Oregon Pre-Engineering & Applied Sciences Initiative
Investment Sub-Proposal
Biennium from July 1, 2009 to June 30, 2011

Segment: Out-of-School Time (OST) Programs for Project-Based Learning in Engineering and Applied Science

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Summary of Proposal: This proposal seeks to create a comprehensive framework to guide the growth and availability of proven programs and to offer specific programs to deliver OST project-based learning experiences in science and engineering for fourth through ninth grade students. This proposal is intended to attract and engage students from diverse backgrounds in a range of OST opportunities in order to prepare them for and retain them in engineering and applied science learning. The outcomes will be an increase in the number and diversity of students poised to continue in science, technology, engineering, and mathematics (STEM) coursework in high school and to consider careers in engineering and applied science fields.

Vision Statement

To have a positive and lasting impact on the OST learning opportunities and engagement of Oregon's fourth through ninth grade students and to assist their educational and career influencers in promoting the school success, STEM participation, and engineering and applied science career aspirations of these youth

Long-Term Goals

This proposal, as one element of a comprehensive statewide effort to create collaborative in-school and out-of-school learning experiences, has four long-term goals:

- Increase student interest in and motivation for further study in STEM, particularly their explorations of and aspirations for engineering and applied science careers.
- Provide and support a variety of OST STEM experiences for all students, so that students can easily find venues in which to pursue additional learning appropriate for their age, learning style, interests and level of achievement.
- Demonstrate transformative partnerships between classroom educators and their counterparts in out-of-school-time (OST) settings, through sustained collaborations to enhance and bridge STEM learning in OST and classroom settings.
- Enhance overall community support of and engagement in STEM education and workforce development in engineering and applied science throughout the state.

Investment Description

This proposal seeks investment to provide statewide coordination to guide and support statewide efforts to build greater participation in engineering and applied science careers by offering project-based learning opportunities in STEM for students in grades four through nine. Work will be undertaken to refine the framework for the design and implementation of programs.

Existing and New OST Programs. Investment in this proposal will support the expansion of proven, existing programs and the development of new programs to address unmet needs, leverage new resources, and enhance statewide capacity. Projects and programs supported through this proposal should address the priority strategies of the Oregon Pre-Engineering and

Applied Sciences Initiative and demonstrate the package of five features that have been extracted from programs with research-based evidence to support their effectiveness (Building Engineering and Science Talent [BEST], 2004). The features, captured directly from the 2004 BEST Report, are:

- ***Defined outcomes*** drive the intervention and are successfully accomplished for the entire target population. Students and educational staff agree on goals and desired outcomes. Success is measured against intended results. Outcome data provide both quantitative and qualitative information. Disaggregated outcomes provide a basis for research and continuous improvement.
- ***Sustained commitment*** enables effective interventions to take hold, produce results and adapt to changing circumstances. Its components are proactive leadership, sufficient resources and steadfastness in the face of setbacks. The minimum conditions for assuring sustained commitment are continuity of funding and of support at the individual school and school district levels.
- ***Personalization*** acknowledges that the goal of intervention is the development of students as individuals. Student-centered teaching and learning methods are core approaches. Mentoring, tutoring and peer interaction are integral parts of the learning environment. Individual differences, uniqueness and diversity are recognized and honored.
- ***Challenging content*** provides the foundation of knowledge and skills that students master. Curriculum is clearly defined and understood. Content is related to real-world applications, goes beyond minimum competencies, and reflects local, state and national standards. Students understand the link between the rigor of the content they study and the career opportunities that await them later in life. Appropriate academic remediation is readily available.
- ***Engaged adults*** who believe in the potential of all students provide support, stimulate interest and create expectations that are fundamental to the intervention. Educators play multiple roles as teachers, coaches, mentors, tutors and counselors. Teachers develop and maintain quality interactions with students and each other. Active family support is sought and established.

Existing OST Programs. Examples of existing, effective programs in project-based STEM enrichment that might be expanded under this proposal include: 4-H Tech Wizards; Mathematics, Engineering, Science Achievement (MESA); Oregon Robotics Tournament and Outreach Program (ORTOP); and The Science & Math Investigative Learning Experiences (SMILE) Program. These programs were selected because of their program elements align with the BEST framework.

- 4-H Tech Wizards is a highly original tiered mentoring project focused on assisting underrepresented youth to bridge the digital divide. The 4-H Tech Wizard project involves youth participants in experiential learning activities focused on science, math, and technology education and careers. The 4-H Tech Wizard Project uses a multi-year multifaceted, systems approach encompassing in school, afterschool and summer math, science, and technology enrichment experiences and opportunities to help 3^{rd} – 12^{th} grade youth annually explore related education and career paths. The Project also provides family education to ensure critical parental awareness and support.

- Oregon MESA is a precollege academic program that makes achievement in STEM fields a reality for more students. Middle and high school MESA students learn by working in teams, conducting scientific research, building hands-on projects and participating in internships. MESA students are surrounded by high expectations that support their progress toward high achievement. Investment in this proposal would bring new MESA chapters, enhanced project-based activities on a college campus, and expanded student and family programming in other venues.
- The mission of the ORTOP is to open doors to the worlds of science and technology for youth of every gender, socio-economic status, and race. It is hoped the experience will lead them to consider careers in technical and scientific fields. ORTOP's flagship program is FIRST LEGO League, in which 9- to 14-year-old youngsters learn to design and build autonomous robots using special LEGO kits. The program includes a 10- to 12-week period in which youngsters form teams, develop robots that can respond to individual tasks as part of an overall challenge, prepare a scientific presentation on the challenge theme, and then compete against other teams in tournaments around the state. Through this process, youngsters experience the fun and excitement of solving complex problems in a positive and supportive team environment. Investment in this proposal would allow ORTOP to expand the number qualifying tournaments and launch less costly, less-competition-driven local events to engage larger numbers of 9- to 14-year olds in OST robotics activities through a proven, exciting format.
- The SMILE Program offers OST pathways that take students from 4^{th} to 12^{th} grade and, ultimately, into higher education. SMILE has a twenty-year history of effective work and positive impact in rural Oregon communities. Each year the schedule of activities centers on weekly afterschool science and math clubs facilitated by two teachers serving as club advisors and mentors. Club activities emphasize inquiry-centered, cooperative learning experiences to enrich student content knowledge and process skills. The clubs take field trips to sites of scientific or technological interest. Middle and high school students attend project-based challenge events on college campuses. These capstone events allow SMILE students to make application of knowledge and skills through a contextual project. Investment in this proposal would bring new SMILE Clubs, enhanced project-based experiences on college campuses, and expanded student and family programming.

Program Administration and Evaluation. Investment in this category would support personnel to coordinate statewide project activities, to facilitate project promotion and public relations, and to manage the expansion and functioning of the TechnoScienceSupersite into a data-base-driven format that would be used to identify, track, and update information on statewide OST programs. Additionally, investment in this proposal would support the evaluation of the framework for Oregon's OST initiatives and the impact of the activities on participants. The evaluation would also examine the structure and efficacy of classroom and OST partnerships and changes in and impact of community capacity around OST STEM learning and career opportunities for youth.

Private and Federal Support

A number of opportunities exist for this investment to be leveraged for both federal and private monies in support of Oregon's efforts to increase its engineering and applied science workforce through early project-based experiences for youth. A number of programs through the National Science Foundation (NSF) are focused on increasing the number and diversity of the nation's STEM workforce and may provide good potential for matching Oregon's engineering and

applied science workforce initiative to federal funding. While NSF has reorganized its directorates and divisions, its strategic plan provides a very clear priority for STEM education and workforce development. Past funding opportunities include NSF Innovative Technology Experiences for Students and Teachers, Informal Science Education, Broadening Participation in Computing, and NSF Academies for Young Scientists.

The Lemelson Foundation, based in Portland, Oregon, currently supports a number of project-based STEM enrichment and classroom programs. While this foundation is currently reformulating the priorities and strategies for its education giving in the United States, its focus on invention and creativity remains. There may be opportunity to connect this investment to the priorities of Lemelson or other private monies.

Results and Benefits

At the end of the first biennium for this proposal, the number of OST engineering and applied science learning opportunities will have increased through the expansion of existing programs and the implementation of new programs that adhere to the framework for projects under this proposal. These additional OST opportunities will bring

While effective in addressing their individual goals of serving underrepresented and other educationally underserved students through effective STEM teaching and learning, institutions, community organizations, and enrichment programs are at a crossroads of achieving critical collaborations that draw on the strengths, experiences, and expertise of one another and other partners to be identified. This proposal offers the resources, context, and focus that would create the synergy to drive the needed collaborations.

Future Plans and Resources

This proposal is envisioned as a six-year initiative to significantly impact the OST learning opportunities for fourth through ninth grade youth throughout Oregon. Future plans include the evolution of the centralized support structure into regional centers to facilitate participant access and program implementation, collaboration, evaluation, and collaboration. It is expected that this change will require similar program costs. By 2011, the number of new OST offerings or sites should increase by 15-20. It is expected that by 2015, 10,000 youth will participate in OST programs through 25-35. It is expected that additional resources to support the additional clubs will result from targeted efforts to leverage investment dollars to gain federal and private funding.

Measuring Results

Measurable participant outcomes are given below

Participating youth will:

- Become excited about, and build confidence in, their ability to successfully learn about STEM, excel in school, and pursue challenging engineering and applied science careers;
- Learn about, develop and maintain positive attitudes about STEM learning, STEM career opportunities and paths to those careers, especially in engineering and applied science;
- Learn in a supportive environment that provides a sense of community;
- Engage in meaningful project-based STEM experiences and connect with mentors to learn about college and careers and to gain a vision for pursuing STEM majors and careers;
- Interact with engaged adults who will encourage the students' school participation and success and support their understanding of STEM content; and

- Persist and succeed in school and STEM learning, in formal and informal settings.

Participating STEM educators and volunteers will:

- Cooperate with other project partners to provide in school and OST project-based STEM activities and opportunities that are designed to connect to and reinforce one another;
- Collaborate with other project partners to expand opportunities for families to be involved in STEM learning at informal science institutions and other community settings; and
- Develop ongoing, beneficial interactions with other project partners to sustain comprehensive support for STEM learning and careers aspirations, especially in engineering and applied science.

Families and community members will:

- Experience lasting partnerships with STEM educators in OST and classroom settings; college and university faculty and students; and business and industry leaders and employees;
- Participate in OST STEM opportunities offered in a variety of venues; and
- Express enhanced capacity to support STEM education and career aspirations for youth.
- Have a clear resource for finding appropriate STEM OST opportunities for their students.

The long-term goals of this proposal will be assessed using the following metrics:

Student Engagement

Metrics: Number and type of OST programs in engineering and applied science
Number of OST participants expressing an interest in engineering and applied
Number and diversity of students in OST programs
Rates of student participation in OST experiences
Proportion of underrepresented participants to proportion of all other participants
Number of adult mentors, advisors, and coaches
Average number of student participant contact hours

Transformative Partnerships

Metrics: Number and type of partnerships between classroom educators and their OST counterparts
Number and type of activities involving classroom and OST learning opportunities
Number of students involved in partnership OST activities
Longevity of partnerships
Number of STEM educators and volunteers involved in the partnership
Amount of leveraged resources gained through the collaborations

Community Capacity

Metrics: Number and type OST activities in partner communities
Proportion of communities' youth participating in OST activities
Number of parents and community members involved in OST activities

The project's development will be guided by its formative evaluation, using a range of data sources appropriate for the goal, activity, and audience. The summative evaluation will be designed to assess the efficacy of the model and the impact on participants. Individual sub-programs may have additional metrics.

Proposed Investment

Project Administration, Database Management, and Evaluation	180,000
Expansion of Existing Programs aligned with BEST Framework	800,000
Request for Proposal Funds for New OST Initiatives and Partnerships	420,000
TOTAL INVESTMENT	1,400,000