

# STEM Hub Capacity Building to Support Evaluative Thinking and Continuous Improvement

An interim report prepared for Oregon's Chief Education Office

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## Executive Summary

**Introduction.** The Educational Policy Improvement Center (EPIC) and the Center for Research on Lifelong STEM Learning at Oregon State University (OSU) are collaborating on a yearlong capacity-building research project in order to better understand the common and unique features and strengths of Oregon’s STEM Hubs. The project is intended to examine the growth and success of the STEM Hubs and their backbone organizations, and to build capacity for evaluative thinking by supporting Hubs in data-driven decision making and continuous improvement. The project is the first of its kind to systematically examine multiple layers of collaboration between publicly funded STEM-focused organizations, partner organizations, and their broader communities.

STEM Hubs are multisector partnerships that link local P–20 educators, workforce and economic development groups, community-based organizations, and business/industry representatives in a collaborative effort to transform the landscape of STEM (Science, Technology, Engineering, and Mathematics) and CTE (Career and Technical Education) teaching and learning. STEM Hubs are implementing strategies that include (amongst others) educator professional development on best practices in STEM instruction; in- and out-of-school, hands-on STEM learning experiences for students; and connections to fast-growing STEM employment opportunities in Oregon.

**Purpose.** The research goals shared by EPIC and OSU are as follows:

1. Better understand the common and unique features and strengths of Oregon’s STEM Hubs by examining growth and success of the STEM Hubs and their backbone organizations.
2. Build capacity for evaluative thinking by supporting STEM Hubs in data-driven decision making and continuous improvement.
3. Provide data that lead to actionable items and recommendations built on best practice.

**Scope of interim report.** The current report draws from preliminary survey and interview data to provide initial insights into the STEM Hubs’ backbone organizations and the “ecosystem” of local or regional integrated STEM teaching and learning within and across each STEM Hub. Emerging themes from the data are presented in this report, with a full summative report to be prepared in the summer of 2017.

**Methods.** Data were collected from STEM Hub backbone staff and leaders and STEM Hub partners using an online survey designed to assess features of collaboration. A select group of STEM Hub partners were also interviewed in order to better understand the unique features and context of each partnership.

**Preliminary results.** Preliminary data indicate that investments into backbone structures and programming by the state have been instrumental in creating local STEM Hubs as communities of practice around providing rich STEM learning opportunities for all. Across STEM Hubs, partners and backbone staff are reporting positive change as a direct result of Hub activity, even those from the second cohort, which was only recently funded. Additionally, STEM Hubs are reporting a wide variety of ideas for promoting further success of their respective STEM Hubs. Overall, backbone staff and partners report satisfaction with the structure and functioning of their regional Hub, with most concerns mainly focused on sustained funding and sufficient staffing.

## Key Findings

- The design of STEM Hubs is tied to **multiple conceptual frameworks** that are themselves based on established theory for learning or for creating social change. We therefore find that the design principles of STEM Hubs can be considered research-based.
- Partners and backbone staff across all STEM Hubs agree that **K–12 STEM education** is a main focus of their work. How they approach this main goal differs somewhat among the Hubs and represents local or regional priorities.
- Hubs differ in regard to their focus on **Career and Technical Education (CTE)**, which is the focus of some but not as strongly developed in others. The same is true for early learning, which tends to be less of a focus for most Hubs (or may not be as strongly identified as a focus by partners). Since Hubs overlap in some communities with Early Learning Hubs or Regional Achievement Collaboratives, early learning initiatives or CTE education might be addressed by those entities.
- Partners and backbone staff of STEM Hubs are reporting **positive change** as a direct result of the Hubs, even those from the second cohort, which was only recently funded. Direct benefits included more and improved STEM programming for children, support for teachers and other educators, improved coordination and cooperation between local partners, or better communication between partners and between STEM education stakeholders and the wider communities of the Hubs.
- Direct positive change in new Hubs is mostly reported in the area of **communication** for new Hubs, indicating that the process of forming Hubs itself played an important role in community building.
- STEM Hubs are reporting a wide variety of ideas for promoting further success of their respective STEM Hubs. Although **sustained funding** and **sufficient staffing** together were mentioned the most, other aspects such as improved external communication and outreach to better embed the Hub into its community, strategic planning to further focus the Hub, improvements to the partnership arrangement, or developing more programs were also mentioned, as was that Hubs were working fine and did not need any improvement at all. There are no silver bullets for strengthening Hubs at this time, but there are many ideas that emerged from the surveys that Hub leaders can make use of in their process of continuous improvement.

“There was NOTHING like this in our region prior to the Hub. It has brought schools, communities, students, and ideas together in our region. I can see the wheels turning in so many of our students, at such an early age. There has also been a side effect of greater positive outlook among our students, knowing there are possibilities that await them after or even before high school graduation.”

~ Frontier Oregon STEM Hub Partner

- Overall, STEM Hub members are reporting **positive connections** within and to the STEM Hubs, indicating that the communities of the STEM Hubs are developing. Overall, partners and (more so) backbone staff report that they can make positive contributions to the Hubs, and that they developed trusted relationships between partners and between partners and the Hub’s leadership. Measures of the Hub’s “health” (i.e., the degree to which individuals have voice within the Hub and trust other members of the Hub) score high. However, they also confirm at times the need to ensure that all partners need to be fully included in the Hub’s community.
- Initial evidence exists that at least some more established and adjacent STEM Hubs are making connections between each other. We will be investigating this evidence in more detail for the final report, and we will report on the connections between Hubs and other institutions (such as Early Learning Hubs and Regional Achievement Collaboratives) charged with improving education in Oregon. Connections among STEM Hubs and between Hubs and other networks are ultimately needed to ensure some form of “diffusion of innovation” in Oregon, and to create a **statewide community** that can be leveraged for improving STEM education and can act as a voice for education in the public sphere.
- Many STEM Hub activities and collaborations in and between schools, community organizations, and business and industry would not have been possible without **leadership and resources from the local STEM Hub**.
- STEM Hubs have been successful in **leveraging funding** support across diverse sources. However, data also suggest that funding issues—including the timing, amount, and sustainability of state funding to support STEM Hub activities—are at the forefront of the minds of STEM Hub leaders and partners alike.

## Oregon STEM Hubs: An Introduction

The Chief Education Office, in collaboration with the Oregon Department of Education (ODE), directly or through partner education agencies, has funded several collaborative partnership programs focused on improving key education outcomes throughout Oregon. These collaborative partnerships include the Early Learning Hubs, Regional Achievement Collaboratives (RACs), and a statewide network of Regional STEM (Science, Technology, Engineering, and Mathematics) Hubs. Each collaborative is focused on coordinating regional communication and partnerships, improving key student outcomes, building capacity and sustainability for change, and encouraging and supporting local and statewide multisector engagement.

In 2013, the Oregon Legislature passed House Bill 3232, Strategic Investments: Connecting to the World of Work, as a means to provide significant funding to strengthen and expand Oregon’s focus on the importance of developing strong programs in science, technology, engineering arts/design, and mathematics (STEM/STEAM). Connecting Oregon students to the world of work by expanding STEM and career and technical education (CTE) programs aligns Oregon with the national priority of keeping our students competitive and preparing them for leadership roles within an increasingly globalized and technical workplace. There is an increasing demand for workers with the content knowledge and skills required to fill fast-growing and high-paying positions within the STEM fields. Filling these positions with locally grown talent also requires that Oregon create and sustain a college-going culture in Oregon schools by supporting programs that prepare students for a successful transition to certificate programs and/or college. Additionally, providing a talent pool of individuals with the skills desired by employers in the STEM occupations will attract and retain STEM businesses and industries in Oregon, contributing to regional and statewide prosperity. Furthermore, students with a strong background in STEM education will contribute to a more scientifically literate populace that will have the critical thinking skills necessary to make balanced and thoughtful decisions that will benefit society as a whole.

“Partners from around the region now meet through the STEM Hub where they learn about needs, assets, challenges, and the current work of a variety of organizations within the areas of education and workforce development. The need for better systems of networking is apparent as these partners connect and realize the impact of shared resources and collaborative partnership.”  
~ Greater Oregon STEM Hub Backbone Staff

In a rapidly changing, technologically rich, global society, literacy in STEM is required to participate in, and drive, an innovation-based economy. Jobs in the 21st century require individuals with the knowledge, skills, and mindsets that will enable them to adapt to flexible workforce needs and to compete for high-wage, high-demand careers. Employment projections by the U.S. Department of Labor’s Bureau of Labor Statistics show that more than 80% of the fastest-growing occupations projected over the next ten years require significant mathematics or science preparation<sup>1</sup>. It is widely recognized that high-quality, cross-disciplinary STEM education encourages skills such as critical thinking, problem solving, collaboration, and creativity.

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<sup>1</sup> Jones, 2014

The statewide network of regional STEM Hubs is an economic development strategy created in order to meet two key goals set forth by the Chief Education Office’s STEM Investment Council:

- Double the percentage of students in 4th and 8th grades who are proficient or advanced in mathematics and science.
- Double the number of students who earn postsecondary credentials requiring proficiency in high-wage, high-demand STEM fields.

To date, 11 STEM Hubs have received funding to establish multisector partnerships linking local educators, community members, and business/industry representatives in a collaborative move to transform the landscape of STEM teaching and learning. Figure 1 shows the geographic distribution of the STEM Hubs for the 2015–2017 biennium.

**Cohort 1**

- Central Oregon STEM Hub
- Greater Oregon STEM Hub
- Oregon Coast STEM Hub
- Portland Metro STEM Partnership
- South Metro-Salem STEM Partnership Hub
- Umpqua Valley Regional STEAM Hub

**Cohort 2**

- Columbia Gorge STEM Hub
- East Metro STEAM Partnership
- Frontier Oregon STEM Hub
- Lane County STEM Hub
- Southern Oregon STEM Hub

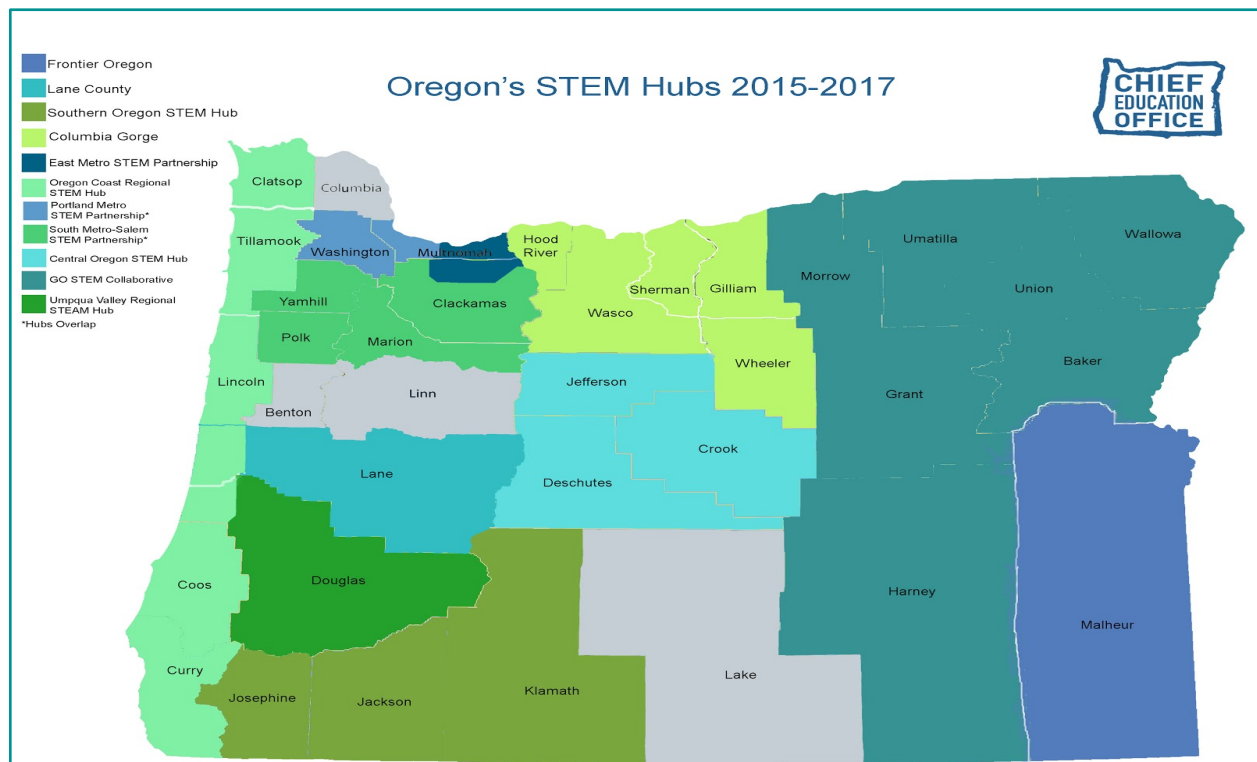


Figure 1. Geographic distribution of Oregon’s STEM Hubs.

## STEM Hubs as Ecosystems

Since their inception, STEM Hubs have each developed their own individual identities, priorities, and outcomes. Some of the collaboratives have established initiatives in their respective regions for a number of years before the recent Chief Education Office/ODE funding, with well-developed networks of partnerships and programming efforts already reaching a large number of students and educators. Others, after receiving funding, have only begun to organize themselves internally and put structures into place to support locally identified goals. Regardless of their developmental position, all the collaboratives share a commitment to improving key student outcomes in their regions through a variety of activities, including the direct deployment of programming activities for students and educators, as well as the support of programming activities already put into place by partner organizations. The collaboratives have also been seeking ways in which to elevate and expand their current work through connections with other RACs and STEM Hubs around the state, and identifying ways in which they can share resources that will increase efficiency and effectiveness.

Creating local ecosystems for STEM education constitutes a shift from institutional focus to learner focus. This approach to improving STEM education, which is the principle behind the creation of the STEM Hubs, is research-based and has been detailed in two recent reports by the National Academy of Science's National Research Council<sup>2 3</sup> as well as in two working papers for a consortium of private foundations and corporate funders who pursue a common goal of creating systemic positive change in STEM education nationwide<sup>4 5</sup>. The key idea that emerged from the research literature on how best to support learning was to build on, nurture, support, expand, and actively manage a STEM learning ecosystem for each learner. Instead of asking what individual organizations can or should do in isolation of others to support a STEM learner, the focus lies on collective impact of all organizations that support learning of individuals within their local contexts (see Figure 2).

In STEM Hubs, the principles of local STEM learning ecosystems are operationalized based on three well-established theories: that of communities of practice<sup>6</sup>, of professional learning networks<sup>7</sup>, and principles of collective impact<sup>8</sup>. Business and other professional communities often use connected networks for sharing best practices. A “community of practice” (CoP)<sup>9 10</sup> is where individuals with common goals and common professional practices form supportive communities that influence individuals via shared norms, customs, practices and various layers of communication and engagement. A very specific application of this idea can be found in so-called networked improvement communities, or NICs<sup>11</sup>, which have been used successfully to improve school culture.

“As a steering committee member, I'd like to hear more about what the other Hubs are doing that is successful. The Hubs are relatively new, and several more sprouted up this year, so this may not have been feasible, but it should be now.”

~Oregon Coast STEM Hub Partner

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<sup>2</sup> National Research Council, 2014

<sup>3</sup> National Research Council, 2015

<sup>4</sup> Traphagen & Traill, 2014

<sup>5</sup> Traill & Traphagen, 2015

<sup>6</sup> Wenger, 1998

<sup>7</sup> Bryk et al., 2011

<sup>8</sup> Kania & Kramer, 2011

<sup>9</sup> Lave & Wenger, 1991

<sup>10</sup> Wenger, 1998

<sup>11</sup> Bryk, Gomez, & Grunow, 2011



Networks enable individuals from many different contexts to participate according to their interests and expertise while sustaining collective attention on progress toward common goals. Since these communities strive toward common goals, the principles of collective impact (CI) might help accelerate progress and lead to agreement on common measures of success. Collective impact organizations are defined by five characteristics: (1) a common agenda, (2) shared outcome measurement, (3) continuous communication among partners, (4) mutually reinforcing activities, and (4) “backbone” support from committed staff<sup>12</sup>. STEM Hubs are encouraged to use the elements of collective impact to form and sustain networked improvement communities of practice that allow for productive participation at any level. In this way, STEM Hubs represent the designed STEM Learning Ecosystem for a community.

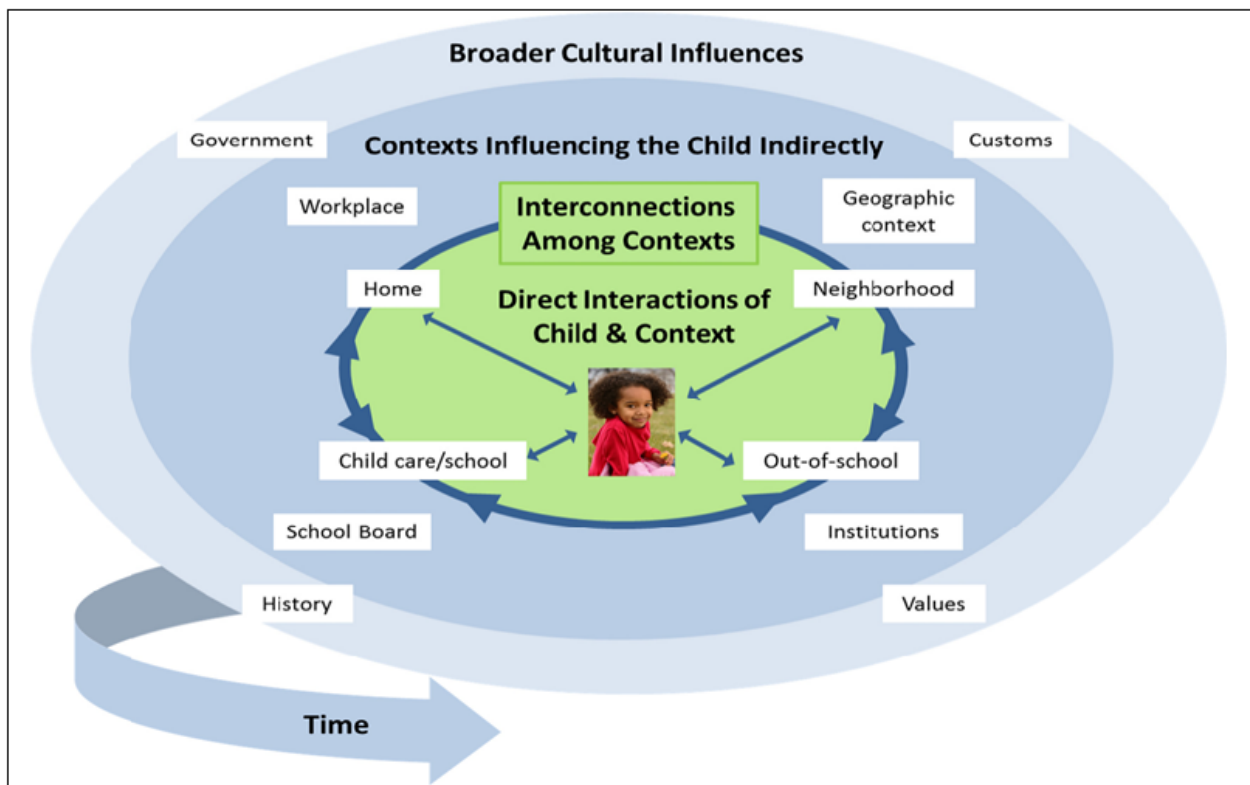


Figure 2. STEM learning ecosystem for a community.

<sup>12</sup> Kania & Kramer, 2011

## Backbone Organizations

Key to the functioning of the collaboratives is the development and sustainability of backbone organizations within each of the STEM Hubs, which act as the core organizers and communicators as a multisector partnership begins to take form. The backbone organization may be structured in any of several ways: It may be an organizational entity on its own (e.g., a nonprofit), a subdivision of a larger agency, or even a group of individuals across agencies that share the duties of the backbone. Regardless of the specific goals and mission of the collaborative, the backbone organization engages in six common activities that provide support and impetus for the working of the collaborative as a whole: (1) Guide vision and strategy, (2) support aligned activities, (3) establish shared measurement practices, (4) build public will, (5) advance policy, and (6) mobilize funding<sup>13</sup>. The data collected in this project will help provide a clearer picture of what success looks like to each stakeholder and why the backbone organization is an essential piece of the collaborative infrastructure and a strategy that is worth supporting and pursuing. One key goal of the current exploration is to examine the growth and success of the STEM Hubs and their backbone organizations.

Through a collaborative, iterative process with feedback provided by representatives from the Chief Education Office, STEM Hubs, and RACs, researchers are developing a set of tools that will provide each STEM Hub and the Chief Education Office with consistent information regarding the effectiveness of the backbone organizations. Five indicators were selected by the Chief Education Office, from a broader set of previously developed backbone effectiveness indicators, to evaluate growth and change within the collaboratives and to gather information on what resources/support are needed and can be provided by the state. The target indicators for backbone effectiveness consist of the following:

1. The extent to which decision makers and influencers from a diversity of different sectors and cultures champion the effort and are engaged in governance of the collaborative
2. The degree of staff/partner satisfaction with the partnership
3. The use and dissemination of disaggregated data
4. The level of visibility in the community via press coverage, reports, media, etc.
5. The ratio of state dollars to collaborative leveraged resources (in-kind and funds)

Effectiveness will be viewed through a developmental progression lens, with the understanding that collaboratives are located within different contexts and at different levels of implementation.

“Our District STEM Plan has helped to communicate goals and strategies with our district staff. The STEM leadership team developed by our Hub has provided support and focus on energizing our STEM efforts K–12 in our district. The Hub continuously provides support for our work through quarterly meetings and resources on the website.” ~ South Metro-Salem STEM Partnership Hub Partner

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<sup>13</sup> Turner, Merchant, Kania, & Martin, 2012

The STEM Hubs in Oregon have been critical in providing resources to promote and encourage STEM learning in K–12 students and to facilitate meaningful connections between educators, community leaders, and business leaders that might otherwise not exist. The Oregon Coast STEM Hub is an excellent example of how a funded backbone structure can make a meaningful impact in the lives of educators and students.

The Oregon Coast STEM Hub serves a very large geographic area, which includes the entire Oregon coast as well as 45 miles inland. Although the area shares a common coastal and marine-oriented culture, this large geographical dispersion can make it difficult to coordinate shared professional development and student learning activities.

In response to these challenges, the Hub has hired coordinators for the North Coast and South Coast in order to bridge these distances. The Hub has been instrumental in enhancing existing learning experiences—such as underwater robotics teams—by promoting increased collaboration between schools. School districts up and down the coast have access—completely free of charge—to a checkout trailer, which stores about \$75,000 worth of science and technology supplies, activities, and classroom curricula. These resources have allowed teachers to introduce rich STEM-related learning activities that would not have been possible without the STEM Hub. Josh Jannusch, Assistant Principal of Warrenton High School and North Coast coordinator for the STEM Hub, has remarked, **“The STEM Hub has switched the mindset. . . . School districts are now working together to form robotics teams, they are working together to enhance professional learning communities. There is a renewed sense of ‘we’re in this together’ rather than keeping things hidden in the schools.”**

## Scope of the Interim Report

The current project is the first to systematically examine multiple layers of collaboration between publicly funded STEM-focused organizations, partner organizations, and their broader communities. The ultimate goal of this effort is to provide specific, data-driven recommendations that will help to strengthen and sustain the positive, regional partnerships between the STEM Hubs and their communities as they work together to promote positive STEM outcomes across Oregon. This interim report is intended to provide initial insights into the functioning of the backbone organizations of the STEM Hubs, and to explore the nature of the collaboration between the Hubs and their various partner organizations. Specifically, we explore the following questions:

1. What is the extent to which STEM Hubs seek out and secure financial and other resources to support their work?
2. What sectors are represented by the STEM Hubs' partner organizations?
3. How do STEM Hub backbone staff and STEM Hub partner organizations view the following:
  - a. The Hub's progress toward its goals
  - b. The nature and quality of the Hub's collaborative efforts
  - c. The extent to which data are collected and used to guide decisions
  - d. The development of a local STEM ecosystem
  - e. The perceived accomplishments of the STEM Hubs to date
  - f. The development of community around STEM Hubs
  - g. The connections that exist between STEM Hubs

STEM Hubs often **act as organizers and conveners of events that give young people a first hand look at jobs and opportunities in STEM fields.** Saint Alphonsus Medical Center partnered with the Frontier STEM Hub to hold an event that was viewed as **“very innovative”** and a **“resounding success”** by Kenneth Hart, the President of Operations at Saint Alphonsus. More than 300 7th-grade students from across Malheur County came together on a local college campus. The event highlighted seven different jobs in a hospital, presenting the background and training needed for each job. Not only was the event able to plant the seed of college by being held on a college campus, but the experience also linked the allied health component of their local CTE program to science and technology training.

## Results

All 11 STEM Hubs were represented in the interim data set. However, due to the different demands that were placed on the STEM Hubs in terms of data collection and reporting during the fall of 2016, there was some variability in the extent and breadth of participation in this survey. More information regarding the survey and its development is provided in the Technical Appendix.

### Leveraged Funding

As mentioned above, one of the primary roles of the backbone organization is to mobilize funding to support its activities. The STEM Hubs coordinate funds from diverse sources to support common priorities and strategies. All Cohort 1 Hubs provided preliminary data at the time of this report; in total they have leveraged more than \$6 million in funds across a variety of funding sources, including \$3.5 million in state funding grants; \$1.8 million in other grants; \$580,000 in direct partner support; \$65,500 in other donated funds; \$281,000 in in-kind donations (e.g. space, equipment, curriculum supplies, etc.); and \$221,000 in volunteer time. Four Cohort 2 Hubs provided preliminary data at the time of this report; in total they have leveraged \$243,000 in funds, including \$210,000 in other state funding sources; \$119,500 in grants; \$70,200 in direct partner support; \$93,900 in in-kind donations; and \$87,300 in volunteer time.

### Sector Representation and Frequency of Communication by Partner Organizations

Figure 3 shows that the majority of partner organizations affiliated with the STEM Hubs are from the education sector (e.g., school districts, community colleges, and universities). Community organizations include local museums, nonprofit organizations, and advocacy centers. Business and industry organizations include small businesses and large corporations. Other organizations identified by respondents include workforce development boards and health organizations.

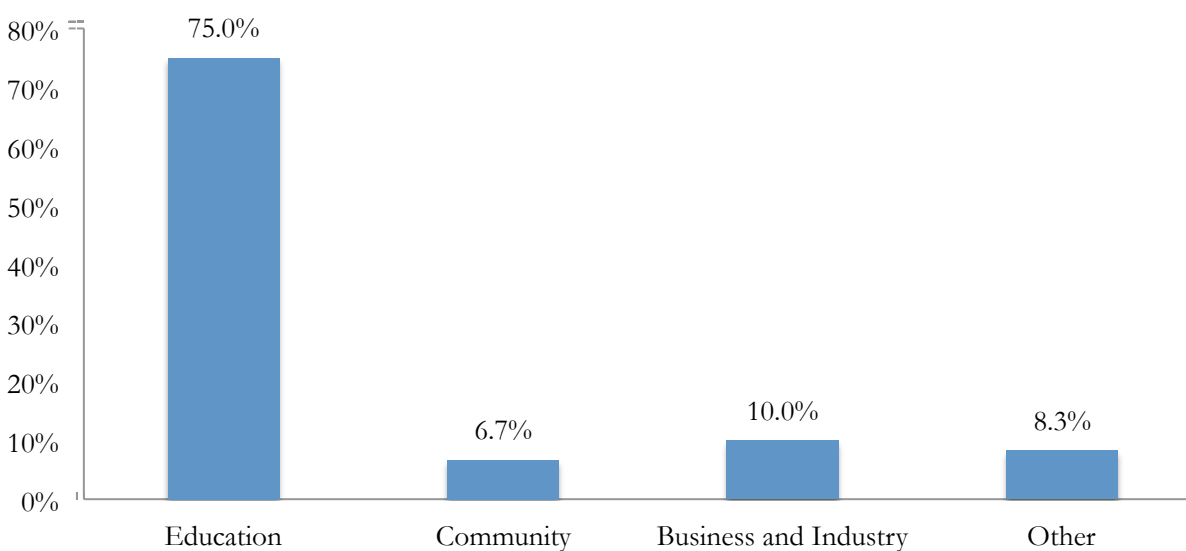


Figure 3. Representation of partner organization sectors.

Partner organizations are in frequent communication with their affiliated STEM Hubs, with 70% of partner organizations interacting with STEM Hubs at least a few times each month (see Figure 4).

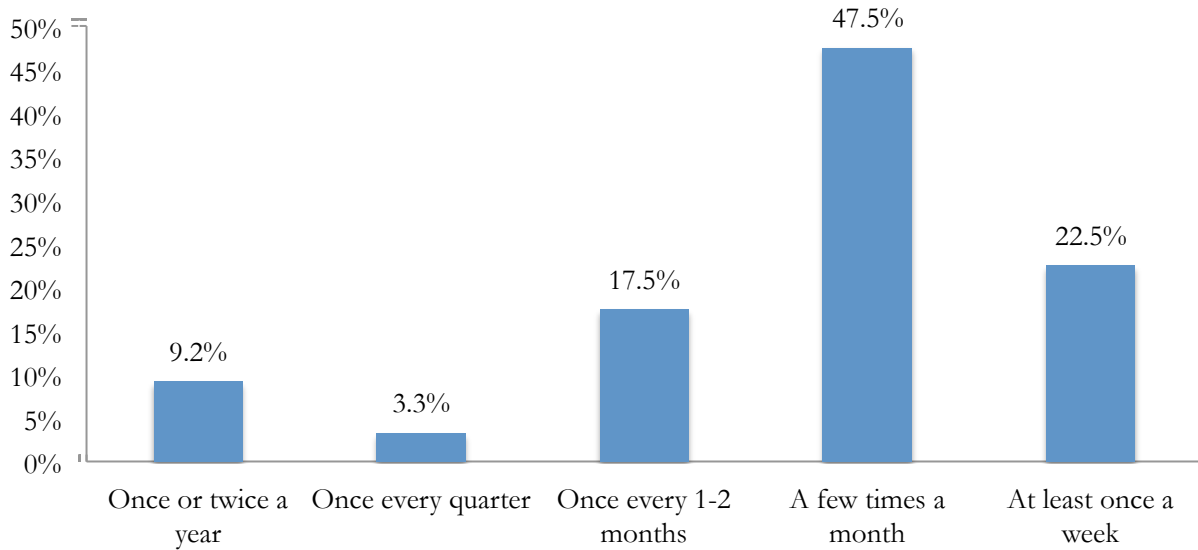


Figure 4. Frequency of partner communication with STEM Hubs.

### Progress Toward STEM Hub Goals

Figure 5 shows that most STEM Hub leaders/backbone staff and their partner organizations report that the STEM Hubs are making satisfactory or exemplary progress toward their goals.

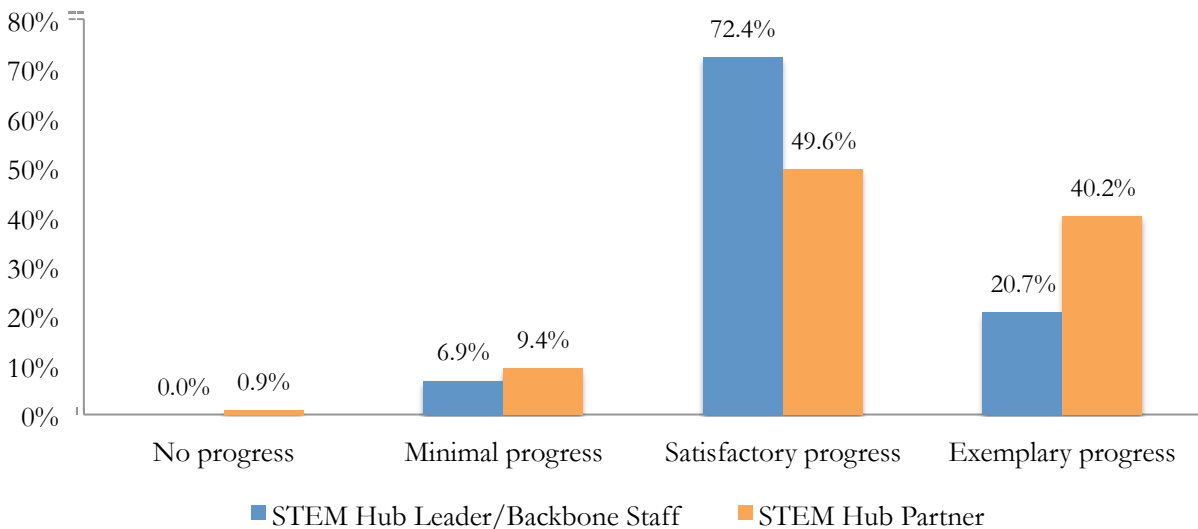
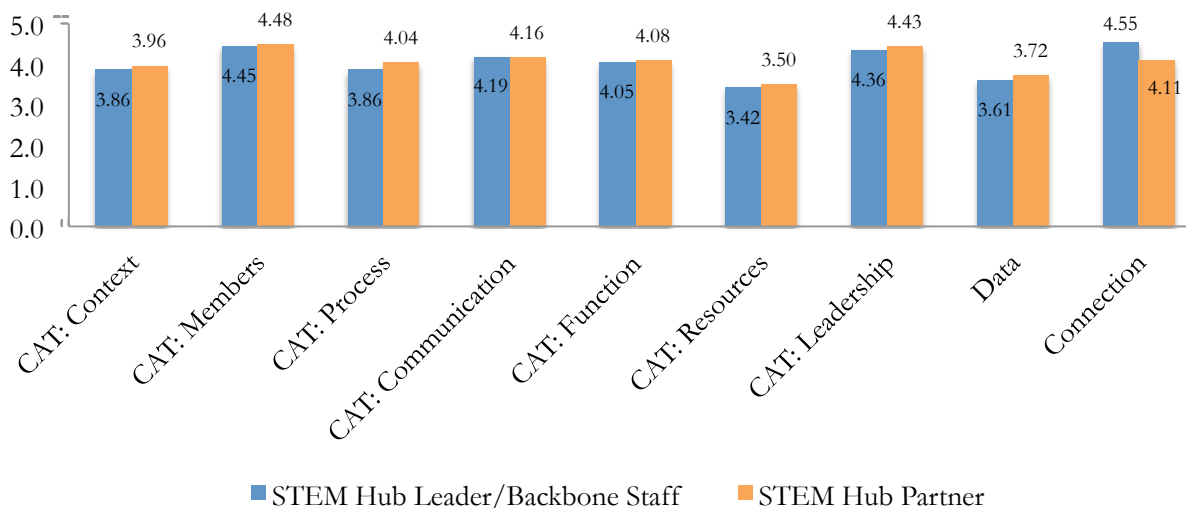


Figure 5. To what extent are STEM Hubs progressing toward their goals?

## Collaborative Efforts and Data Use in STEM Hubs

The majority of the items contained in the survey related to the functioning of the backbone structure; these items were adapted from the Collaboration Assessment Tool, or CAT (see the Technical Appendix for further detail). Additional researcher-developed items related to Data and Connection were included in this portion of the survey as well. Figure 6 shows the mean scores for each of the survey subscales for the backbone staff and partner survey respondents. Open-ended items from the survey were also analyzed and used to provide a deeper understanding of the subscale results for each construct where applicable.



*Figure 6.* Subscale means from the Collaboration Assessment Tool (CAT) scale and other scales. *Note.* Subscale scores range from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Subscale means were calculated by taking the simple average of all responses within each set of subscale questions, excluding missing values and *Not Applicable* responses.

Preliminary results indicate that both STEM Hub leaders/backbone staff and their partner organizations share very similar views on each dimension of the CAT. Due to the preliminary nature of the data set, we did not conduct formal significance tests to determine whether STEM Hub leader responses were statistically different from STEM Hub partner responses. Tests of significance will be presented for the final report.

**Context.** This subscale refers to the shared history and context between collaboratives and their partners and the collaborative’s role within the greater community. Many respondents stated that their STEM Hub had increased awareness of the diversity of community partners in their region and how they are working to promote STEM and STEM activities. As one respondent reported, “*I would say the most positive change has been a[n] increased understanding by partners of what other agencies and partners are doing in the local communities to educate our students.*” Additionally, some respondents felt that the STEM Hub in their region was able to bring together and connect partners that would not necessarily work together, including those located in rural areas. At the same time, other respondents reported that they would like to see their STEM Hub become more visible to the larger community; suggestions range from having more information available on the STEM Hub website to increasing the scope of their outreach activities.

**Members.** The items in this subscale are designed to collect data about the skills, attitudes, and beliefs of collaborative members to examine how these characteristics affect successful outcomes. Many survey respondents reported that their STEM Hub had brought together multiple partners toward a common goal. Some respondents noted it would benefit their STEM Hub to continue to work to increase the representativeness of the partners to reflect underserved populations in their communities.

**Process.** Items in this subscale refer to the processes enacted by the collaborative to achieve their goals and objectives. No open-ended items in the initial analyses fell into this category.

**Communication.** This subscale includes items about both the formal and informal communication between collaborative members and outreach with the larger community. Many survey respondents reported satisfaction with communication both within their STEM Hub and across partners, while other respondents felt that communication could be improved, suggesting more increased communication about current projects among partners, as well as the need for an avenue for the partners to communicate among themselves outside the STEM Hub backbone structure.

**Function.** This subscale refers to the articulation of the goals and objectives of the collaborative. Some survey respondents suggested that a narrower focus of the goals and objectives would benefit the STEM Hub in their region.

**Resources.** The items in this subscale were used to examine both the financial and human resources required by and available to the collaborative to meet goals and build capacity and sustainability. Across all STEM Hubs, many survey respondents reported the need for clear pathways to long-term, stable funding in order to ensure the continued success and growth of their STEM Hub. A need for more dedicated staff to help enact the goals and outreach of the STEM Hubs was also a common theme.

**Leadership.** This subscale refers to the presence of successful collaborative leader characteristics. Within individual STEM Hub responses, many survey respondents reported their satisfaction and mentioned specific instances of leadership exhibited by their STEM Hub backbone leaders.

**Data.** This subscale was created by the research team to examine the presence and use of data sources and measurement tools used to gauge progress and make decisions. Several survey respondents suggested that STEM Hubs should provide more data to partners on the impact of the work being done. One respondent noted that data visualization tools could be used to enhance partner understanding, while another suggested “*awareness raising about successes and impacts on students.*”

**Connection.** The items in the subscale address personal connections of participants in the Hub, both in their thoughts about their contributions and their work with others in the Hub (e.g., voice, respect, and trust). The results from this subscale are discussed in further detail in the next section.



## Development of a Local STEM Learning Ecosystem as a Result of STEM Hubs

The initial intention behind STEM Hubs was to create local ecosystems for STEM learning designed as collective impact communities that involve a variety of partners from across a multitude of societal sectors. STEM Hubs were also intended to address local or regional needs and focus on the most pressing issues in STEM or CTE education, in light of potentially other local institutions that might address relevant issues for Hubs, such as Regional Achievement Collaboratives or Early Learning Hubs.

We used three methods to characterize the main purpose or focus of each Hub: a quantitative survey question that asked respondents to indicate whether their Hub was addressing a range of particular issues; an open-ended question in interviews with Hub staff and partners that asked respondents to succinctly describe the main purpose of their Hubs, and a document analysis of STEM Hub websites, as well as STEM Hub profiles compiled by EPIC. In the final report we will triangulate across these three methods to understand what the key directions for each Hubs are, what issues are likely being addressed, and what issues likely remain to be addressed. Results from this analysis allow Hubs to determine whether the perception of their Hub is aligned with their strategic goals, provide the state with a potential gap analysis that can focus future investments or guidance, and provide policymakers with a simple “narrative” of what their investment in STEM Hubs is trying to accomplish regionally and across the state.

Respondents were asked in a closed-ended question to agree or disagree with a variety of statements that represented “what their STEM Hub was all about.” Table 1 summarizes the results for the five STEM Hubs for which we had more than 10 responses per Hub. Figure 7 illustrates the key differences across all Hubs in the answers of backbone staff and partners; they occurred for increasing graduation rates, reaching underserved audiences, and supporting local STEM workforce development. In each of these categories, backbone staff agreed on at least a ten percent higher rate than partners. At this point, we can show detailed results for the focus of STEM Hubs for five Hubs. Across all Hubs, improving K–12 STEM Education, preparing students for STEM careers, and providing teacher/educator professional development ranked high as key aspects for Hubs. Supporting local STEM workforce development rated slightly lower, but was identified across all hubs as relevant. More disagreement was shown across the other statements:

- Three out of five STEM Hubs responded “no” more than 50% of the time for two categories—“increasing graduation rates” and “providing early learning experiences”—and respondents from one STEM Hub responded “no” more than 50% of the time to “improving/providing CTE.”
- Some of the STEM Hubs had “yes” answers to more than 90% of the options (besides the K–12 STEM Education option), which indicates that the partners and staff see a focus on “providing teacher professional development” for the Portland Metro STEM Hub and “reaching underserved communities” for the South-Metro Salem STEM Partnership Hub, for example. Note that these are trends we are seeing from initial data, and we have not yet conducted significance tests on this data yet.

- Across represented Hubs, more than 60% of respondents indicated that their Hub was about “reaching underserved communities” and “improving out-of-school learning opportunities.” Agreement was higher in some Hubs in these categories, with “yes” responses from more than 80% or 90% of respondents.

When asked in open-ended questions, the majority of partners across the STEM Hubs mentioned that they provide students with opportunities for STEM learning in general (other than CTE), followed by various types of support for teachers, general support for the Hub, career development opportunities for students (i.e., allowing students to know what careers might be available to them), and specifically providing career and technical education for students (see Figure 8). Much of the CTE capacity mentioned in the survey was concentrated in one Hub, the Central Oregon STEM Hub (six out of a total of ten). The other four were scattered across four other Hubs. Only four percent of respondents specifically addressed issues of diversity and inclusion in their respective Hubs. About half of the partners reported their partnership as supporting the STEM Hub (49%) and close to half (39%) as benefiting from the STEM Hub (11% of responses were coded both).

*Table 1. What Is Your STEM Hub All About? (% Responding Yes)*

STEM Hub	Prep students for STEM careers	Improve K 12 STEM ed.	Increase graduation rates	Reach underserved communities	Provide/improve CTE	Provide early learning exp.	Improve out of school learning	Provide teacher PD	Provide local STEM work force dev.
Central Oregon	79	82	46	67	61	36	70	64	76
Frontier Oregon	86	97	71	91	63	63	63	89	77
Oregon Coast	82	94	47	65	65	59	71	82	65
Portland Metro	90	100	45	86	41	24	90	97	69
South Metro-Salem	94	100	86	94	56	38	63	88	75

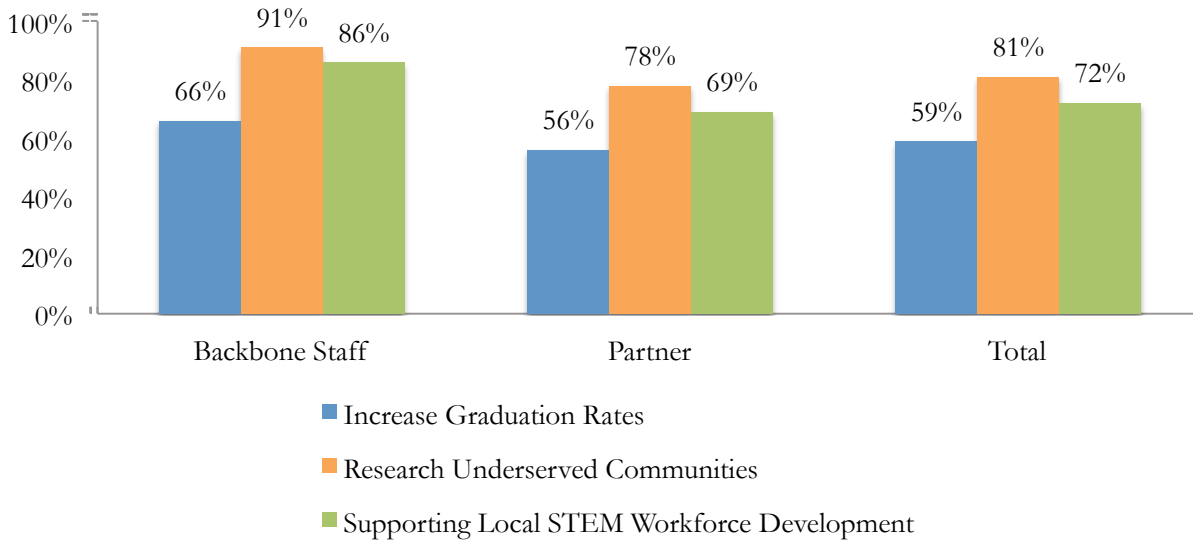


Figure 7. Means of % of respondents to the survey question, “What is your STEM Hub all about?” for three of the options (increase graduation rates, reaching underserved communities, supporting local STEM workforce development) that had differences in responses by backbone staff or partner.

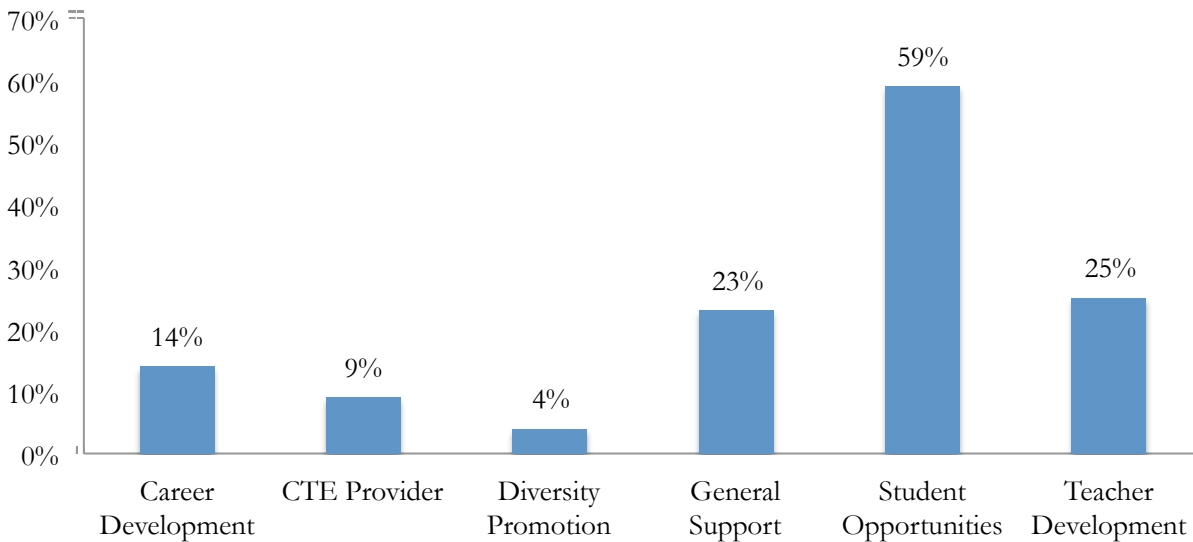


Figure 8. Nature of partnership with the STEM Hubs (% of respondents). For descriptions of each of the codes, see the Technical Appendix.

## Accomplishments of the STEM Hubs

When asked what one change respondents could identify *as a result of STEM Hub*, improved or new types of student programming was mentioned most frequently, followed by new or improved professional learning opportunities for educators, improved communication and exchange by various partners within the Hubs, access to resources that were previously not available, direct help in implementing change or programs, increased awareness of the need for local collective action around STEM/CTE education, and a general sense of improved collaboration around STEM within the local community (see Figure 9). Important to note is that by asking respondents to provide only one example, they are giving the most important, salient or top-of-mind value added of the Hub, rather than a comprehensive list. Although some respondents could not help but provide more than one answer, the nature of the question allows us to see any of the answer categories, no matter how small the frequency of the answers within, as important. For descriptions of each of the codes, see the technical appendix.

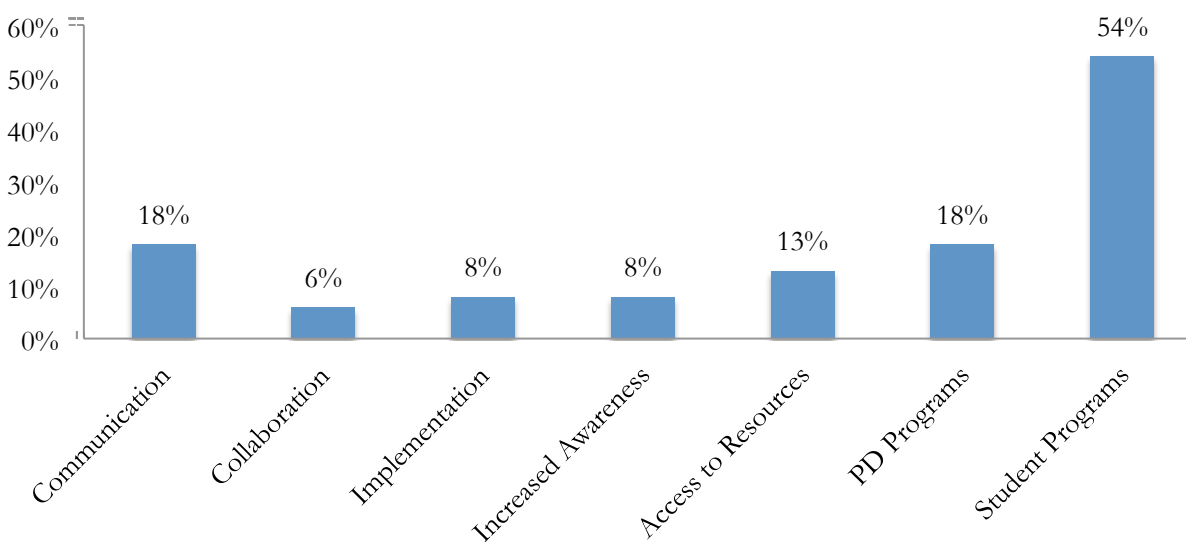


Figure 9. One positive change as a direct result of the work of the STEM Hub (% of respondents).

Asked in a similar fashion about the one thing that would make their respective STEM Hub more successful, not surprisingly almost a third of the respondents indicated sustained or predictable funding, and relatedly, another 13% of respondents mentioned increasing staff capacity (see Figure 10). However, about one in seven respondents each mentioned improved external communication, outreach, or engagement to ensure that the Hub and its work is better known and understood in the community. One in 10 respondents mentioned more or better opportunities for students and educators/teachers, and one in 11 making improvements to the existing partnership itself.

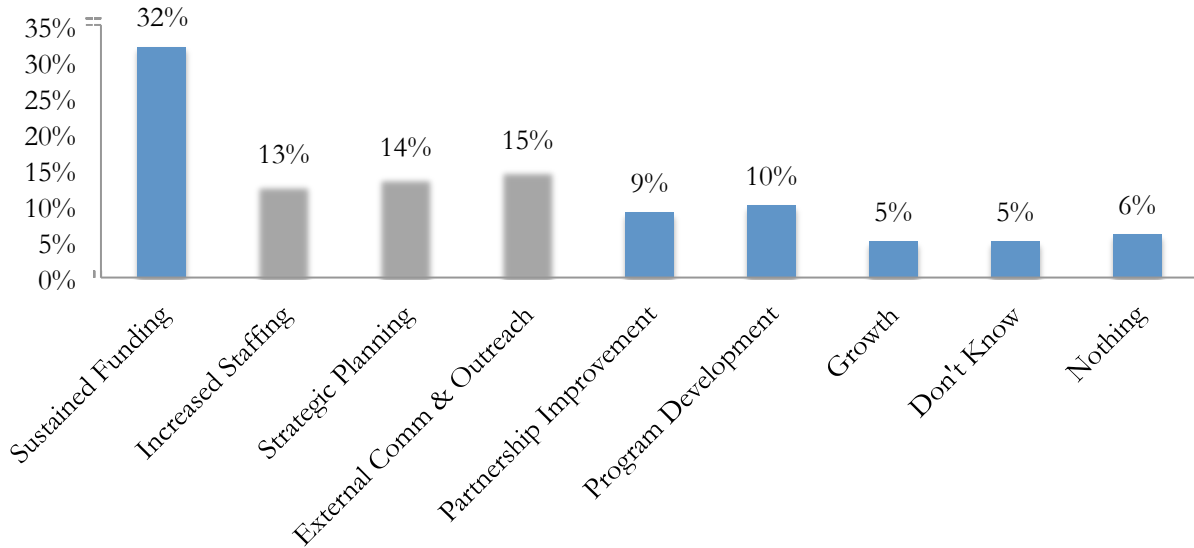


Figure 10. One change that would make the STEM Hub more successful (% of respondents). For descriptions of each of the codes, see the Technical Appendix.

Respondents were most excited about engaging students, experiencing more generally the overall impact of the Hub (and specifically, the collective impact of the Hub), networking with others and experiencing community around STEM learning and teaching, and being connected or engaged with the Hub in general (Figure 11).

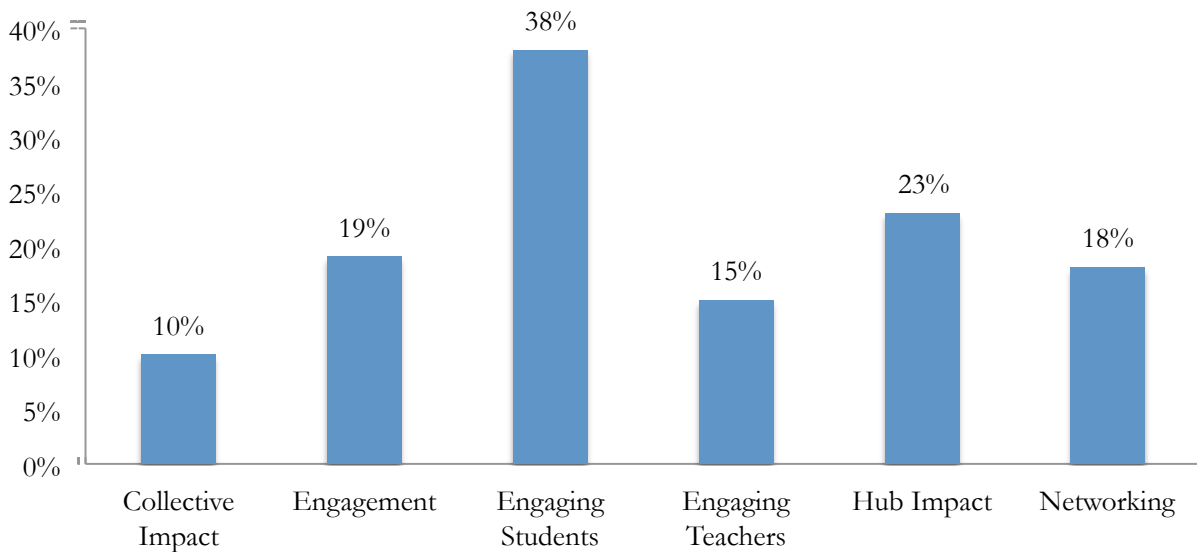


Figure 11. What makes you most excited about being engaged in the STEM Hub (% of respondents)? For descriptions of each of the codes, see the Technical Appendix.

### Development of the STEM Hub as a Community

We developed a 14-item Connection subscale that captured in various ways how much respondents felt they could or were contributing to their respective STEM Hub and how much they saw their STEM Hub and its partner organizations (and members) as trustworthy and productive partners. Figure 12 shows the mean percentage of responses in each answer category (from strongly disagree to strongly agree) across the 14 items that form the subscale. The combined results across partners and backbone staff (“Total”) shows that there was about equal agreement or strong agreement across all items, and very little disagreement, indicating that the Hubs are perceived as inclusive and safe spaces overall. Not surprisingly, backbone staff rated the health of the Hubs higher than partners (see Figure 6). Note also that the subscale means for the 14 items combined showed a difference between backbone staff and partners in their responses, but that overall, with means of 4.55 and 4.11 for backbone staff and partners, respectively, both groups had generally positive responses to the questions about connections being developed as part of the STEM Hub.

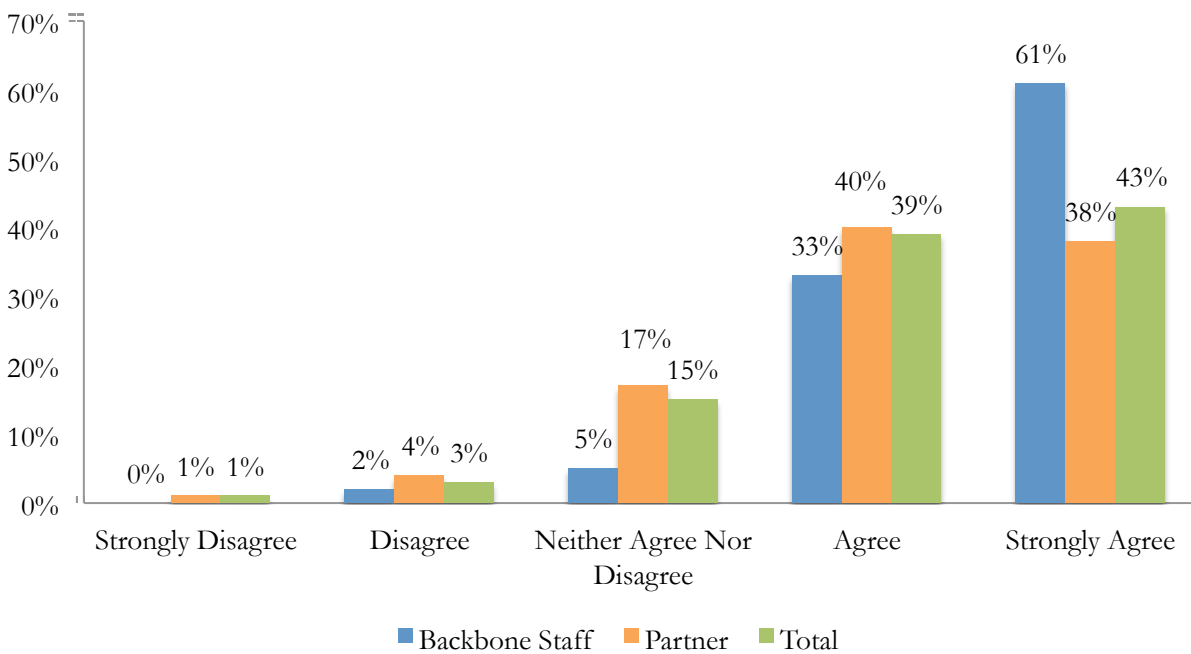


Figure 12. Means of responses (in %) to STEM Hub community health Likert-scale questions.

### Connections Among the STEM Hubs

Table 2 provides an overview of interactions that existed between individuals of five STEM Hubs. One new Hub (Frontier) has no interaction so far with the other Hubs, but we can see that 55% of staff and partners of the South Metro-Salem STEM Partnership Hub and the Portland Metro STEM Partnership interacted, indicating considerable flow of information and experience between the older, adjacent, and relatively well-established Hubs.

*Table 2.* Answers to “Which of the Following STEM Hubs Have You Interacted With?” for Five of the STEM Hubs With > 10 Responses

STEM Hub	Central Oregon STEM Hub	Frontier Oregon STEM Hub	Oregon Coast STEM Hub	Portland Metro STEM Hub	South Metro Salem STEM Partnership Hub
Central Oregon	x	0%	21%	18%	12%
Frontier Oregon	0%	x	0%	0%	0%
Oregon Coast	29%	12%	x	24%	12%
Portland Metro	21%	21%	31%	x	55%
South Metro-Salem	6%	6%	13%	56%	x

## Conclusions and Next Steps

STEM Hubs are perceived as valuable entities that promote regional STEM Hub activities and collaboration in and between schools, community organizations, and business and industry. Importantly, preliminary data indicate that Hub-supported student STEM learning experiences as well as partnerships with community organizations would not have been possible without leadership and resources from the local STEM Hub. However, there are some potential challenges. In particular, funding issues—including the timing, amount, and sustainability of state funding to support STEM Hub activities—are at the forefront of the minds of STEM Hub leaders and partners alike. It is clear that STEM Hubs are beginning to play a vital role in the regions they serve, and that regional STEM Hubs have been particularly effective at representing the unique needs across the diverse cultural and geographical landscape across Oregon.

The final report, to be published in the summer of 2017, will present summative findings from our full survey and interview data. This upcoming report will provide a more in-depth discussion of the specific roles that STEM Hubs and their backbone organizations play in terms of promoting collective impact and positive STEM outcomes across the state. A major focus of the current research effort is to help STEM Hubs build internal capacity within and across their organizations; to that end, we will also report on the successes and challenges associated with capacity building, with the goal of highlighting evidence-based recommendations and best practices which include (1) guidance to improve implementation of the STEM Hubs, (2) balance between continued core support relative to programming support, and (3) challenges associated with decision making, influence, and communication within the STEM Hubs.

“I am most excited about our ability to work across school district, institutional, and community boundaries as we **work together to improve STEM education for all students, and particularly historically underserved students**. Multiple projects we are working on—such as the Equity Leadership Network for STEM, the STEM school toolkit, Math in Real Life, and the STEM Beyond School project—have **facilitated connections between diverse stakeholders around a common mission, facilitating learning for all parties and broadening our collective impact**.” ~ Portland Metro STEM Partnership Partner



## References

- Bryk, A. S., Gomez, L. M., & Grunow, A. (2011). Getting ideas into action: Building networked improvement communities in education. In M. Hallinan (Ed.), *Frontiers of sociology of education* (pp. 127–162). New York, NY: Springer. Retrieved from [https://www.carnegiefoundation.org/wp-content/uploads/2014/09/bryk-gomez\\_building-nics-education.pdf](https://www.carnegiefoundation.org/wp-content/uploads/2014/09/bryk-gomez_building-nics-education.pdf)
- Jones, J. I. (2014). An overview of employment and wages in science, technology, engineering, and math (STEM) groups. *Beyond the Numbers: Employment and Unemployment*, 3(8). Washington, DC: U.S. Bureau of Labor Statistics. Retrieved from <https://www.bls.gov/opub/btn/volume-3/an-overview-of-employment.htm>
- Kania, J., & Kramer, M. (2011). Collective impact. *Stanford Social Innovation Review*, 1(9), 36–41.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, England: Cambridge University Press.
- Marek, L. I., Brock, D. P., & Savla, J. (2015). Evaluating collaboration for effectiveness: Conceptualization and measurement. *American Journal of Evaluation*, 36(1), 67–85.
- National Research Council. (2014). *STEM learning is everywhere: Summary of a convocation on building learning systems*. Washington, DC: The National Academies Press. doi: 10.17226/18818.
- National Research Council. (2015). *Identifying and supporting productive STEM programs in out-of-school settings*. Washington, DC: The National Academies Press. doi: 10.17226/21740.
- Trail, S., & Traphagen, K. (2015). *Assessing the impacts of STEM learning ecosystems: Logic model and recommendations for next steps* [Working paper]. Retrieved from [http://stemecosystems.org/wp-content/uploads/2015/11/Assessing\\_Impact\\_Logic\\_Model\\_Template\\_STEM\\_Ecosystems\\_Final.pdf](http://stemecosystems.org/wp-content/uploads/2015/11/Assessing_Impact_Logic_Model_Template_STEM_Ecosystems_Final.pdf)
- Traphagen, K., & Trail, S. (2014). *How cross-sector collaborations are advancing STEM learning* [Working paper]. Retrieved from [http://www.expandedschools.org/sites/default/files/STEM\\_ECOSYSTEMS\\_REPORT\\_140128.pdf](http://www.expandedschools.org/sites/default/files/STEM_ECOSYSTEMS_REPORT_140128.pdf)
- Turner, S., Merchant, K., Kania, J., & Martin, E. (2012). Understanding the value of backbone organizations in collective impact. *Stanford Social Innovation Review*. Retrieved from [https://ssir.org/articles/entry/understanding\\_the\\_value\\_of\\_backbone\\_organizations\\_in\\_collective\\_impact\\_1](https://ssir.org/articles/entry/understanding_the_value_of_backbone_organizations_in_collective_impact_1)
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge, England: Cambridge University press.

## Technical Appendix

This section includes a description of the research methods and data collection instruments used in this study.

### Identification of Partner Organizations

STEM Hubs identified a list of partner organizations in three main categories—education, business and industry, and community. Using this list, STEM Hub leaders were asked to identify two lists of partners using the instructions below:

- **List #1:** Please indicate the three partners with which you collaborate and interact with most directly and frequently. For the three partners you have selected, please provide the name of a contact person and e-mail address; the project team will contact these partners in the winter to schedule a brief interview to discuss in greater detail your Hub's successes as well as to identify opportunities to improve collaborative efforts.
- **List #2:** Please use this list to help you generate a list of partners that have been directly engaged as part of your STEM Hub in the past 12 months. You may invite as many as you would like to take the survey, but please make sure to indicate the number of individuals you plan to invite from each organization so we can help you track survey responses. This list would exclude organizations whose primary role involves providing monetary or in-kind donations to your Hub.

### Survey Development

The survey used as a primary data collection instrument in this study was developed as a composite of multiple approaches to documenting the development of a community as a collaborative structure. Most of the survey questions came from the Collaboration Assessment Tool (CAT), which has been developed, tested, and used successfully in similar organizational settings and is intended to provide feedback to organizations on various dimensions of effective collaboration<sup>14</sup>. Additional items were researcher-developed and/or based on items used in previous studies. The Connection subscale was developed based on a similar study investigating development of an Oregon regional collaborative.<sup>15</sup> In order to better understand the context of the partnerships in each STEM Hub, we also asked a set of open-ended questions that allowed both STEM Hub backbone staff and partners to provide additional information to supplement their responses to the Likert-type questions. For this project, a crosswalk was conducted between the items on the CAT and target indicators for backbone effectiveness developed in conjunction with the Chief Education Office and STEM Hub and RAC leaders. The CAT is designed to be used in conjunction with open-ended questions and interviews with partner organizations, and is intended to facilitate a community of practice across multiple stakeholders. The open-ended and partner survey questions were adapted—using developmental evaluation principles—from a previous similar study at one Oregon regional achievement collaborative.

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<sup>14</sup> Marek, Brock, & Savla, 2015

<sup>15</sup> Alan Daly, pers. comm. 2016

The survey was administered to both STEM Hub backbone staff and selected partners using an online format and was designed to be completed in 15–30 minutes, depending on the partner’s level of interaction with the STEM Hub. A link to the survey was provided to the STEM Hub leaders and thus distributed to their extended staff, where applicable, and partners for completion. The first portion of the survey included closed-ended items adapted from the CAT. Survey respondents were asked to rate how much they agreed with each item using a set of five Likert-type response choices (1 = *Strongly Disagree* to 5 = *Strongly Agree*). The items in this portion of the survey related to the functioning of the backbone structure and included the following constructs: Context (9 items), Members (11 items), Process (9 items), Communication (9 items), Function (8 Items), Resources (10 Items), and Leadership (9 items). A separate set of questions on Data Use (5 items) were developed by the research team and included in the survey, as well as the Connection items. The CAT, Data Use, and Connection questions were not displayed to those partners who reported interacting with the STEM Hub once every quarter (or less frequently), in order to limit these questions to those partners who were best able to report on features of the STEM Hub as well as to reduce respondent burden. The number of completed surveys and response rates for each STEM Hub are presented in Table A1.

Table A1. Completed Survey Responses by STEM Hub and by Role

STEM Hub	STEM Hub leader / Backbone staff	STEM Hub partner	Total
Central Oregon STEM Hub	6	27	33
Columbia Gorge STEM Hub	2	6	8
East Metro STEAM Partnership	1	1	2
Frontier Oregon STEM Hub	2	33	35
Greater Oregon STEM Hub	1	5	6
Lane County STEM Hub	1	0	1
Oregon Coast STEM Hub	7	10	17
Portland Metro STEM Partnership	4	25	29
South Metro-Salem STEM Partnership Hub	4	12	16
Southern Oregon STEM Hub	1	1	2
Umpqua Valley Regional STEAM Hub	2	0	2
Total	31	120	151

## Timing and Dissemination

The survey was constructed using Qualtrics software and was designed to be completed online using a dedicated survey link. This link was sent directly to STEM Hub leaders on October 25, 2016, with instructions to share the survey link with representatives from the partner organizations they had identified earlier. Responses received on or prior to December 31, 2016, were included in the present analysis; any responses received after December 31 will be used in the analysis for the final report.

## Partner Interviews

Acknowledging that survey responses can sometimes mask important subtleties and the unique contexts of each Hub ecosystem, the project team conducted short phone interviews separately with Hub partners in order to better understand the strengths and needs of each STEM Hub from different perspectives. Interview participants were nominated by STEM Hub leaders and contacted by the project team. Partner interviews are currently still in the process of being conducted, and the results of the interview analyses will be included in the final report.

The project team developed an interview protocol designed to gather information regarding each STEM Hub's backbone structure, ecosystem, and examples of positive collaboration and partnership from a partner organization perspective.

Each partner was asked four open-ended questions that were developed to elicit open-ended responses that would provide a richer context behind the collaboration between the partner organization and the STEM Hub:

1. Imagine you have a chance to have a cup of coffee with Governor Kate Brown, and she asks you about your STEM Hub, what it is and what it is good for. What do you tell her?
2. What is the value added of your STEM Hub? That is, what exists now that didn't (or wouldn't) exist before your STEM Hub?
3. What is something your STEM Hub really needs and doesn't have yet (or needs to expand on or improve) in order to fulfill its potential?
4. Can you provide specific example(s) of successful partnerships between your organization and the STEM Hub?

## Sample Sizes and Analysis Plan

The interim data set included 163 responses. Twelve responses were excluded because at least one of the following was true: (1) Survey progress was less than 100% or (2) Survey was not recorded as "Completed." Data presented in this interim report reflect 151 valid responses from both STEM Hub partner organizations and STEM Hub leaders and backbone staff.

Open-ended data were analyzed and summarized thematically. See Table A2 for a description of the coding categories. Given the preliminary nature of the sample size and the scope of this interim report, quantitative data were analyzed using simple descriptive statistics.

Table A2. Descriptions of Codes Developed for Survey Qualitative Item Analysis

Code Name	Example Code
<b>In a few sentences, please describe the nature of your organization's partnership with the STEM Hub.</b>	
Career Development	We partner on a number of cradle to career initiatives and career pathways work for youth.
CTE Provider	[Our organization] provides several career technical education programs and courses.
Diversity Promotion	Nonprofit partner that supports engagement of local businesses with local underserved/underrepresented students to increase elementary students interest in STEM Careers.
General Support	We support the mission and participate when available.
Student Opportunities	Provide support to the STEM Hub activities and ideas for developing opportunities for PK–12 students to learn more about and participate in STEM activities.
Teacher Development	We have worked with our STEM Hub to develop a professional learning community for our teachers for the last three years.
<b>Please provide one example of positive change in your community as a direct result of the work of the STEM Hub.</b>	
Communication	At this point since the STEM Hub is just beginning I would say the most positive change has been an increased understanding by partners of what other agencies and partners are doing in the local communities to educate our students.
Collaboration	Oregon Connection program to enhance our outreach efforts with business/school partners.
Implementation	For the past three summers we have worked with the STEM Hub to offer mobile STEM camps for middle school students at several locations along the coast. The Hub staff helped us partner with teachers and community organizations that helped coordinate the camps in their communities. Since then, these partnerships have grown to include other programs such as Beaver Hangouts and teacher PD that are not mediated by the Hub staff.
Increased Awareness	Classroom visits have been provided and local newspapers have carried stories about the visits raising awareness and confidence amongst the general public.
Resources Access	Through the resource lending library, teachers at small schools have access to technical science equipment that their district can't afford to purchase and are in turn able to support an NGSS aligned curriculum.
Professional Development Programs	Professional development for community-based education organizations around effective practice and Next Generation Science Standards have dramatically improved STEM education in the nonformal environments outside of schools.

Code Name	Example Code
Student Programs	The Frontier STEM Hub has developed a pathway [for] (Grade 5–9) students to be exposed to STEM, and to progress toward STEM/CIE pathways in the high school and college level.
<b>What one change would make the STEM Hub more successful?</b>	
Sustained Funding	Stable funding is likely to be needed to keep the effort going.
Increased Staffing	Larger staff would provide greater outreach and have greater impact.
Strategic Planning	As districts increase their capacity for STEM, the goals of the Hub need to change with the changing needs of partners.
External Communication and Outreach	More external communication, more awareness-raising about successes and impacts on students, more data showing an impact.
Partnership Improvement	It should be more clear about what is expected from our nonprofit and what we can expect in exchange.
Program Development	Development of nonprofit program committee to discuss partnerships with schools to design effective program support strategies.
Growth	We need time to see how the Hub forms and grows. We are still writing the partnership plan.
<b>What makes you most excited about being engaged in the STEM Hub?</b>	
Collective Impact	Collaborative opportunities that can increase funding for 3–6-year programs and advocacy to build stronger capital investments in our network capacity.
Engagement	The shared enthusiasm for the success of the STEM Hub and the possibilities for improving our community's opportunities through STEM.
Engaging Students	Opportunities to prepare and engage students in real-world work experiences.
Engaging Teachers	Opportunities for professional development and resources.
Hub Impact	I like the work that they are doing and the impact they have in the Portland Metro community.
Networking	The opportunity to collaborate with neighboring communities