Idaho STEM Action Center –

Definitions and Clarifications Related to Idaho Code §67-823

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INTRODUCTION

During the 2015 Idaho legislative session, a small group of visionary legislators, education leaders and industry stakeholders began a biweekly meeting referred to as "The STEM Caucus." This group eventually crafted and pushed through legislation that led to the creation of a new agency housed within the Executive Office of the Governor, the Idaho STEM Action Center (the Center). Idaho House Bill 302 became law on July 1, 2015 (Idaho Code §67-823). This new law permits some flexibility for the Center to develop unique grant, training, and, professional development (PD) opportunities as well as scholarships throughout Idaho from kindergarten through career. Decisions related to the STEM Action Center, including legislative intent and implementation, are guided by a nine member Board. The Board is a unique blend of two educational leaders from both the Idaho State Board of Education and the Idaho State Department of Education and seven Idaho industry leaders including the Idaho Department of Labor, the Idaho Department of Commerce, Idaho National Laboratory (INL), Micron, LCF Enterprises, Glanbia and AlertSense.

The legislation dictates the composition of the Board as well as the five broad areas upon which the Center will focus: a) student learning and achievement (including achievement gaps and underrepresented populations); b) student access to STEM including equity issues; c) high quality STEM PD and teacher opportunities; d) college and career STEM pathways; and e) industry and workforce needs. With these five areas in mind, the STEM Action Center Board developed mission and vision statements. The mission of the Idaho STEM Action Center is "Connecting STEM education and industry to ensure Idaho's long-term economic prosperity." The vision for the Center is to

"Produce a STEM competitive workforce by implementing Idaho's kindergarten through career STEM education programs aligned with industry needs."

Given the broad dictates outlined in the legislation, it is imperative that working definitions around the major concepts be described. Specifically, this research will define:

1) STEM
2) High quality STEM professional development
3) Traditionally underrepresented populations in STEM
4) Typical pathways that students take which lead to a STEM career
5) Industry and workforce needs in STEM throughout the U.S. and within Idaho

Researching these topics will allow the Idaho STEM Action Center to better implement projects and programs, ensuring legislative intent through clarifying definitions. This will promote understanding and consistency within the Center, between the Center and its Board members, and among other agencies, including the legislature, local districts, educators (formal and informal), out of school entities, and Idaho communities.

This paper contains five major sections, each describing one of the areas listed above based upon current research. After each section, a discussion will address how the STEM Action Center can use this research to make relevant decisions. With nearly $4.5 million dollars appropriated in fiscal year 2017 (FY17), it is essential that the Center thoughtfully use the funding in a consistent and appropriate manner. Defining these terms in relation to the Center will convey clear and stable messages to all the Center stakeholders.

DEFINITION OF STEM

Many people can recite the words associated with the acronym STEM: science, technology, engineering, and math. However, various stakeholders often have significantly different conceptions of STEM. Breiner, Johnson, Harkness, and Koehler (2012) conducted a short, two question survey of university faculty to determine 1) How is STEM defined? and 2) How does STEM impact/influence your life? STEM was defined simplistically by nearly all the faculty as science, technology, engineering, and math; however, conceptually, there were significant variations. To some, it was a very single subject, segregated expression of science related content areas, such as chemistry *or* biology *or* physics *or* engineering. Others described STEM as integration of the fields (two or more disciplines), such as math *and* engineering. Still others focused on the need for STEM to mirror the practices of the profession which often include integration of the STEM fields as well as critical thinking and the ability to solve real world issues. The authors indicate, “the way STEM is taught is often much different than the way STEM is done.” While STEM professionals “naturally practice integrated STEM and are less likely to compartmentalize disciplines”, most K-12 classroom teachers do not necessarily teach STEM in this fashion (Breiner et al., 2012, p. 5). Further, from a policy perspective, many educational stakeholders including the National Science Foundation, K-12 agencies and school districts, STEM is often considered traditional disciplinary coursework (separate courses of science, mathematics, technology, and engineering), lacking an integrated approach (Briener, et al., 2012). According to Labov, Reid, and

Yamamoto (2010) one of the most important modern conceptions of STEM education might be the idea of an integrated STEM approach that is practical and purposeful, which connects the STEM disciplines and is used to solve real-world problems.

In a 2012 Congressional Service Report, it was estimated that federal spending and investment in STEM education programs was between $2.8 billion and $3.4 billion annually (Gonzales, 2012). The report indicated that the "differences between the inventories [values] are due, in part, to the lack of a common definition of what constitutes STEM" (p. 7). Not only are the estimated amounts of STEM spending vastly different, the estimated number of workers also differs. At a recent workshop entitled *Developing a National STEM Workforce Strategy*, Kalvin Droegemeier, the vice president and general manager of Manpower's northeast division, a company devoted to helping others find temporary and permanent employees, noted that,

> …there is no consensus definition of the STEM workforce and it consists of many sub-workforces. One reason for the vastly different analyses about the state of the STEM workforce is because the definition of a STEM worker is not consistent from article to article and report to report. (p. 13)

Not only is the lack of a clear definition of STEM making it difficult to estimate spending and workforce counts at the federal level, but different definitions within state agencies also cause state and local agency estimates to differ from one another. This is especially true when estimating the STEM workforce and employer needs. Some agencies use a definition of STEM that includes psychology and social sciences such as economics, and health care in addition to the more traditional disciplines of sciences and engineering (Corbett & Hill, 2015; Gonzalez & Kuenzi, 2012; Kuenzi, 2008; Maltese &

Tai, 2011). Others use a much narrower definition that excludes social sciences and health care. These different definitions lead to significant variations in numbers when attempting to quantify spending and job reporting (Alper, Board on Higher, Education and Workforce, Policy and Global Affairs, National Academies of Sciences, & Engineering and Medicine, 2015; Wang, 2013).

The disparities in definitions become particularly problematic when attempting to 'target' STEM for specific populations. For example, a 2007 report on women in STEM shows significant gender gaps in numbers of women in STEM jobs and pay equity. However, this report uses a very narrow definition of STEM, excluding occupations such as business (i.e. economics), health care, and social science majors (Beebe, et al., 2007). A different study by Wang and Degol (2013), which uses a broader definition of STEM to include physical and biological science, medical, health, computer sciences, engineering, and mathematics, found smaller STEM gender gaps than Beebe, et al. (2007).

STEM Action Center Definition of STEM

As indicated in Breiner et al. (2012), STEM professionals practice integrated STEM on the job. Therefore, when the STEM Action Center focuses on STEM, it means integration of *at least* two STEM subjects. The ability to integrate science, technology, engineering, math, and/or computer science should be illustrated when implementing projects and programs in order to ensure that the Center is meeting the demands of Idaho's STEM workforce. This integrated approach is not only practiced in the workforce, but will also allow the Center to differentiate itself from the State Department of Education (SDE). At the SDE, science, math, English language arts (ELA), health, PE, government, and social sciences are directed by individual coordinators who assist with revising standards, supporting assessments, and PD related to their content area. In light of this, it is critical that the STEM Action Center forge its own path in the world of integrated STEM PD and other STEM projects and programs. It is important that the Center not duplicate the efforts of the SDE which seems to view the disciplines as more segregated than integrated. The STEM Action Center must focus primarily on projects and programs which are representative of a truly interdisciplinary approach to STEM education.

In addition, to promote consistency between the STEM Action Center and the Idaho Department of Labor, a clear definition of which professions are encompassed in the STEM workforce is also necessary. The Idaho Department of Labor often uses a very broad definition of the STEM workforce. According to the Idaho Department of Labor, the STEM workforce is made up of four subdomains (Appendix A). Subdomain 1 includes life and physical science, math, engineering, and information technology occupations. Subdomain 2 includes social science occupations such as economists, psychologists, geographers, and archeologists. Subdomain 3 focuses on architecture and architects. Subdomain 4 is grounded in health care, which includes doctors, dentists, nurses, and others related health care professionals. In total, 184 occupations are defined by the Idaho Department of Labor as STEM-related and requiring STEM skills.

When implementing the policies and programs of the Idaho STEM Action Center, it is important that the Center operates under a clear definition of STEM. Through adopting a broad, integrated definition of STEM aligned to the definition used by the

Idaho Department of Labor, consistency will prevail when discussing STEM throughout Idaho.

HIGH QUALITY STEM PROFESSIONAL DEVELOPMENT

STEM Action Center legislation dictated that the Center “support high quality STEM professional development” (Idaho Code §67-823). This term is used seven times throughout the legislation, but there is no clear definition to indicate what the term “high quality STEM professional development” means. Because of the ambiguity and various definitions used in journals and by vendors, it is critical that the Center ensure a clear and transparent definition of high quality STEM PD. In addition, the Center has allocated significant funds to support this targeted effort throughout Idaho making it even more important to ensure consistency.

Regarding the potential range of PD opportunities, numerous articles discuss the need for teachers to receive ‘job-embedded professional development’ (Blank, de las Alas, & Smith, 2007; Darling-Hammond & Richardson, 2009; Saxe, Gearhart, & Nasir, 2001; Wenglinsky, 2000; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Job-embedded PD is a type of professional development where educators have time to reflect upon and improve their practice through activities such as peer observations, analysis of student work, educator work groups, and/or professional learning communities (PLCs) (Darling-Hammond & Richardson, 2009).

Job embedded PD is very different than single day “drive-by” professional development which ranks low amongst the most effective methods of delivery for PD; however, this “one and done”, single-day approach tends to be the most common type of PD that teachers experience (Darling-Hammond & Richardson, 2009; Stein, Smith, &

Silver, 1999). In a study by Yoon, et al. (2007) nine different PD opportunities for educators were compared to student outcomes including student achievement. Educator PD lasting less than 14 hours showed no effect; whereas more than 14 hours showed a positive effect. However, the largest positive gains were found in PD that was between 30 to 100 hours and was spread out over a period of six to twelve months. These findings are similar to a study by Supovitz and Turner (2000) that found it was only after 80 hours of PD that teachers reported using inquiry-based, hands-on teaching strategies, which had positive impacts on student outcomes, at a significantly higher rate than those with less time spent in PD.

According to a study by Banilower, Smith, Weiss, Malzahn, Campbell, and Weis, (2013), science teachers spend, on average, less than 35 hours in PD over a three-year period. This was particularly true of elementary teachers who "rarely have the opportunity to collaborate with colleagues or participate in science-focused professional development" (p. 50). Numerous researchers have recognized that this is simply not enough time to truly develop professionally (Darling-Hammond & Richardson, 2009; Stotts, 2011; Supovitz & Turner, 2000; Wilson, Schweingruber, & Nielsen, 2016). Unfortunately, the "drive-by" method of PD is the most common method as it is relatively inexpensive compared to long-term, sustained PD involving opportunities such as mentorship, coaching or the formation of PLCs (Brasiel & Martin, 2015; Darling-Hammond & Richardson, 2009; Flynn, 2013; Stotts, 2011; Wilson, et al., 2016.). The importance of on-the-job training, situated in practice, is illustrated in many professions including student teaching, apprenticeship programs, and numerous service jobs and should be incorporated into educator PD (Alper, et al., 2015; Wilson, et al., 2016).

However, these opportunities for sustained PD are more time-consuming and/or cost intensive when compared to “drive-by” PD (Brasiel & Martin, 2015; Darling-Hammond & Richardson, 2009; Flynn, 2013; Stotts, 2011; Wilson, et al., 2016). In addition to the time required for delivery of sustained PD, often peer mentors/coaches are required, necessitating the reduction of teaching loads in order for educators to serve in this capacity (Stotts, 2001; Wilson, et al., 2016; Young, House, Wang, Singleton, & Klopfenstein, 2011). Consequently, administrators may not fully support this type of PD due to the intensity and/or expense (Darling-Hammond & Richardson, 2009).

This lack of administrative support is unfortunate because it is a critical yet often overlooked component of successful PD and must go beyond simple administrative encouragement. According to Hernandez and Brendefur (2003), three important conditions appeared to have an impact on the quality of an integrated mathematics units produced by teacher-teams: “teachers’ teaching practices, school supports, and collaborative patterns” (p. 274). Effective school supports included appropriate resources such as materials, time to reflect on one’s own practices, and time to observe other teachers’ practices. The administration must be wholly committed to supporting teacher collaborative teams in order for teachers to receive the full gains from PD (Hernandez & Brendefur, 2003). Similarly, Supovitz and Turner, (2000) reported that science educators who felt more supported by their administration often have students that engage in more inquiry-based investigations than those educators who feel less supported which highlights the importance of administrator buy in and support.

In a synthesis of the research on educator PD, Darling-Hammond and Richardson (2009) found that successful PD:

a) “Deepens teachers' knowledge of content and how to teach it to students;

b) Helps teachers understand how students learn specific content;

c) Provides opportunities for active, hands-on learning;

d) Enables teachers to acquire new knowledge, apply it to practice, and reflect on the results with colleagues;

e) Is part of a school reform effort that links curriculum, assessment, and standards to professional learning;

f) Is collaborative and collegial; and

g) Is intensive and sustained over time.” (p. 51)

Conversely, from the same article, unsuccessful PD:

a) “Relies on the one-shot workshop model;

b) Focuses only on training teachers in new techniques and behaviors;

c) Is not related to teachers' specific contexts and curriculums;

d) Is episodic and fragmented;

e) Expects teachers to make changes in isolation and without support; and

f) Does not provide sustained teacher learning opportunities over multiple days and weeks.” (p. 51)

In addition to the key components listed above, another support found to impact the success of PD is collaboration with entities outside of the traditional school setting. Horn and Little (2010) followed a highly collaborative group of math teachers whose students consistently demonstrated significant gains in learning and advanced coursework. The educators cited external factors as being significant to their successes, namely the active participation in university-based PD, the opportunity to collaborate on university-lead research projects, and strong professional networks.

To this point, all of the PD methods discussed involve face-to-face delivery. However, this mode of delivery may be impractical for teachers in rural or remote areas. One potential solution is virtual PD including coaching. McConnell, Parker, Eberhardt, Koehler, & Lundeberg (2013) conducted a study regarding the perceived effectiveness of virtual science PD which included the use of video conferencing and message boards. The educators felt that the experience helped them gain new information, work more effectively in collaborative groups, and development new professional friendships. Educators indicated that they still preferred face-to-face, but sustained virtual PD certainly appears to be a viable alternative to single day or no PD.

PD and the STEM Action Center

Using the research by Darling-Hammond and Richardson (2009), the Center should focus on the seven major characteristics of high quality PD including increasing educator content knowledge, applications of that knowledge, student activities and outcomes, educator reflection and collaborations, all of which are sustained and in-depth. In order to define this as high quality *STEM* professional development, the focus of the PD must be STEM-based, defined as two (or more) STEM disciplines. As indicated previously, the Center's definition of STEM is an integrated approach necessitating that PD opportunities require an integration of at least two STEM fields.

Idaho currently uses an in-depth, collaborative approach for PD in math and ELA. Currently, eight ELA coaches are supported through the SDE with legislative funding. Math specialists are also supported through university collaborations and legislative funding. Activities supported by Idaho ELA coaches and math specialists include assisting teachers in implementing the Idaho Core Standards and assessments (formative, interim and summative), serving as mentors, supporting development of new skills, applications of knowledge, and providing resources. Science coaches, however, remain non-existent in Idaho. This is not surprising as Banilower et al. (2013) noted that only 17% of elementary and middle schools and 22% of high schools across the nation reported having access to a science coach. This study also indicated that access to coaching in general is much less common in rural schools. However, there is mounting data supporting the effectiveness of the science coaching model (Kuenzi, 2008; Stotts, 2011; Supovitz, & Turner, 2000; Wilson, et al. 2016).

Another important variable in PD is the recipient of the opportunity; therefore, a definition of an eligible *educator* also needs to be determined. The STEM Action Center will take a broad definition of the term 'educator'. An educator could be a formal PK-20 public educator, but it could also be an informal (non-profit) educator, including a librarian, a counselor, a career consultant, or even an adult mentor. Certain PD opportunities will allow the Center to focus on the broad definition of educator; while others will require the Center to narrow the definition to include only certified, formal K12 public education teachers.

Yet another significant consideration around PD is the method of delivery. Although a number of studies cite that teachers prefer the face-to-face mechanism of PD (Brasiel & Martin, 2015; Wilson, et al., 2016), with Idaho's geographic distribution, it will be necessary to look into virtual and blended models of delivery in order to reduce overall cost. It would be impractical to expect localized, content-focused PD to be able to effectively support all regions of the state. To assess different modes, comparability studies should be conducted to determine if virtual or blended PD is as effective as in person. As indicated by McConnell, et al., (2013), while educators prefer face-to-face, there has been surprisingly little research conducted on comparability of face-to-face with virtual and blended models of educator PD. In addition, incentives, such as teacher stipends, may increase educator participation and completion rates and ultimately, have a long-term impact on teacher practices and student outcomes and therefore, should also be measured.

As the STEM Action Center begins to systematically support ‘high quality STEM professional development’ opportunities, it will be essential to create a rubric which clearly outlines the expectations of vendor- and university- delivered opportunities for educators. Although the expense may increase, ensuring that PD is effective may require that communities of practice be formed throughout the state as recommended by numerous researchers (Brasiel & Martin, 2015; Darling-Hammond & Richardson, 2009; Flynn, 2013; Stotts, 2011; Wilson, et al., 2016). Communities of practice would allow educators to share what they are doing in their classrooms (both successfully and less successfully) and interact with others (often educators who experienced similar PD) who can support them and give them advice and encouragement.

In addition, the local administration must be informed of the opportunity to ensure not only encouragement, but also effective partnerships and adequate supports. This will likely look very different from school to school, and the supports may come in the form of resources, unique scheduling to allow teacher collaboration or stipends for those serving as mentor teachers.

High quality PD has been shown to be more effective if it is sustained and intense (Garet, Porter, Desimone, Birman, & Yoon, 2001), is immersive in experiments, inquiry and questioning with strong administrative support (Supovitz & Turner 2000), and demonstrates measurable outcomes (Brasiel & Martin, 2015). Therefore, it is important that the STEM Action Center incorporate a clear definition of what constitutes 'high quality STEM professional development' that incorporates these critical elements in order to ensure that the Center is truly supporting effective statewide STEM PD and ensuring long-term successful outcomes.

UNDERREPRESENTED POPULATIONS IN STEM

Traditionally underrepresented populations in STEM have been discussed by numerous authors with the primary focal groups including gender (women), geography (rural), minorities (including African American and/or Hispanic ethnicity) and low socioeconomic status (often identified by free/reduced priced lunch status as defined by the federal government) (Alper, et al., 2015; Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011; Cole & Esponoza, 2008; Committee on Improving Higher Education's Responsiveness to Regional STEM, Workforce Needs, 2016; Gonzalez & Kuenzi, 2012; Kuenzi, 2008; Malcolm, 2010; Morganson, Jones, & Major, 2010; Slotts, 2011; Walton, 2014). Each group presents a unique set of challenges in relation to recruitment and retention in STEM, kindergarten through career.

Women as an Underrepresented Population in STEM

According to an economic briefing by Beede et al. (2011), women fill nearly half of all U.S. jobs, but they hold less than 25% of the STEM jobs. However, the briefing uses a narrow definition of STEM, excluding heath care, education, and social sciences. The briefing states,

> There are many possible factors contributing to the discrepancy of women and men in STEM jobs, including: a lack of female role models, gender stereotyping, and less family-friendly flexibility in the STEM fields (p. 1).

It is noted that often times STEM career pathways are less accommodating for women who may cycle in and out of the workforce to raise a family. The report concludes that this strong gender stereotyping might discourage women from pursuing STEM education and STEM jobs altogether leading to the discrepancy between the percentages. Wang and Degol (2013) also found that the work/family 'imbalance' is a major factor turning women away from STEM careers.

If these factors are true, then why should women be encouraged to pursue STEM careers? In relation to pay equity, it is estimated that women in STEM make approximately 33% more than women in non-STEM jobs (Corbett & Hill, 2015). In addition, the gender wage gap is smaller for women in STEM professions than non-STEM professions. As Beede, et al. (2011) describe, men consistently earn more money than women; however, in STEM jobs, women make 86 cents per each dollar men make or 14% less than men, on average. In non-STEM jobs, women make approximately 21% less than men. Another interesting point from the research is that engineering, which is dominated by men 7:1, has one of the "smallest regression-adjusted wage gaps" (p. 5). This translates into female engineers earning on average 93 cents per dollar compared to male wages or just 7% less than men.

While it is economically beneficial for women to enter STEM fields, many women still do not pursue these pathways – particularly in the U.S. as compared to other countries. In Malaysia, for example, women earn half of the computer science degrees while in Indonesia women earn half of the engineering degrees. However, in the U.S., women earn only 18% of the computing degrees and 19% of the engineering degrees (Corbett & Hill, 2015). Morganson, et al. (2010) believe that this is due to STEM environments in the U.S. being male-dominated, very individualistic, and highly impersonal with the climate being referred to as "chilly". For example, a female Latina student described her experience in a male-dominated STEM classroom:

> It can be intimidating when the professor asks a question. I'm afraid to raise my hand because I'm afraid to say something wrong. Being one of the few women in a class of mostly men is intimidating, and I'm afraid of giving the wrong answer and being laughed at. (Alper, et al., 2015, p. 35)

Droegemeier, echoes this young Latinas concerns and tries to provide some encouraging advice,

> STEM is for everyone and STEM skills provide empowerment for individuals. Too often, women and students of color who may be struggling with a STEM course are encouraged to drop it and switch to something 'easier,' but this is exactly the wrong advice. They need to be challenged and encouraged and not treated as if they are not smart enough to get the job done (Alper et al., 2015, p. 17).

What can be done, then, to encourage more women to enter STEM? Women and girls who are interested in STEM should be encouraged and supported (Beebe, et al., 2011). Strong, positive female STEM role models/mentors are another factor which could increase female retention rates in STEM pathways (Beebe, et al., 2011; Corbett & Hill, 2015; Morganson et al., 2010; U.S. Congress Joint Economic Committee, 2012). STEM career awareness at several levels (middle school, high school and postsecondary) has also been shown to be ‘absolutely essential’ for encouraging females to enter nontraditional STEM careers (Morganson, et al., 2010). In addition, forming female study groups and taking similar classes with other females can help women navigate STEM pathways during postsecondary education (Morganson et al., 2010). Once in a STEM career, employers should be flexible with women, many of whom are not only working, but are also often serving as the primary caregiver for the family (Wang & Degol, 2013).

Rural Geography as an Underrepresented Population in STEM

There are a variety of challenges for rural communities related to K12, postsecondary education, and industry. Rural K12 schools often face challenges of finding (and retaining) STEM educators (Stotts, 2011; Walton, 2014, Wiebe, 2013). In addition, rural schools often lack STEM electives that can typically be offered in larger districts. This is due to the lack of qualified educators and/or the lack of the numbers of students needed to fill these classes (Stotts, 2011). Also, because of the limited staff, there are often few opportunities for teacher collaboration and coaching. In turn, this reduces educator access to job-embedded professional development, mentoring, reflection, and collaborative (content-focused) learning groups which are more common in larger districts (Banilower et al., 2013). Finally, rural communities also often face difficulties with industry interactions and mentorship due to the lack of major industry

(Walton, 2014). According to Wiebe (2013), “it is clear that all groups from these mostly rural, under-resourced areas could use additional support” (p. 7).

While the rural issues are larger than STEM, there are a number of approaches that could be taken to support rural populations. Teachers could benefit from online (virtual or blended) PD and students could be encouraged and supported when taking online STEM coursework (Wilson, et al., 2016). Some rural districts lack instructional resources including supplies for hands-on STEM labs or technology (Brasiel & Martin, 2015). Providing grants and funding to access these resources could serve to close the access gap. As mentors may be limited in rural areas, providing virtual mentors would connect rural areas to urban mentors (Alper, et al., 2015).

Race/Ethnicity as an Underrepresented Population in STEM

According to an article by Malcolm (2010), Latino(a) students currently represent only 4.2% of the STEM workforce; however, this population represents nearly one half of the potential workforce (current school-aged U.S. population). This means that there is an opportunity to significantly “enlarge the STEM talent pool” and “to strengthen the U.S. competitive condition in an increasingly knowledge-based economy” (p. 29).

If the goal is to “enlarge the STEM talent pool,” then it is not enough to simply encourage minority students to enroll in postsecondary coursework. Cultural factors including relevance and congruity are critically important for retention of minority populations in STEM fields and must be address (Cole & Esponoza, 2008). Cultural relevance involves educators working to ensure that students can relate course content to his or her cultural context; whereas, cultural congruity includes “factors such as peer and faculty support, and co-curricular involvement,” both of which have been shown to “play a role in the retention of [minority] student population" (p. 286). For minority students in STEM, it is important that "faculty or staff members, in particular, serve as role models and as examples of [minority] individuals who have successfully navigated the educational system" (Cole & Espinoza, 2008, p. 286). This echoes the findings of Bonous-Hammarth (2000) who found that minority students report leaving STEM because they feel that there is a disconnect between their majors and the values shared by their peer groups outside of their majors. Both studies are supported by the findings from the Committee on Improving Higher Education's Responsiveness to Regional STEM Workforce Needs, et al. (2016) which indicated that minority role models are an important factor for retaining minority students in STEM pathways.

Community college might be the answer to creating cultural congruity as many minority populations often attend community college on their path to a STEM career (Alper, et al., 2016; Committee on Improving Higher Education's Responsiveness to Regional STEM Workforce Needs, et al., 2016; Malcolm, 2010). In fact, Malcolm (2010) discovered that 61% of the all Latinos who hold bachelor degrees attended community college at some point during their postsecondary education. In addition, Latinos who were from a more disadvantaged background were even more likely to attend community college to earn an associate degree. While the number of minority STEM majors is still relatively low, more minority students are earning STEM degrees than ever before. According to Gonzalez and Kuenzi (2012), enrollment for Hispanic/Latino, American Indian/Alaska Native, and African American students in science and engineering "grew by 65%, 55%, and 50%, respectively" (p. 2). Even so, minority populations still remain significantly underrepresented throughout the STEM fields. From the industry perspective, as the minority population of the U.S. continues to grow, it would make sense to invest in recruitment of minority populations into STEM fields (Alper, et al., 2015).

Socioeconomic Status as an Underrepresented Population in STEM

Research has shown that students (especially minority students) with low socioeconomic status (SES) have significantly less representation in STEM, beginning in high school and then carrying through to postsecondary and onward into STEM careers (Corbett & Hill, 2015; Wang, 2013). Why do students with low SES leave (or never enter) STEM pathways? One reason could be the lack of access to rigorous STEM coursework (Wang, 2013). Another reason may be the lack of awareness of potential STEM careers as students with low SES might not personally know STEM professionals (Alper, et al., 2015; Corbett & Hill, 2016; Wang & Dregol, 2013).

Kennedy (1998) found that teachers who worked with high percentages of low SES students had, "on average, significantly lower levels of both investigative culture and inquiry-based practices" and often used the more traditional lecture-style format when teaching STEM courses (p. 976). It could be that this general lack of hands-on STEM turns today's 21st century learners with low SES away from traditional STEM subjects in K12. In reference to students with low SES, Barcelona (2014) stated, "we are failing to prepare large numbers of our young people for postsecondary education or training" (p. 864).

Once students with low SES leave high school, the financial challenges of postsecondary education are soon recognized. A study by Kienzl and Trent (2009) found that receiving financial aid was a major factor for students with low SES entering into longer duration/higher cost STEM fields. Wang (2013) found that persistence after the first year is critical for retention of low SES students in STEM. This underscores the importance of schools to inform students (especially those with low SES) about financial aid opportunities that are available for postsecondary education.

What can be done to encourage students with low SES to pursue a STEM pathway? In K12, using culturally relevant, hands-on projects, as indicated in STEM best practices could lead to increased retention (Darling-Hammond & Richardson, 2009; Maltese & Tai, 2011). Holding family financial aid nights could help raise student and family awareness and generate family/peer support for STEM degrees, certificates and career options. In postsecondary education, finding supportive peer groups could help students be successful and persist in STEM (Cole & Espinoza, 2008). Throughout K12 and postsecondary, it is critically important for educators to truly educate and support *all* students regardless of SES.

STEM Action Center Definition of Traditionally Underrepresented Populations

In defining “traditionally underrepresented populations in STEM”, the STEM Action Center needs to be aware of Idaho’s different demographic populations and work to ensure that these populations are methodically supported while also seeking external guidance to capture the more challenging aspects of certain populations. Capturing information related to gender and geography will prove to be easier than race/ethnicity and SES. However, the focus of the Center should remain primarily on these four groups as the majority of research (illustrated previously) highlights these as being significantly underrepresented in STEM. Should other groups be identified through the Center’s work, this definition should be updated accordingly to reflect Idaho-specific data.

Working to bolster increased participation in STEM through the Center in relation to race/ethnicity will be challenging because racial identification is often not known outside of the formal K12 school setting. It would be possible to require that at Center-sponsored events, the grant coordinators attempt to collect aggregate counts and percentages. For example, at a Family STEM event, the Center could request that attendance include not only a total count, but also aggregate numbers (or percentages) of different races/ethnicities. However, this type of data would likely not be collected in a systematic manner at each site and could prove inaccurate. Census data might be a better estimator, but certain populations may attend (or not attend) an event in a different ratio than census data would suggest.

Even more difficult to capture is SES. It would be possible to use aggregate numbers of free/reduced lunch data reported by a school or district, but obtaining SES data could prove to be more difficult in programs that do not capture this information such as summer camps, family STEM events, library activities, after school activities, and student competitions.

Aggregate data will verify that classroom grants and teacher professional development opportunities target all four traditionally underrepresented populations. However, capturing the same information from informal events may not be possible and proxy measures may need to be extrapolated based on self-report race/ethnicity data, free/reduced lunch data or census data. While not ideal, it is critically important to attempt to capture the full impact of STEM Action Center projects and programs in supporting traditionally underrepresented populations in STEM. Using rubrics to score grant applications which contain additional points awarded to communities serving traditionally underrepresented populations in STEM may counter some of these issues and help to ensure that the Center can specifically impact these four focal groups.

In relation to postsecondary education, knowing that traditionally underrepresented populations often attend community college (Malcolm, 2010) is important in the Center's efforts to support diversification of the Idaho STEM talent pool. Continuing to expand the Center's effort to partner with community and technical colleges to support programs focused on recruitment and retention would likely increase the number of underrepresented STEM graduates earning associate degrees or certificates or transferring to university. Idaho-specific data will be collected to determine if this is a common pathway for minority and other underrepresented STEM students in Idaho colleges and universities.

By clearly defining and effectively monitoring Idaho's STEM target populations, the Center will be able to verify the effectiveness of Center projects and programs and measure outcomes and impact.

COLLEGE AND CAREER STEM PATHWAYS

Research indicates that from as early as middle school, student interest in pursuing a career in STEM becomes an important factor in providing the momentum which serves to carry students through STEM pathways (Cleaves, 2005). In fact, students who indicate interest in a STEM career in middle school are two to three times more likely to graduate college with degrees in STEM than their peers who do not indicate such an interest (Tai, Liu, Maltese, & Fan, 2006). Therefore, it is advantageous to better understand factors that impact STEM pathways and how to cultivate interest in STEM.

Major Factors that Favorably Impact STEM Pathways

According to one longitudinal data review (8^{th} grade through college) by Maltese and Tai (2011), students who study STEM in college (community college or four-year university), have often made that choice by high school. They concluded that this choice is based on the following:

- Student interest in STEM;
- The perception that math and science is challenging;
- The perception that they have a strong ability in math and/or science;
- Higher 8^{th} grade math and science scores;
- Teacher enthusiasm;
- Engaging lessons that are hands-on with group discussions and few lectures;
- Relevance to real-life topics with student choice;
- Discussions about potential careers in science;
- Working in groups (which showed a positive impact on attitudes for female and minority students). (p. 881 – 885)

By 12^{th} grade, the study found that those who indicated they planned to major in a STEM field in college were then four times more likely to actually complete a STEM degree (Maltese & Tai, 2011). This finding is supported by research from Wang and Dregol (2013) who found that the intent to major in STEM was positively correlated with exposure to math and science courses as well as the belief that it is possible to be successful in math. Conversely, students who reported that their teacher lectured more and that they had more bookwork did not persist in STEM.

The conclusion of the Maltese and Tai (2011) sums up the importance of early STEM education, “When [our] model is pared down to include only variables maintaining significance, it is evident that early indication of interest in STEM is associated with completion of a STEM degree” (p. 898). In fact, although fewer students from (non-Asian) minority groups completed a STEM major overall, this study suggests that “once in college the likelihood of students earning STEM degrees is equivalent, regardless of demographic background” (p. 899). This is critically important in that it indicates the significance of early STEM education for all students; once a STEM-interested student enters college or university with the intention of majoring in STEM, they often do in fact complete the degree regardless of race/ethnicity and gender.

How Can STEM Interest Be Achieved?

A number of studies have explored appropriate ways to achieve STEM interest with today’s 21st century students, via increasing relevance, raising STEM career awareness, and providing mentors with a background similar to the students’ (Cleaves, 2005; Maltese & Tai, 2011; Rivet & Krajcik, 2007; Tai, et al., 2006)..

By utilizing projects which involve real-world investigations of STEM concepts, students have the opportunity to make the material relevant and applicable (Rivet & Krajcik, 2007). It is absolutely critical that math and science curriculum be applicable to the students’ lives because it will maintain student interest in STEM (Matlese & Tai, 2011).

In addition to focusing on relevant, project-based learning approaches, more emphasis could also be placed on middle school STEM career awareness. Matlese and Tai (2011) found that there is a strong positive correlation between educators who discuss

STEM careers and student interest in pursuing a STEM career. In fact, many middle grade students often are not aware of the variety of STEM career choices and may not personally know any currently practicing STEM professionals (Alper, et al., 2015; Corbett & Hill, 2016; Kier, Blanchard, Osborne, & Albert, 2014; Wang & Dregol, 2013).

Mentoring relationships also offer an opportunity to expose students to STEM professionals. "If every person mentored one student, think of the impact that would make," said Debra Stewart, former president of the Council of Graduate Schools at a 2015 workshop *Developing a National STEM Workforce Strategy*. "Imagine, then, if that became a national theme—if each STEM professional mentored a student" (p. 95). She proposed creating an inexpensive web-based infrastructure where students could select a STEM professional as a mentor and use e-mentoring via Skype and other technologies to expose students of all ages to the many careers available in STEM.

Research focusing on mentorship and minorities has demonstrated that some traditionally underrepresented populations respond well to mentors who are similar to themselves (Alper, et al., 2015; Cole & Espinoza, 2008; Committee on Improving Higher Education's Responsiveness to Regional STEM Workforce Needs, 2016; Kuenzi, 2008; Morganson, et al., 2010 ; National Governors Association, 2011; Office of Education Access and Success, 2012; U.S. Congress Joint Economic Committee, 2012). Mentorship has been shown to be successful in a number of forms including face-to-face, virtual and blended (Alper, et al., 2015; Corbett & Hill, 2015).

Role of the STEM Action Center in College and Career Pathway Selection by Students

Research indicates that STEM interest should be cultivated by the STEM Action Center using a variety of methods. First, the Center should seek to increase student interest in and awareness of STEM. It should not only focus on community STEM events to increase STEM awareness, but should also support STEM career awareness events targeting middle school students as research indicates that this is a critical time to build STEM awareness. Secondly, classroom or project-based STEM mentors should be leveraged to create awareness. By working with local industries and matching classrooms to industry mentors, the Center could help inform students about potential STEM career options as well as giving them the opportunity to work on a real-world project with a STEM mentor.

Finally, the Center will also sponsor competitions that bring together students, educators, and industry mentors around a specific project or event, serving as a bridge between students and mentors. As with professional development, the Center needs to be keenly aware of the geographical distribution of educators, students, and STEM professionals in order to create opportunities that will meet the needs of Idaho’s widely diverse and dispersed groups.

STEM NEEDS IN INDUSTRY AND WORKFORCE

Idaho is facing a crisis: citizens are not entering STEM pathways at a rate that will sustain Idaho’s continued economic development and future prosperity. According to a report by the Idaho Department of Labor, by 2025 Idaho will be lacking over 63,000 individuals needed to fill projected positions ranging from construction and service jobs to medical and technology positions, many of which involve STEM-related fields (Shaul & Uhlenkott, 2014). This fact illustrates that strengthening Idaho’s STEM pathways is an urgent supply and demand issue. On one hand, workers looking to enter a STEM field have a large selection of jobs from which to choose. On the other hand, Idaho STEM industries and businesses are unable to fill their demand for STEM-skilled workers.

This shortage of STEM workers in Idaho and across the country has raised economic concerns about the ability of the U.S. educational system to produce a large enough workforce to fill the STEM workforce need (U.S. Congress Joint Economic Committee, 2012). Many see this as a pressing requirement to immediately increase efforts to recruit and retain students in STEM pathways (Boothe & Vaughn, 2009; Breiner, et al., 2012; Committee on Improving Higher Education's Responsiveness to Regional STEM Workforce Needs, 2016; Corbett & Hill, 2015; National Governors Association, 2011; Office of Education Access and Success, 2012). Idaho is meeting this challenge head on by increasing the appropriation to the STEM Action Center to $4.5M during FY17 in an effort to increase STEM retention, recruitment, and the supply of workers that are STEM-savvy.

STEM Skills Gaps

Research points to the fact that there is a disconnect between the needs of industry and the preparation of the future workforce in K16 programs. This is not just a technical skills gap, but also a soft skills gap. Many of these gaps could be addressed through increased communication between K12, postsecondary and industry.

At a September 2015 workshop entitled *Developing a National STEM Workforce Strategy* and hosted by the National Academies of Science, 150 participants discussed some of these gaps. The attendees included a wide variety of experts in STEM fields (academic and research) and workforce development specialists from a variety of STEM industries throughout the U.S. From this workshop, numerous potential solutions were developed with the intention of helping to serve as a roadmap to increase the number of individuals pursuing STEM pathways and entering into a STEM career while also reducing the STEM skills gaps that currently exist. National Science Foundation Director Frances Córdova said,

> We have little data indicating what [technical] skills employers require of new graduates entering the workforce. There is a clear need for communication about workforce training expectations between business and higher education, and perhaps no one cares more about this than the very students we educate—the millennials. (p. 4)

This quote illustrates the need for increased conversations between industry and post-secondary institutions (including trade and certificate schools and community colleges) to ensure that these technical STEM skills are clearly recognized, defined, and ultimately implemented into postsecondary instruction with systematic revalidation to confirm that postsecondary institutions keep up with the ever-changing needs of STEM industries.

While technical skills are lacking in some STEM graduates, there is also a soft skills gap. Employers define soft skills to include critical thinking, problem-solving, collaboration, teamwork, and creativity which many employers indicate are missing from recent STEM graduates. Emphasis was again placed on addressing this mismatch by systematic discussions between postsecondary institutions and businesses.

A final topic discussed at the workshop focused on the need for K12 to partner and collaborate with higher education to ensure that students are prepared for life after high school. It is estimated that in Idaho 60% of the jobs in 2020 will require college and/or training beyond a high school diploma (Idaho Department of Labor, 2014). Therefore, as noted by numerous participants in the workshop, successful K12-university partnerships should be assessed for transferability and scalability.

Another report entitled *Promising Practices for Strengthening the Regional STEM Workforce Development Ecosystem* (Committee on Improving Higher Education's Responsiveness to Regional STEM Workforce Needs, et al., 2016) discussed similar recommendations in relation to the need for increased communication between postsecondary and industries to reduce both the technical and the soft skills gaps. This report cites the importance of giving students real-world, hands-on experiences *with* industry especially during the college and university years. The key focus of this report was

> …how to create the kind of university-industry collaboration that promotes higher-quality college and university course offerings, lab activities, applied learning experiences, work-based learning programs, and other activities that enable students to acquire knowledge, [technical] skills, and attributes [soft skills] they need to be successful in the STEM workforce. (p. 1)

The report concluded that while students have degrees in STEM, they lack the requisite technical and soft skills to be employable. Echoing other research, this report also found that "there is also a growing need for students with a breadth of skills outside of their core STEM discipline, these include problem solving, critical thinking, teamwork and collaboration, communication, and creativity" (p. 2). These findings mirror the discussion that occurred at the *Developing a National Workforce Strategy Conference*, in which industries agree that both technical and soft skills are lacking in many STEM graduates and increased collaboration between postsecondary and industry could serve to effectively address this issue.

Currently, there truly is a vast divide between what employers ascertain as "student preparedness" to enter the workforce and what colleges and universities believe. Busteed (2014) found that only 11% of business leaders indicate that "college graduates are well prepared for success at work" (p. 1). This is in stark contrast to the views of chief academic officers of colleges and universities of whom 96% indicate that they are "either somewhat or very confident they are preparing college students for success in the workplace" (p. 1).

Regardless of the perceived lack of preparedness by employers, there is still a great advantage in possessing a STEM degree. Often graduates find that STEM knowledge and STEM skills transfer to a wide variety of non-STEM sectors, allowing them to be highly flexible, easily transferrable, and mobile. For example, launching a business does not require a STEM degree, but a person with a STEM degree can form a STEM-related startup company. The benefit of a STEM degree means that there are many more viable job options for students than for those with non-STEM degrees (Apler, et al., 2016).

Strengthening STEM Pathways

Droegemeier stated at the 2015 *Developing a National STEM Workforce Strategy* conference that,

> …policymakers need to be thinking beyond a distinct and separate STEM workforce and instead be discussing what it would take to create a STEM-capable U.S. workforce. By fostering such a workforce—composed of individuals with

> distinct career interests and aspirations who require different educational and training opportunities throughout their careers—will require government, educational institutions, and businesses to fulfill their individual and collective responsibilities to assess, enable, and strengthen career pathways for all students and incumbent workers. (p. 18)

Droegemeier was emphasizing the need to focus on the acquisition of STEM skills and knowledge (through education and workforce training) by *all* individuals and that while people may take unique paths, the overarching goals should be to create individual opportunity and national competitiveness.

Greg Camilli, professor of educational psychology at Rutgers University's Graduate School of Engineering, expanded on those comments by adding, "We are far from a policy consensus on what constitutes 'high demand' [STEM jobs], and we have not as a nation effectively addressed how to reorient the funding agencies to address a global knowledge-based economy" (p. 39). In this, Camilli was suggesting that it might be time to evaluate federal and state funding (or lack of funding) of STEM and potentially shift funds into high demand areas, such as computer science. The quotes from Droegemeier and Camilli illustrate the need for support from a variety of entities to solve the U.S. STEM workforce issue.

According to a report entitled *Promising Practices for Strengthening the Regional STEM Workforce Development Ecosystem* (Committee on Improving Higher Education's Responsiveness to Regional STEM Workforce Needs, et al., 2016) there are numerous activities which could strengthen entry into STEM pathways. To begin with, businesses should "prioritize the development of as many work-based learning opportunities as possible for students and faculty—including paid internships, apprenticeships, and other experiences that provide hands-on, experiential learning at the worksite" (p. 3). To accomplish this, the report advises that these student and faculty experiences should be paid and should encourage diversity to increase the number of minority populations entering STEM fields. The report also advocates for partnerships among stakeholders and suggests that businesses support employees who want to serve as mentors especially to traditionally underrepresented populations in STEM including involvement in student projects.

In the same report, universities are encouraged to "work with local business leaders and others to 'take stock' of local employer workforce needs, and make a public commitment to better aligning the university's education programs, labs, curricula, and applied learning experiences to future STEM workforce projections" (p. 3). Universities are also encouraged to provide real-world job experiences. "Changing the way STEM education takes place is an area in which corporate America should exercise its influence," said Lida Beninson, an American Association for the Advancement of Science and Technology policy fellow working at the National Science Foundation (Alper, et al., 2015, p. 43). Echoing this statement, the founder and CEO of Ted Childs, a workforce diversification company agreed, "Companies are getting involved in education reform and training because they realize the talent they need tomorrow will not be there if the status quo holds" (Alper, et al., 2015, p. 43).

How Will the Center Address the Needs of Industry?

While creating STEM jobs and ensuring a healthy economy are much larger than the Idaho STEM Action Center, the creation and funding of the Center indicates that

Idaho is on the right path in addressing how to “reorient the funding” to ensure that STEM receives the dollars necessary to continue to grow Idaho’s (and the nation’s) economy. The funding increase to the STEM Action Center in FY17 certainly indicates that Idaho is willing to support STEM throughout the state. In FY16, the Center’s appropriation allowed approximately $250,000 to flow out of the Center, primarily in the form of grants, community events and professional development opportunities. The FY17 appropriation will move about $4 million dollars into Idaho’s STEM pathways, kindergarten through career, allowing the Center to expand its projects and program and implement new opportunities. The necessity to do this in a disciplined fashion with tangible outcomes is absolutely essential.

It is also important to note that the multiplier effect of STEM jobs is tremendous. According to Enrico Moretti (2013), for every STEM job that is created, the multiplier effect is approximately five other jobs. Moretti’s research suggests that these five additional jobs are both professional, such as doctors, lawyers, nurses and teachers, and nonprofessional, such as waitresses and store clerks (p. 60). As a result, focusing on bolstering well-paying, high demand STEM jobs could have a ripple effect throughout Idaho’s economy.

The Center must also evaluate regional and local incentives which would result in education-industry collaborations. This could be accomplished through grant partnerships involving the Center, university and industry. Looking to facilitate and expand “educators in industry” and “industry in the classroom” could also improve the understanding and open dialogues between groups. Working with the Idaho Department of Labor to better understand the workforce development and industry sector grants will ensure that there is not duplication of efforts while also promoting collaboration between agencies and local communities. By increasing communications and interactions between K12, postsecondary and Idaho industries, the Center can help ensure that the students of today have skills for the STEM jobs of the future.

As indicated by Busteed (2014), the perceived “skills mismatch” between employers and postsecondary institutions should be openly discussed by Idaho industries and institutions in order to ensure that students enter the workforce with not only the technical skills, but also the soft skills which are required to be successful in the workplace. Perhaps a meeting which brings together these groups could be facilitated by the Center in an effort to foster these tangible connections.

Another potential solution in Idaho could be a university-industry co-op program. On a recent visit to the University of Waterloo in Canada, an Idaho delegation made up of university computer science representatives and government officials discovered the potential benefits to both students and employers via a co-op system. Through this model, college students would experience four months of full-time work without the additional burden of coursework. These work experiences would be incrementally integrated throughout their college career, giving students rich work-based skills that will prepare them to enter the workforce with both the technical and soft skills that businesses prefer. With this in mind, the STEM Action Center will look to partner with Idaho universities and focus on computer science in the upcoming year by piloting a university-industry co-op model in an effort to not only improve the employability skills of students, but to also provide industries with a series of employees that can fill full-time positions. This university-industry pilot program could serve to close the employability and skills gaps.

As summarized by Busteed (2014), “schools and colleges don’t have jobs and internships—employers do. If we don’t get schools and businesses working together to give students these opportunities, everyone will lose” (p.1). Therefore, actively connecting these groups is going to be critical to the long-term impacts of the Center and the effects of STEM workforce-preparedness throughout Idaho.

CONCLUSION

The Idaho STEM Action Center has a unique opportunity to expand and support STEM throughout Idaho. By deriving clear and consistent definitions of STEM, high quality STEM PD and traditionally underrepresented populations in STEM as well as understanding STEM pathways and industry/workforce needs, the Center will be able provide more targeted, consistent, systemic support. Through clearly defining high quality STEM PD, the Center can ensure that opportunities meet the needs of Idaho educators and ultimately, maximize students’ persistence in STEM pathways. Evaluating the needs of Idaho industries and businesses and working to bring groups together could serve to increase the number of STEM students prepared to enter the workforce upon completion of postsecondary programs. By continuing to work with Idaho industries, colleges and the K12 system to incorporate more workforce ready projects, it will be possible to meet the goals and objectives outlined in the Idaho STEM Action Center’s Strategic Plan (Appendix B).

The most critical piece of the puzzle at this time is educator PD. Educators need tools to successfully implement STEM coursework, inspire students with hands-on, real world projects, and have access to industry mentors to ensure that students persist in STEM pathways and perhaps through to a STEM career. That is why during FY17, 25%

of the Center's budget will be devoted to K12 STEM PD. In FY17, the STEM Action Center anticipates it will spend $1 million dollars on STEM PD. Consequently, every aspect of PD must be critically analyzed, from selection to implementation, and teacher evaluations as well as long-term outcomes of both teachers and students. Synthesizing the literature on this topic and defining related key terms are important first steps in forming structures that will support these efforts.

The Center is working with Change the Equation to develop an online platform to accept proposals for STEM PD. To ensure that these opportunities are high quality, proposals must speak to a variety of measures including: need; evaluation; sustainability; replication/scalability; partnerships; capacity; challenging and relevant content; STEM practices; inspiration; and underrepresented groups (Appendix C). As indicated throughout this research, these measures are critical aspects of successful PD and should be the primary focus of high quality STEM PD for Idaho educators.

Finally, an additional set of questions is being layered on top of the Change the Equation rubric which will focus on Idaho specific questions (Appendix D). This additional information will require that the opportunities are truly integrated as that is the Center's definition of STEM. Replicability and sustainability in *Idaho* are also important aspects for PD to be supported by the Center. Demonstrating that the PD will assist Idaho's educators who work with traditionally underrepresented populations in STEM is another important aspect which the Center will consider.

However, these two research-based rubrics need to be evaluated by Idaho educators to ensure efficacy. With Idaho's vast geographic distribution and diversity population, Idaho educators need to have input into not only assessing PD, but also improving upon the research-based rubrics for future opportunities. In FY17, educator PD will be selected based solely on the research-based rubrics (Appendix C and D). The opportunities which are selected from these rubrics will then be thoroughly evaluated by Idaho educators who participate in the PD. Educators will provide intensive feedback (both quantitative and qualitative) on the PD to ensure that the opportunity met their needs and was of high quality (as defined by the research-based rubrics). In addition to feedback on FY17 STEM PD opportunities, educators will also be asked to join focus groups where they will communicate with the Center about what they desired from STEM PD. This will be another way that the Center can improve upon the research-based method. In this fashion, selected opportunities will be evaluated and the research-based PD selection rubrics will be modified in subsequent years to reflect Idaho educator inputs.

High quality STEM PD is not only mandated in Idaho Code §67-823, it is also absolutely essential to provide educators with the tools to help them recruit and retain Idaho's future STEM workforce. With nearly one million dollars devoted to STEM PD in FY17, it is absolutely vital that the Center get this right! Moretti (2013) summarized it best, "We are at one of those major historical crossroads that determines the fate of nations for decades to come." Applying this to Idaho, the work of the Idaho STEM Action Center will determine the fate of STEM in Idaho for decades to come.

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APPENDIX A – Idaho Department of Labor, STEM Occupations by Subdomain

Key	Sub-domain	
	1	Life and Physical Science, Engineering, Mathematics, and Information Technology Occupations
	2	Social Science Occupations
	3	Architecture Occupations
	4	Health Occupations
		Split across 2 sub-domains
	Types of occupations	
	A	Research, Development, Design, or Practitioner Occupations
	B	Technologist and Technician Occupations
	C	Postsecondary Teaching Occupations
	D	Managerial Occupations
	E	Sales Occupations
Sub-domain and Type of Occupation	2010 SOC code	2010 SOC title
1.A	15-1111	Computer and Information Research Scientists
1.A	15-1121	Computer Systems Analysts
1.A	15-1122	Information Security Analysts
1.A	15-1132	Software Developers, Applications
1.A	15-1133	Software Developers, Systems Software
1.A	15-1134	Web Developers
1.A	15-1141	Database Administrators
1.A	15-1142	Network and Computer Systems Administrators
1.A	15-1143	Computer Network Architects
1.A	15-1199	Computer Occupations, All Other
1.A	15-2011	Actuaries
1.A	15-2021	Mathematicians
1.A	15-2031	Operations Research Analysts
1.A	15-2041	Statisticians
1.A	15-2099	Mathematical Science Occupations, All Other
1.A	17-2011	Aerospace Engineers
1.A	17-2021	Agricultural Engineers
1.A	17-2031	Biomedical Engineers
1.A	17-2041	Chemical Engineers
1.A	17-2051	Civil Engineers

1.A	17-2061	Computer Hardware Engineers
1.A	17-2071	Electrical Engineers
1.A	17-2072	Electronics Engineers, Except Computer
1.A	17-2081	Environmental Engineers
1.A	17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
1.A	17-2112	Industrial Engineers
1.A	17-2121	Marine Engineers and Naval Architects
1.A	17-2131	Materials Engineers
1.A	17-2141	Mechanical Engineers
1.A	17-2151	Mining and Geological Engineers, Including Mining Safety Engineers
1.A	17-2161	Nuclear Engineers
1.A	17-2171	Petroleum Engineers
1.A	17-2199	Engineers, All Other
1.A	19-1011	Animal Scientists
1.A	19-1012	Food Scientists and Technologists
1.A	19-1013	Soil and Plant Scientists
1.A	19-1021	Biochemists and Biophysicists
1.A	19-1022	Microbiologists
1.A	19-1023	Zoologists and Wildlife Biologists
1.A	19-1029	Biological Scientists, All Other
1.A	19-1031	Conservation Scientists
1.A	19-1032	Foresters
1.A	19-1041	Epidemiologists
1.A	19-1042	Medical Scientists, Except Epidemiologists
1.A	19-1099	Life Scientists, All Other
1.A	19-2011	Astronomers
1.A	19-2012	Physicists
1.A	19-2021	Atmospheric and Space Scientists
1.A	19-2031	Chemists
1.A	19-2032	Materials Scientists
1.A	19-2041	Environmental Scientists and Specialists, Including Health
1.A	19-2042	Geoscientists, Except Hydrologists and Geographers
1.A	19-2043	Hydrologists
1.A	19-2099	Physical Scientists, All Other
1.B	15-1131	Computer Programmers
1.B	15-1151	Computer User Support Specialists
1.B	15-1152	Computer Network Support Specialists
1.B	15-2091	Mathematical Technicians
1.B	17-1021	Cartographers and Photogrammetrists
1.B	17-1022	Surveyors

1.B	17-3012	Electrical and Electronics Drafters
1.B	17-3013	Mechanical Drafters
1.B	17-3019	Drafters, All Other
1.B	17-3021	Aerospace Engineering and Operations Technicians
1.B	17-3022	Civil Engineering Technicians
1.B	17-3023	Electrical and Electronics Engineering Technicians
1.B	17-3024	Electro-Mechanical Technicians
1.B	17-3025	Environmental Engineering Technicians
1.B	17-3026	Industrial Engineering Technicians
1.B	17-3027	Mechanical Engineering Technicians
1.B	17-3029	Engineering Technicians, Except Drafters, All Other
1.B	17-3031	Surveying and Mapping Technicians
1.B	19-4011	Agricultural and Food Science Technicians
1.B	19-4021	Biological Technicians
1.B	19-4031	Chemical Technicians
1.B	19-4041	Geological and Petroleum Technicians
1.B	19-4051	Nuclear Technicians
1.B	19-4091	Environmental Science and Protection Technicians, Including Health
1.B	19-4092	Forensic Science Technicians
1.B	19-4093	Forest and Conservation Technicians
1.B and 2.B	19-4099	Life, Physical, and Social Science Technicians, All Other
1.B and 3.B	17-3011	Architectural and Civil Drafters
1.C	25-1021	Computer Science Teachers, Postsecondary
1.C	25-1022	Mathematical Science Teachers, Postsecondary
1.C	25-1032	Engineering Teachers, Postsecondary
1.C	25-1041	Agricultural Sciences Teachers, Postsecondary
1.C	25-1042	Biological Science Teachers, Postsecondary
1.C	25-1043	Forestry and Conservation Science Teachers, Postsecondary
1.C	25-1051	Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary
1.C	25-1052	Chemistry Teachers, Postsecondary
1.C	25-1053	Environmental Science Teachers, Postsecondary
1.C	25-1054	Physics Teachers, Postsecondary
1.D	11-3021	Computer and Information Systems Managers
1.D	11-9121	Natural Sciences Managers
1.D and 3.D	11-9041	Architectural and Engineering Managers
1.E	41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
1.E	41-9031	Sales Engineers
2.A	19-3011	Economists
2.A	19-3022	Survey Researchers

2.A	19-3031	Clinical, Counseling, and School Psychologists
2.A	19-3032	Industrial-Organizational Psychologists
2.A	19-3039	Psychologists, All Other
2.A	19-3041	Sociologists
2.A	19-3051	Urban and Regional Planners
2.A	19-3091	Anthropologists and Archeologists
2.A	19-3092	Geographers
2.A	19-3094	Political Scientists
2.A	19-3099	Social Scientists and Related Workers, All Other
2.B	19-4061	Social Science Research Assistants
2.C	25-1061	Anthropology and Archeology Teachers, Postsecondary
2.C	25-1062	Area, Ethnic, and Cultural Studies Teachers, Postsecondary
2.C	25-1063	Economics Teachers, Postsecondary
2.C	25-1064	Geography Teachers, Postsecondary
2.C	25-1065	Political Science Teachers, Postsecondary
2.C	25-1066	Psychology Teachers, Postsecondary
2.C	25-1067	Sociology Teachers, Postsecondary
2.C	25-1069	Social Sciences Teachers, Postsecondary, All Other
3.A	17-1011	Architects, Except Landscape and Naval
3.A	17-1012	Landscape Architects
3.C	25-1031	Architecture Teachers, Postsecondary
4.A	29-1011	Chiropractors
4.A	29-1021	Dentists, General
4.A	29-1022	Oral and Maxillofacial Surgeons
4.A	29-1023	Orthodontists
4.A	29-1024	Prosthodontists
4.A	29-1029	Dentists, All Other Specialists
4.A	29-1031	Dietitians and Nutritionists
4.A	29-1041	Optometrists
4.A	29-1051	Pharmacists
4.A	29-1061	Anesthesiologists
4.A	29-1062	Family and General Practitioners
4.A	29-1063	Internists, General
4.A	29-1064	Obstetricians and Gynecologists
4.A	29-1065	Pediatricians, General
4.A	29-1066	Psychiatrists
4.A	29-1067	Surgeons
4.A	29-1069	Physicians and Surgeons, All Other
4.A	29-1071	Physician Assistants

4.A	29-1081	Podiatrists
4.A	29-1122	Occupational Therapists
4.A	29-1123	Physical Therapists
4.A	29-1124	Radiation Therapists
4.A	29-1125	Recreational Therapists
4.A	29-1126	Respiratory Therapists
4.A	29-1127	Speech-Language Pathologists
4.A	29-1128	Exercise Physiologists
4.A	29-1129	Therapists, All Other
4.A	29-1131	Veterinarians
4.A	29-1141	Registered Nurses
4.A	29-1151	Nurse Anesthetists
4.A	29-1161	Nurse Midwives
4.A	29-1171	Nurse Practitioners
4.A	29-1181	Audiologists
4.A	29-1199	Health Diagnosing and Treating Practitioners, All Other
4.B	29-2011	Medical and Clinical Laboratory Technologists
4.B	29-2012	Medical and Clinical Laboratory Technicians
4.B	29-2021	Dental Hygienists
4.B	29-2031	Cardiovascular Technologists and Technicians
4.B	29-2032	Diagnostic Medical Sonographers
4.B	29-2033	Nuclear Medicine Technologists
4.B	29-2034	Radiologic Technologists
4.B	29-2035	Magnetic Resonance Imaging Technologists
4.B	29-2041	Emergency Medical Technicians and Paramedics
4.B	29-2051	Dietetic Technicians
4.B	29-2052	Pharmacy Technicians
4.B	29-2053	Psychiatric Technicians
4.B	29-2054	Respiratory Therapy Technicians
4.B	29-2055	Surgical Technologists
4.B	29-2056	Veterinary Technologists and Technicians
4.B	29-2057	Ophthalmic Medical Technicians
4.B	29-2061	Licensed Practical and Licensed Vocational Nurses
4.B	29-2071	Medical Records and Health Information Technicians
4.B	29-2081	Opticians, Dispensing
4.B	29-2091	Orthotists and Prosthetists
4.B	29-2092	Hearing Aid Specialists
4.B	29-2099	Health Technologists and Technicians, All Other
4.B	29-9011	Occupational Health and Safety Specialists

4.B	29-9012	Occupational Health and Safety Technicians
4.B	29-9091	Athletic Trainers
4.B	29-9092	Genetic Counselors
4.B	29-9099	Healthcare Practitioners and Technical Workers, All Other
4.C	25-1071	Health Specialties Teachers, Postsecondary
4.C	25-1072	Nursing Instructors and Teachers, Postsecondary
4.D	11-9111	Medical and Health Services Managers

APPENDIX B – Idaho STEM Action Center Strategic Plan

Idaho STEM Action Center

2017 – 2020 Strategic Plan

Introduction, History and Future

Idaho is facing a crisis: Idaho citizens are not entering the STEM pipeline at a rate that will meet the current and future workforce needs of Idaho employers and sustain Idaho's economic development and future prosperity. According to a report by the Idaho Department of Labor, by 2025 Idaho will be lacking approximately 63,000 individuals needed to fill projected positions ranging from construction and service jobs to medical and technology positions, many of which involve STEM-related skills and knowledge. Numerous research studies including the Georgetown Center for Education and the Workforce, Idaho Business for Education and Idaho Department of Labor demonstrate that more than 60% of the projected jobs by 2020 will require a college degree or certificate beyond a high school diploma.

During the 2015 Idaho legislative session, a small group of visionary legislators, education leaders and industry stakeholders began a STEM Caucus that led to legislation creating the Idaho STEM Action Center. House Bill 302 became law on July 1, 2015 (Idaho Code §67-823). This new law permits some flexibility in implementation which will allow the Center to develop unique grant, training, professional development and student opportunities aligned to Idaho's workforce needs from kindergarten through career. Decisions related to the STEM Action Center are guided by a nine member Board appointed by the Governor. The Board is a unique blend of educational leaders from the State Board of Education and the State Department and seven Idaho industry leaders including the Idaho Department of Labor, the Idaho Department of Commerce, Idaho National Laboratory (INL) and Micron.

The Idaho STEM Action Center's enabling legislation focuses on five broad areas: a) student learning and achievement (including underrepresented populations); b) student access to STEM including equity issues; c) teacher professional development and opportunities; d) college and career STEM pathways; and e) industry and workforce needs.

During the 2016 legislative session, two pieces of legislation were passed that focused on a statewide computer science initiative. The STEM Education Fund was created through Senate Bill 1279 into which two million dollars was deposited from the state's general fund to support the computer science initiative (House Bill 379).

The legislative intent of the computer science initiative is to increase statewide efforts in computer science awareness and access, kindergarten through career. These efforts will continue to be driven by the needs of Idaho's industry and developed in partnership with industry, the state board of education, professional-technical education, the state department of education, administrators, educators and the community at large. The ultimate goal is to secure industry participation in the funding of the state's computer science education initiatives.

The Idaho STEM Action Center supports the recommendations of the Idaho Task Force for Improving Education and the State Board of Education's STEM Strategic Plan, which support the state's 60% goal and seeks to meet the workforce needs of Idaho business and industry.

As a result of these statewide efforts, Idaho will become a STEM business destination. Idaho will have a citizenry that not only recognizes the importance of STEM, but also possesses the necessary STEM skills for the workforce. A highly skilled STEM workforce will lead to increased investment and business opportunities throughout Idaho. Educators will have the necessary STEM skills to engage students. Students will possess the 21st century skills that employers require: critical thinking, problem-solving, collaboration and innovation. The result of this multi-tiered approach will be an increase in the number of businesses in Idaho and the number of STEM jobs available for Idahoans which will serve to bolster Idaho's economy and lead to long-term economic prosperity for the state and her citizens.

Mission Statement:

Connecting STEM education and industry to ensure Idaho's long-term economic prosperity.

Vision Statement:

Produce a STEM competitive workforce by implementing Idaho's Kindergarten through Career STEM education programs aligned with industry needs.

GOAL #1: Coordinate and facilitate implementation of STEM programs throughout Idaho

Objective 1A: Create/identify and fund STEM opportunities for Idaho students

Performance Measure 1: Number of students receiving services from the STEM Action Center

-*Baseline 1*: During FY16, 10,428 students received services from the STEM Action Center, primarily through grants disseminated to educators and/or adult mentors

-*Benchmark 1:* Increase the number of student served annually until at least 25,000 students are served throughout Idaho each year

How was this benchmark established? 25,000 students represent nearly 10% of the K12 populations which would be served annual by the Center. Given the current number of staff, this is the maximum number that the Center can serve effectively.

Objective 1B: Identify and facilitate delivery of high quality STEM educator professional development

Performance Measure 1: Number of educators receiving high quality STEM professional development

-*Baseline 1*: Four opportunities impacting 1,200 educators were offered in FY16

-*Benchmark 1*: Increase the number of opportunities by at least one each year until 10 opportunities are reached

-*Benchmark 2*: Continue to expand opportunities until at least 5,000 educators are reached annually

How were these benchmark established? Four opportunities were offered by the Center staff in FY16. With the addition of another staff member, contractors and an increased appropriation, ten opportunities (serving 5,000 educators) would be the maximum number to ensure that educators receive the highest quality STEM professional development as directed in Idaho Code §67-823

Objective 1C: Develop new and expand existing STEM Action Center grant programs for educators and the community at large

Performance Measure 1: Total number of grants distributed

-*Baseline 1*: Two grant opportunities for educators and one for students were made available in FY16

-*Benchmark 1*: Increase the existing opportunities to at least five including computer science opportunities for educators and at least two opportunities for students

How was this benchmark established? Given the current level of Center staffing, seven grant opportunities are the maximum number that can be managed annually and effectively.

<u>Performance Measure 2</u>: Percentage of applicants receiving funding

-*Baseline 1*: 22% of educator requests were filled for the PK12 grant in FY 16.

-*Benchmark 1*: Fill at least 30% of the PK12 grant requests by FY20

How was this benchmark established? The number of grant requests will likely continue to increase and the need for additional support will be required to fill the requests. 30% will allow for a competitive process and will ensure that applications are thoughtful and through with measurable outcomes and evident need.

Objective 1D: Support the Idaho State Board of Education STEM Strategic Plan

GOAL #2: Align education and workforce needs throughout Idaho

Objective 2A: Engage industry to support STEM education outcomes

<u>Performance Measure 1</u>: Number and amount of industry contributions and personal donations to Center to promote and enhance opportunities for K-career

Baseline 1: $62,000 in industry contributions and $10,000 in personal donations to the Center in FY16 = $72,000

Benchmark 1: Increase industry contribution each fiscal year until $500,000 is reached annually

Benchmark 2: Hold additional fundraisers to double personal donations by FY20 by advertising the Idaho income tax credit option

How were these benchmark established? If the contributions to the Center double annually, this benchmark can be reached. As the Center becomes more established, industry will become more familiar with Center projects and programs. As a result, partnerships are anticipated to grow and donations will increase.

Objective 2B: Involve industry to collaborate with the STEM Action Center and focus outcomes and goals on workforce needs and opportunities

-<u>Performance Measure 1</u>: Number of opportunities for workforce certifications in high demand fields

Baseline 1: The STEM Action Center currently does not support these types of certifications; a baseline will be established in FY17

Benchmark 1: Benchmark(s) will be set after the FY17 baseline data is collected and analyzed

<u>Performance Measure 2</u>: Number of trainings in STEM and/or computer science and number of computer science and/or STEM endorsement received

-*Baseline 1*: No efforts were deployed in FY16

-*Benchmark 1*: Benchmark(s) will be set after the FY17 baseline data is collected and analyzed

Objective 2C: Create opportunities for schools to partner with local companies to provide for student and teacher mentoring and internships in computer science and/or STEM.

<u>Performance Measure 1</u>: Number of mentors and students involved in the Center's virtual, project-based mentorship platform

-*Baseline 1*: No virtual mentorship project-based platform currently exists. In FY17 an RFP will be released and a vendor will be selected to design a platform

-*Benchmark 2*: Baseline user data will be collected in FY18 and user benchmarks will be established for FY19

Performance Measure 2: Number of industries and students involved in the Computer Science Coop Project

-*Baseline 1*: No Coop program currently exists in Idaho

-*Benchmark 1*: Baseline data will be collected in FY17 with a scaling plan in place for FY18 – FY20

Objective 2D: Support computer science initiatives, programs, events, training and other promotions throughout the state for the benefit of school districts, students, parents and local communities

Performance Measure 1: Number of community events related to computer science

-*Baseline 1*: No support was provided in FY16

-*Benchmark 1*: Benchmarks will be set after FY17 once baseline data is collected and analyzed

Performance Measure 2: Number of educator professional development opportunities in computer science

-*Baseline 1*: In FY16, the Center supported one opportunity involving 44 educators with $8,000 in continuing education credits and training through Code.org

-*Benchmark 1*: By FY20 increase to at least three opportunities and support at least 150 educators

How was this benchmark established? Given the increase in the FY17 appropriation and the addition of staffing to the Center, it will be possible to support at least three opportunities annually and collect effective outcome data.

Performance Measure 3: Number of student competitions in computer science

-*Baseline 1*: Computer science student competitions were not supported by the Center in FY16

-*Benchmark 1*: Support at least two computer science competitions per year by FY20

How was this benchmark established? With the additional Center staffing, computer science competitions can be researched for implementation in Idaho. Currently, computer science competitions are not common and students are not abundant so two competitions would allow student choice while ensuring sufficient numbers of competitors.

GOAL #3: Increase awareness of STEM throughout Idaho

Objective 3A: Collaborate with Idaho's state board of education, division of career-technical education, the state department of education, public higher education institutions and industry to develop a communication plan related to the computer science initiative and STEM

Performance Measure 1: Number of collaboratively created communication resources

-*Baseline 1*: No collaborative communication resources were created in FY16

-*Benchmark 1*: Benchmarks will be established after FY17 baseline data is collected

Objective 3B: Communicate about STEM and computer science initiatives, programs, events, training and other promotions throughout the state for the benefit of school districts, students, parents and local communities

Performance Measure 1: Number of users of the STEM Action Center online portal of resources and best practices

-*Baseline 1*: No online portal currently exists. Portal will be created in FY17 and deployed by FY18

-*Benchmark 1*: Benchmarks will be established after FY18 baseline data is collected

-*Benchmark 2*: Deploy online pilot database during FY18 which annually identifies at least five (5) best practice innovations used in Idaho schools that have resulted in growth in interest and performance in STEM and/or computer science by students and teachers

How was this benchmark established? This benchmark is required by Idaho Code §67-823.

Performance Measure 2: Number of industries involved in the STEM Matters Media Campaign

-*Baseline 1*: No media campaign currently exists

-*Benchmark 1*: Benchmarks will be established after FY17 baseline data is collected

Performance Measure 3: Number of monthly communication efforts using the monthly newsletter, website and social media such as Facebook

-*Baseline 1*: Four newsletters were sent in FY16, reaching 1,500 subscribers

-*Benchmark 1*: Increase the number of newsletter subscribers by at least 10 subscribers per month until 2,000 subscribers are reached

How was this benchmark established? All K12 principals and superintendents were automatically enrolled in the newsletter. Self-subscriptions occur at a slower rate of 10 on average per month.

Objective 3C: Increase access of students, educators and communities that represent traditionally underrepresented populations in STEM and computer science

Performance Measure 1: Number of grants and professional development opportunities which target traditionally underrepresented populations in STEM and/or computer science

-*Baseline 1*: Three grants and one professional development opportunity were provided to support traditionally underrepresented populations in STEM in FY16

-*Benchmark 1*: Support at least three grants and two professional development opportunities in both STEM and computer science by FY20 to support traditionally underrepresented populations including rural, socioeconomic status, race/ethnicity and gender.

How was this benchmark established? As dictated in Idaho Code §67-823, the Center must support grants and professional development for traditionally underrepresented populations. Given the current staffing and funding levels, supporting at least five opportunities would allow high quality customer service and ensure effective outcome measurements.

External Factors Affecting Goals

1) Infrastructure
    a. As a small agency of three full time individuals, infrastructure can significantly influence outcomes. Contractors will be hired to fulfill legislative intent for Center programs and projects which will lead to increase productivity for the Center. Additional staffing would help the Center meet its goals in a more timely fashion.
    b. The Center needs to continue to leverage existing resources to prevent duplication. This will require knowledge of activities occurring outside of the Center and clear, timely communication between numerous entities which could be challenging.
2) Funding and Economic Conditions
    a. Funding will be needed in an ongoing capacity to fulfill the intent of both the STEM Action Center legislation and the Computer Science Initiative.
    b. Partnering with industry will require industry awareness and confidence in the Center as well as the financial confidence in the economy.
    c. Grant availability will also drive certain aspects of Center activity and may vary annually.
3) Statewide Awareness
    a. In order to ensure statewide equity, it will be critical that the Center raise awareness of the availability of grants, professional development opportunities and scholarships. Increased communication efforts will be necessary to facilitate this awareness.
    b. When soliciting requests for proposals, the Center must assume that it will receive numerous applications that are within the proposed budgets.

c. Unrecognized demand for STEM Action Center resources could lead to an increased need to reviewers/volunteers to determine recipients of project and program opportunities.

d. When offering professional development and grant opportunities, messaging to ensure statewide interest and diversity will be paramount to guarantee educators and communities from diverse backgrounds are represented.

APPENDIX C (ATTACHED SEPARATELY as PDF) – Change the Equation STEM Works Design Principals Rubric

APPENDIX D – Idaho-Specific PD Rubric

Idaho STEM Action Center: STEM Professional Development Program Proposal

STEM professional development programs that meet Change the Equation's criteria for "accomplished" or "promising" programs will be included in the Change the Equation STEMworks database (http://changetheequation.org/stemworks). To be considered for the Idaho STEM Action Center Scale-Up Initiative, STEM professional development programs must also answer questions that address objectives specific to this Idaho initiative.

Idaho STEM Professional Development Program Proposal Guidelines:

- A select number of programs will be identified for Idaho STEM Action Center Scale-Up.
- Budgets must be clearly defined to the "smallest unit", ideally an individual educator or school.
- Programs must be scalable with fidelity in all Idaho communities.
- No more than two proposals may be submitted by a single provider.
- Program proposers who seek feedback and insight on their program may request the collective advice of managers and evaluators through the program officer only, in order to ensure fairness, equal opportunity, and neutrality on the part of the network managers and evaluators.

Idaho Specific STEM Professional Development Program Proposal Objectives:

Meeting the CTEq "accomplished" or "promising" criteria, will ensure that applicant programs embrace and include the key elements of professional development in their programs, and is the basic requirement for consideration for Idaho STEM Action Center Scale-Up. Further, *successful Scale-Up applications must answer Idaho specific questions and demonstrate how they meet Idaho specific objectives will be met. To meet these programs must:*

- Provide educators with strategies to better engage with educators in other disciplines, create and teach interdisciplinary programs, and evaluate interdisciplinary work.
- Have the human and resource capacity to be replicable anywhere in Idaho regardless of community size or location.
- Have the human and resource capacity to be sustainable anywhere in Idaho regardless of community size or location.
- Be based on current best-practices, research and data and 1) immerse participants in inquiry and models inquiry forms of teaching; 2) be intensive and sustained; 3) engage teachers in concrete tasks and be based on teacher experiences with students; 4) deepen teacher content skills; and 5) be grounded in a common set of professional development standards. See Supovitz JA and HM Turner (2000) J Res Sci Teach 37(9):963-80.
- Communicate strategies, methodologies, and content that can be used by educators to effectively engage all learners in an integrated approach to STEM, including traditionally underrepresented populations such as female students, ethnic minority groups, students living in rural communities and those of low socioeconomic status. Provide educators strategies to better embed the practice of 21st century skills in their teaching. Go to http://www.p21.org/about-us/p21-framework for more information about 21st century skills.

Timeline:

- August 22, 2016 – STEM Professional Development Program Provider application opens.
- October 4, 2016 – STEM Professional Development Program Provider application closed.
- December 2, 2016 – Programs notified of selections
- December 14, 2016 – Complete STEM Professional Development Program descriptions for statewide announcement.

Idaho Specific STEM Professional Development Program Proposal Elements:

Applicant Please Note: *Attachments are not allowed unless specifically note in the instructions, although you are welcome to reference websites within the body of the narrative to which reviewers may view additional information. There is no assurance that reviewers will view your links, however.*

1. Interdisciplinary Aspects: Does the project integrate multiple disciplines?

Accomplished (4-5)	Developing (2-3)	Undeveloped (0-1)
Project explicitly demonstrates how it integrates at least one STEM discipline with one or more other STEM or non-STEM disciplines	Project mentions multiple disciplines, but does not clearly specify how they will be integrated into the program.	Project makes no clear attempt to engage participants in multiple disciplines
Project unambiguously integrates or	Project attempts to integrate or	Project makes no clear attempt to

merges disciplines beyond STEM.	merge disciplines beyond STEM.	integrate or merge disciplines beyond STEM.
Project explicitly demonstrates how it addresses Idaho content standards and/or specifies content objectives where Idaho content standards do not exist in multiple disciplines.	Project explicitly aims to address content standards and/or specific content objectives where specific Idaho content standards do not exist in multiple disciplines, but does not clearly specify how.	Project makes no clear attempt to meet standards or specific objectives in multiple disciplinary areas.

In 350 words or less, describe ways that your program will help educators promote interdisciplinary learning. Interdisciplinary learning relates to or involves two or more academic disciplines that are usually considered distinct. It consciously applies methodology and language from multiple disciplines to examine a central theme.

To access the Idaho Content Standards:
http://www.sde.idaho.gov/academic/standards/index.html

2. Replicability in Idaho: Does the program demonstrate the human and resource capacity to be replicated in any Idaho communities regardless of size or location?

Accomplished (4-5)	Developing (2-3)	Undeveloped (0-1)
Project demonstrates how it can be scaled and replicated in Idaho communities regardless of size or location and offers tool to support it.	A process for replicating the program in Idaho communities regardless of community size of location is offered, but it is not well documented.	There is no effort to show how the project might be scalable to sites regardless of community size of location in Idaho.
Project regularly communicates results publicly to promote replication in Idaho to new sites of all sizes and locations.	Project provides information to other sites but only on an ad hoc basis, when requested and not to communities of all sizes and locations in Idaho.	There is no effort to show how the project might be scalable to sites of all sizes and locations in Idaho.
Project demonstrates that it can be replicated and adapt to many new sites and local conditions in Idaho.	Project is documented so it can be replicated, but it does not account for local conditions that may affect implementation.	Project is tied exclusively to a specific or only a few sites because of its unique resources, personnel or other requirements.

In 300 words or less, describe how your program can be scaled and replicated in Idaho. Demonstrate that the program can adapt to diverse new sites and conditions, regardless of the size of the community or its location. Successful scale-up programs should demonstrate the capacity to expand the delivery model beyond the original site and sustain continuity of program outcomes over time. Describe program capacity. What infrastructure in Idaho will you establish or utilize to sustain the program as it grows? If possible, provide examples of successful program expansion/replication to communities of different sizes and geographic remoteness.

3. Sustainability in Idaho: Does the program demonstrate the human and resource capacity to be sustainable in Idaho communities regardless of their size or remoteness?

Accomplished (4-5)	Developing (2-3)	Undeveloped (0-1)
Plans are clear for sustaining the	Opportunities to sustain the	No viable plan or commitment to

program in limited resource settings and regardless of community size or location.	program have been identified, but they are more hopeful than viable in some settings.	ensure the program's long-term survival in communities of all sizes and locations is presented.
Projected benefits to teaching and/or learning justify the cost per participant and are likely to be affordable in communities with limited resources.	The cost per participant is high but justified, and there is a viable plan to make the program affordable in communities with limited resources.	The program cannot demonstrate that it will be affordable in communities with limited resources.

In 300 words or less, describe your program's potential for sustainability in Idaho in limited resource settings including small and remote communities. If possible, provide examples.

4. Professional Development: **Does the professional development address STEM teaching and learning criteria?**

Accomplished (4-5)	Developing (2-3)	Undeveloped (0-1)
Includes the theory and modeling of common practices of STEM disciplines of solving problems, gathering and synthesizing information, using models, using technology to develop/demonstrate conceptual understanding, and communicating findings.	Discusses, but does not model common practices of STEM disciplines	Does not or minimally addresses the common practices of STEM disciplines.
Supports development of educators' conceptual understanding of content.	Focuses on development of content knowledge but not the conceptual understanding of content.	Does not address conceptual understanding or competency.
Ensures rigorous academic concepts are coupled in a real-world context, student assessment tasks resemble real-world reading and writing, and the environment is learner-centered.	Includes some, but not all of the practices listed.	Does not or minimally addresses the practices listed.
Provides sustained support for implementation including provider support, stakeholder engagement, educator leadership and collaboration, and career awareness	Provides implementation support, but support is not sustained and/or does not engage all stakeholders.	Does not demonstrate a plan for support beyond the initial training.
Project explicitly demonstrates how it builds critical thinking, problem-solving, creativity and teamwork skills.	Project explicitly aims to promote these skills but it does not clearly specify how.	Project makes no clear attempt to engage participants in these skills.

All PD programs are expected to provide professional development that will enhance teachers' content knowledge and provide them with pedagogical skills to provide instruction based on these criteria. In 300 words or less, please provide a detailed description of how the professional development associated with your project will address the STEM teaching and learning criteria and career awareness.

5. Engaging All Learners: Does the project provide the tools to equip educators to effectively engage all learners in an integrated approach to STEM?

Accomplished (4-5)	Developing (2-3)	Undeveloped (0-1)
Clearly communicates strategies, methodologies, and content that can be used by educators to effectively engage all learners in an integrated approach to STEM, including Idaho target groups of females, rural students and racial/ ethnic minorities and students with low socioeconomic status.	Clearly communicates strategies, methodologies, and content that can be used to effectively engage all learners in an integrated approach to STEM for some but not all of Idaho's target groups.	Does not or poorly communicates strategies, methodologies, and content that can be used to effectively engage all learners in an integrated approach to STEM.
Ensures content is accessible and can be modified to accommodate all learners.	Content is accessible but there is limited evidence that methods can be adapted to accommodate all learners.	Content is not accessible and there is limited evidence that methods can be adapted to accommodate all learners.
Identifies and communicates diverse role models related to the program content, and conveys the importance of exposing students to relevant role models.	Identifies and communicates diverse role models related to the program content, or conveys the importance of introducing students to relevant role models but not both.	Does not communicates diverse role models related to the program content, or the importance of introducing students to relevant role models.
Project integrates best practices for traditionally underrepresented populations by teaching content and language simultaneously. There is evidence of differentiation of materials – readings and products are available that require less language for students to show rigorous learning without language barriers.	Project aims to integrate best practices for traditionally underrepresented populations in STEM, beyond teaching vocabulary.	Project just teaches vocabulary.
Communicates effective strategies for educators to help all students believe in their own ability to understand and do STEM.	Communicated strategies are not clearly research based and/or are applicable to only some students.	Does not communicate effective strategies for educators to help all students believe in their own ability to understand and do STEM.

In 300 words or less, provide evidence of the program's effectiveness in successfully engaging all students, including those from groups under-represented in STEM. Under-represented groups include African Americans, Latinos, females, low socio-economic status, and/or rural, etc. Demonstrate how the project integrated or merges disciplines beyond STEM which may include Arts and Culture when possible and appropriate.

6. Project Resources: Does the project ensure the budget to handle significant growth?

Accomplished (4-5)	Developing (2-3)	Undeveloped (0-1)
Project budget is presented with clarity and sufficiently meets the needs of the project for optimal success.	Project budget has areas of question regarding its ability to meet the needs of the project, but overall seems adequate, or the program overestimates the resources required.	Project budget is unreasonable and not adequately justified.