As an example, for math related programming, we will follow the general methodology as described in *Introduction -*

*Factors that Affect Alaska Native Students' Mathematical Performance*²⁶, a culturally responsive scoring instrument will be developed in collaboration with program staff, advisory board members, and other members of the Native community. The program will then utilize classroom observations as well as course content analysis and interviews to identify where students were 1) engaged, 2) communicated mathematically, 3) engaged in problem-solving, and 4) where instructors made use of the local context. Correlation between incorporation of traditional experiential knowledge and student academic achievement will be examined. **Methods:** *Culturally Responsive Scoring Instrument, Classroom Observation, Course Content Analysis, Student Interviews*

Evaluation Design

MT-AIMS Program will utilize an active evaluation approach in which a team comprised of internal and external evaluators will collect and analyze project-relevant data throughout the life of the project. The Office of Educational Innovation and Evaluation (OEIE) at Kansas State University will serve as external evaluator for the program. Cindi Dunn, Ed.D., will serve as lead evaluator for the evaluation team, facilitating evaluation activities through duration of the five-year project (see resume). OEIE has provided evaluation services for over 360 federally funded projects, including 33 U.S. Department of Education funded projects designed to improve student outcomes. The Social Science Research Laboratory on the UM campus will serve as internal evaluator, implementing surveys and evaluation tools developed by OEIE. MT-AIMS' key-project outcomes include improved participant academic achievement in math and science. Each of the three summer modules will serve as an intervention hypothesized as responsible for achieving these outcomes.

Participant math and science outcomes will be tested using standardized assessments administered annually through Montana's Office of Public Instruction (i.e., Smarter Balanced Assessment (SBAC) , the new Montana Science Assessment (MSA) that replaces the CRT, and the ACT for high school students). This data set will also be used as the sampling frame to identify matched comparison students. The summative SBAC assessment is administered to students in grades 3rd-8th each May, with results released the following Fall semester. The MSA is aligned with Montana's Content Standards and is administered to students in 5th and 10th each May, with results released the following Fall semester. All 11th graders take the ACT with writing in their spring semester that Montana uses as assessment for math, science, and writing.

OEIE will collaborate with the project team to develop a survey²⁷ that will be administered at the end of each summer experience to collect participant feedback regarding changes in STEM interest; science identity/self-concept (e.g. persistence in science, competence in discipline, performance and recognition); resilience (e.g., support from family, friends, and teachers; sense of belonging; and cultural loyalty), and education/career interests as well as participant perceptions of intervention activities (e.g., reaction, satisfaction, and intentions)²⁸⁻³⁰. These concepts derive from the conceptual framework on which MT-AIMS project components were based and will serve as metrics for the external evaluation. Data collection and analysis will be conducted keeping a variety of demographic, social, cultural, and institutional factors in mind. Utilizing resources and information gleaned from Beyond Rigor (beyondrigor.org/), OEIE will collaborate with the project team to ensure all data collection instruments and methodologies are culturally sensitive. The project team will be responsible for collecting participant interactions, GPA, course completions, and creating a database for longitudinal tracking.

Methods: SBAC, MSA, and ACT Outcome Analysis, Retrospective Survey, Counts (participant interactions, GPA, Course Completion), Longitudinal Tracking.

Intervention Process/Fidelity Evaluation: **Research question:** *What activities are implemented for each module (pilot)? To what extent is each module implemented with fidelity (test)?* Because this is an early-phase intervention, evaluation of the first iteration of each intervention implementation (i.e., pilot) will focus on documenting inputs and activities. Instrumentation and protocols will be developed to measure program implementation fidelity through site visit and/or video-based observations of program delivery. Fidelity of the program model will assess curricula, implementation, pacing, use of appropriate learning principles, capacity of instructional staff, match of student knowledge/skill requirements with curricula content, and student as well as instructor reactions. Program implementation data may also assist OEIE in documenting any additional support, assistance, or resources students and/or instructors may need. These data will be used to refine the project logic model, develop a description of complete and acceptable program delivery and assist the project team in developing a fidelity of implementation checklist for each intervention. **Methods:** *Site Visit, Observations, Document Review, Focus Group w/Project Leadership, Participant Surveys, Progress and Implementation Checklistⁱ*

Impact Evaluation: **Research question:** *What is the effect of MT-AIMS summer modules on AI student participant's (6th to 12th grade) academic achievement in math and*

ⁱ Given the uncertainty of the evolving situation around COVID-19, OEIE has and will continue to consider constraints to the evaluation imposed by the virus. Multiple contingency plans for data collection are suggested should the virus prevent in-person observation and other data collection activities. These alternative virtual data collection strategies may include real-time observation of program activities via Zoom as well as virtual focus groups and interviews via Zoom. Final evaluation methodology will be determined in collaboration with the program team and, if needed, a modification to estimated budget expenses will be requested.

Science? The impact evaluation will use a quasi-experimental design (QED)³¹⁻³² to assess the impact of the MT-AIMS summer modules on a core set of student outcomes during the five years of the grant. The project's impact evaluation will be structured to meet *What Works Clearinghouse (WWC) standards with reservations* using the *Example Evaluation Plan for Quasi-experimental Design* developed by Abt Associates as a guide and OEIE, who is familiar with WWC Group Design Standards, will collaborate with MT-AIMS project team to determine an acceptable threshold for implementation of each project outcome using data collected during pilot implementation.

Standardized testing scores (i.e., MSA, Math SBAC, and ACT) will be analyzed following completion of each intervention (i.e., AIMS Gatherings, AIMS Journeys, AIMS Pathways). Propensity-score matching (PSM) will be used to select a matched comparison sample from the data provided by the SBAC, MSA, and ACT. Individuals eligible for comparison will be identified as American Indian (AI) and matched on grade level, age, and gender. Baseline GPA may also be considered. The WWC baseline equivalence standard for quality of matching will be ensured by calculating the mean of each matching convention for the intervention and comparison groups. In compliance with the WWC standards, baseline equivalence will be calculated for each domain, and matching will be repeated for each respective intervention group. If differences in comparison groups are between 0.05 and 0.25 SD, an acceptable statistical adjustment as specified in the WWC handbook will be applied.

T-test analyses of math and science competencies will take place upon the release of state assessment data (anticipated Fall of 2022 and 2023) using an alpha level of 0.05. Results of the t-test will determine whether the intervention is significant for increasing students' math and science competencies. Analyses will be calculated using mean values and standard deviation

from the intervention and comparison groups. Using the WWC standards for calculating and reporting, effect size will also be used to determine the magnitude of impact on the intervention group. Following the second implementation of each intervention, the analytic samples will be tested and compared to the matched business-as-usual sample of non-participants.

Data collected by the project team will be used to understand if the model of project delivery and mediators (i.e., connectedness and culturally responsive pedagogy) influence outcomes, as well as guide project refinement for scaling and replication. **Methods:** *Quasi-Experimental Design Evaluation, SBAC, MSA, and ACT Outcome Analysis*

Progress/Replication Evaluation: **Research question:** *To what extent is the project making progress towards stated goals, activities, outcomes, and objectives? What program components are vital to successful implementation of MT-AIMS summer modules? What components should be improved to facilitate future replication?* An implementation/progress checklist will track activities throughout the life of the project. OEIE will collect data via site visits and/or video-based observations, interviews, and focus groups virtual focus groups²⁷ with project leadership, and web-based post-participation surveys³³ administered to students. **Methods:** *Site Visit, Document Review, Focus Group w/Project Leadership, Progress and Implementation Checklist, Post-Participation Survey*

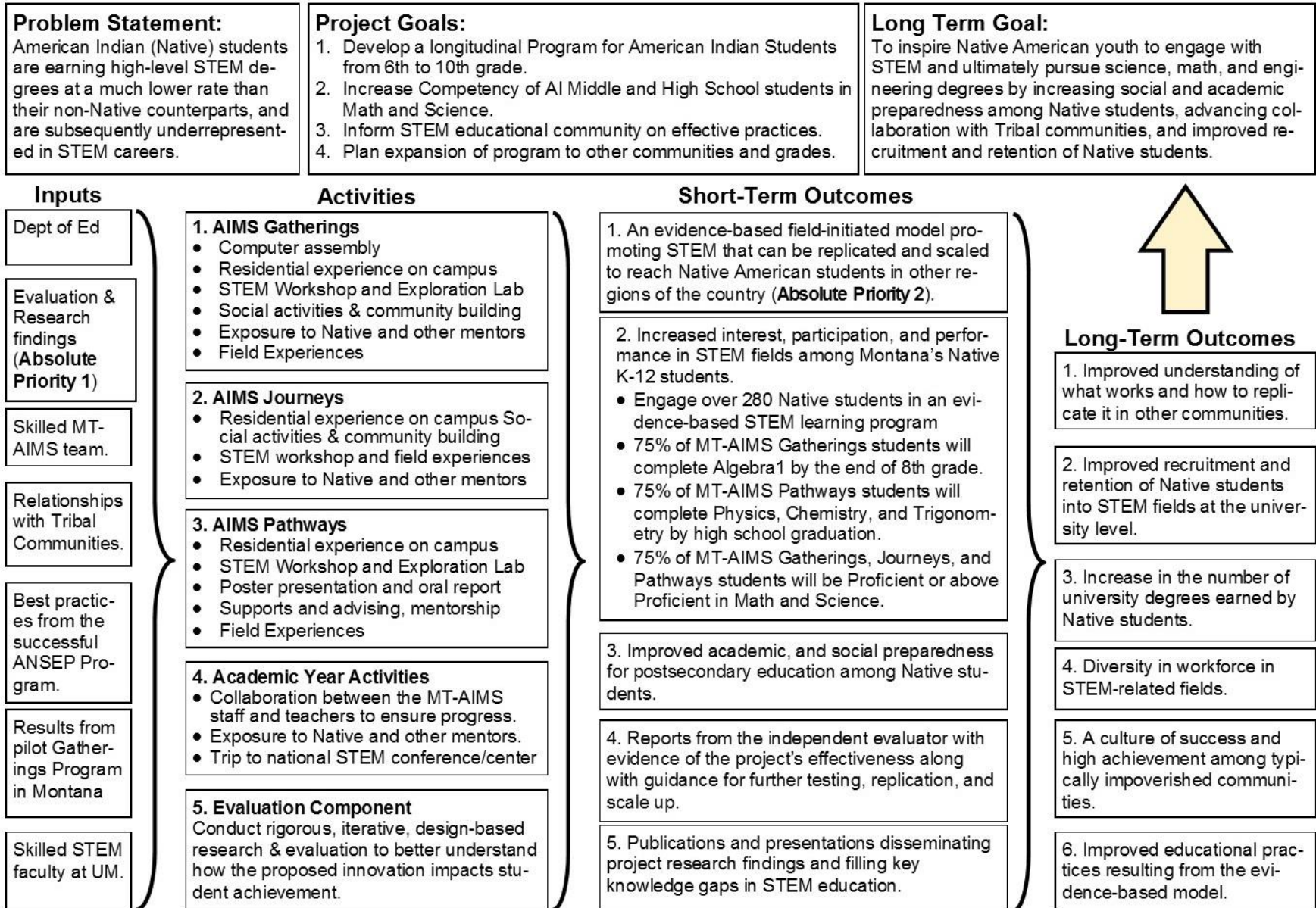
Reporting: OEIE will communicate and collaborate with the project team through regularly scheduled phone and video conference meetings. Dissemination of evaluation activities will include summaries of evaluation findings that may be used to enhance project planning and replication, improve project management, and inform annual reporting to the funding agency.

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	2021	2022		2023			2024			2025		
	Summer	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
	Jun-Aug	Jun-Aug	Sept-Dec	Jan-May	Jun-Aug	Sept-Dec	Jan-May	Jun-Aug	Sept-Dec	Jan-May	Jun-Aug	Sept-Dec
AIMS Gatherings (grades 6-8)	X	X		MSA	X	Matching & Analysis	MSA	X	Matching & Analysis	MSA	X	Matching & Analysis
	P, S	F, S		Math SBAC	F, S		Math SBAC	F, S		Math SBAC	F, S	
AIMS Journeys (grades 7-8)	X	X		MSA	X	Matching & Analysis	MSA	X	Matching & Analysis	MSA	X	Matching & Analysis
	P, S	F, S		Math SBAC	F, S		Math SBAC	F, S		Math SBAC	F, S	
AIMS Pathways (grades 9-12)	X	X		ACT	X	Matching & Analysis	ACT	X	Matching & Analysis	ACT	X	Matching & Analysis
	P, S	F, S			F, S			F, S			F, S	
X = Intervention	Cohort Impact Evaluation		P = Process Evaluation	F = Fidelity to Implementation		S = Participant Survey	MSA = Montana Science Assessment (8th graders)		Math SBAC = Smarter Balanced Assessment (6th-8th graders)		ACT (11th Graders)	

Table 5: Intervention Process/Fidelity and Impact Evaluation

MT-AIMS LOGIC MODEL



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