Transforming STEM Education in Oregon

A Strategic Plan

March 2016

STEM VISION FOR OREGON

Reimagine and transform how we educate learners in order to enhance their life prospects, empower their communities, and build an inclusive, sustainable, innovation-based economy. Oregonians of all races, economic status, and regions will develop the fundamental STEM-enabled skills and mindsets necessary to:

- Improve the prosperity of all individuals and communities across the state
- Become creative life-long learners who can adapt to changing social and economic conditions
- Fully contribute to an increasingly complex and technologically rich global society
- Address high-demand, competitive workforce and industry needs

We live in a time of exponential change – where knowledge periodically doubles, technologies alter every facet of our lives, and global developments touch each of us in new ways. In this shifting context Oregon must prepare its young learners for a future that we can't even imagine today. In their various personal and occupational roles Oregonians will be called on to understand complex challenges, find solutions, adapt and innovate, work together, and build on the knowledge, enterprise, and achievements of previous generations.

THE RELATIONSHIP OF STEM AND CTE

Although STEM and Career Technical Education (CTE) programs have traditionally had different funding streams and delivery structures, they are highly complementary. They share intended outcomes, the kinds of learning experiences they afford students, and the preparation they offer for high-demand careers. (See Venn diagram, Appendix A.) In particular, both CTE and STEM engage and motivate students through hands-on, real-world learning; both hone creativity, critical thinking, problem-solving, communication, and teamwork; and, both prepare students for well-paying careers and successful lives.

Our students' education must enrich their lives, prepare them to successfully adapt to an unforeseeable future, and strengthen the economic prospects of Oregon's communities.

Right now, an economic resurgence infused by emerging technologies in every sector of the business landscape offers unprecedented job and career opportunities to Oregonians who've acquired the skills, passion, and initiative that come from studies in science, technology, engineering, and math (STEM). This is evident, as expected, in electronics, software, clean energy, and cutting edge cancer research. But it's also true in more established sectors such as food processing, manufacturing, agriculture, and forest products.

In 2013, Oregon companies added more than 220,000 jobs, the majority of them STEM-related. That number is expected to increase in the foreseeable future.[1] In 2015 the state boosted job growth above 3 percent, making it the nation's 8th fastest growing

[1] 2015-2017 Initial Oregon Talent Plan – 11/5/15

economy.[2] One major driver of this job growth is Oregon's high-technology and software sectors, which pay average wages of $100,000 per year. Additionally, Oregon's small-business innovators and entrepreneurs continue to propel the economies of Portland, the North Coast, the Gorge, and the East Cascades. The state's wages have rebounded too, and are now growing at nearly 8 percent per year.[3] And, every region of the state is experiencing various degrees of recovery in population growth and economic activity, even though many rural regions are still in distress. Highly skilled and educated newcomers are attracted to the state's quality of life and innovative economy.

Against this backdrop, there is a looming and growing disconnect between the demand for skills and talent in Oregon's economy and the number of young Oregonians emerging from our education system who possess such skills and talent, especially in the STEM disciplines. This disconnect represents a threat to the job prospects of our people, the prosperity of our communities, and the competitive capacity of our economy.

This needn't be so. Each one of Oregon's students has the potential to acquire and apply capabilities in the jobs demanded by a cutting-edge economy. Yet, important performance benchmarks indicate that not enough Oregon students are on the path to be ready for the challenging, high-paying jobs in Oregon's evolving economy. In 2015, for instance, only 37 percent of Oregon fourth graders scored at or above the proficient level for math in the National Assessment of Educational Progress. That's 3 percent fewer than in 2013. NAEP performance was even more problematic for students from communities of color and families navigating poverty. Only 17 percent of African American students, 19 percent of Latino students, and 27 percent of students eligible for lunch subsidy scored at or above the proficient level in math.[4]

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Oregon cannot afford its growing talent shortages. By 2020, our economy will have almost 40,000 new job openings per year in STEM-related fields, and 94 percent of those will require a postsecondary credential.[5] Today, based on current labor market data, the state's three most in-demand industry clusters are healthcare (with 11,157 job openings), manufacturing (with 6,213 job openings) and information services (with 2,269 job openings). Within these industries, healthcare practitioners (with 3,813 job openings), computers and IT (with 2,171 job openings) and architecture and engineering (with 1,241 job openings) lead the technical and professional occupations.[6]

The bottom line: Oregon's growing economy requires that the state prepare individuals for high-wage, high-growth STEM jobs. Although there were still more than 117,000 unemployed workers in August 2015,[7] Oregon companies indicated that they cannot find qualified talent. This mismatch of talent and available jobs will only intensify if the skills and preparation gaps are not addressed.

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[2] Oregon Economic Review and Forecast, September 8, 2015; accessed December 2, 2015: http://www.oregon.gov/DAS/OEA/docs/economic/oregon.pdf

[3] Ibid.

[4] U.S. Department of Education, *The Nation's Report Card* (2015), accessed on November 24, 2015, http://nces.ed.gov/nationsreportcard/subject/publications/stt2015/pdf/2016009OR4.pdf.

[5] Oregon STEM Employer Coalition, *Oregon Learns: Time to Invest Seriously in STEM* (2012)

[6] Ibid.

[7] Oregon Economic Review and Forecast, September 8, 2015; accessed December 2, 2015: http://www.oregon.gov/DAS/OEA/docs/economic/oregon.pdf

STEM Literacy for All

Oregon must act now. Too many of our learners are unprepared to meet tomorrow's societal and economic needs. We must strive to help *each* student reach his/her full potential, achieve individual prosperity, and thrive as a citizen of Oregon and of the world. Each student must be equipped with the cross-cutting skills, attitudes, and dispositions needed to be successful in work, family, and community life. When asked what those skills, attitudes, and dispositions are, educators and employers have nearly identical responses. They say that what students need goes far beyond specific content knowledge and should include critical thinking, problem solving, creativity, communication, flexibility, perseverance, risk-taking, adaptability, teamwork, and initiative. In a society where information and academic content is readily searchable, those who are able to analyze, synthesize, and apply that information in unique situations are the ones who will be in the highest demand.

STEM and CTE education are a critical way that Oregon can fully prepare each student for success. Both increase the relevance of teaching and learning. In STEM and CTE students become more engaged in the learning process. Engaged learners succeed and graduate.

The state must continue to transform its student-centered approach to teaching and learning by scaling STEM education. In its truest form, STEM is a multidisciplinary approach to learning that eliminates the walls between academic and applied learning, in-school and out-of-school learning, and education and employment. The applied learning of STEM and CTE engages and motivates students, ignites curiosity and creativity, encourages problem solving, and instills strong work habits. STEM education equips Oregon students with the knowledge, skills, creative thinking, and dispositions that will help them thrive in a rapidly changing, technologically rich world.

Oregon's Current STEM Ecosystem: Robust STEM Goals, Policies & Investments, But More Work Remains

In 2011, Oregon leaders adopted the bold 40-40-20 goal: By 2025, 100 percent of Oregon's students will graduate from high school, with 40 percent going on to earn a bachelor's degree or higher, and 40 percent holding at an associate's degree or other technical credential.

STEM education plays an important role in achieving this statewide goal. Using the 40-40-20 goal as a springboard, the Oregon Legislature established the STEM Investment Council to 1) double the number of 4th and 8th grade students proficient in math and science by 2025 and 2) double the number of CTE-STEM degrees and certificates by 2025. The STEM Investment Council is also committed to achieving equity of access, opportunity, and attainment for underserved and underrepresented populations. [8] These goals were created to increase state productivity, reduce poverty, and meet the talent needs of businesses and communities.

Oregon must 1) double the number of 4th and 8th grade students proficient in math and science by 2025, and 2) double the number of STEM and CTE degrees and certificates by 2025.

[8] For the purposes of this plan, "underserved and underrepresented" populations include individuals and communities of color—specifically, African American, Latino/Hispanic, Native American, Alaskan Native, and Pacific Islander. It also includes both rural and urban students facing poverty, as well as women.

To reach these goals, Oregon has aggressively invested in STEM policies and initiatives (see Figure 1). These include:

- In 2012, adopting college- and career-readiness standards to increase expectations – and the quality of teaching and learning – for Oregon students.
- In 2012, creating a statewide network of regional STEM Hubs and forged stronger industry partnerships.
- In 2013, establishing the STEM Investment Council.
- In 2014, adopting and implementing the Next Generation Science Standards (NGSS). (Through the NGSS, students are immersed in the engineering design process, which cuts across the science standards.)
- In 2015, creating the Oregon Talent Council to help state agencies and education institutions develop talent to meet the growth and competitive needs of Oregon's traded sector and high-growth industries. This coherent set of policies and strategic actions seeks to address the state's full education and workforce continuum.

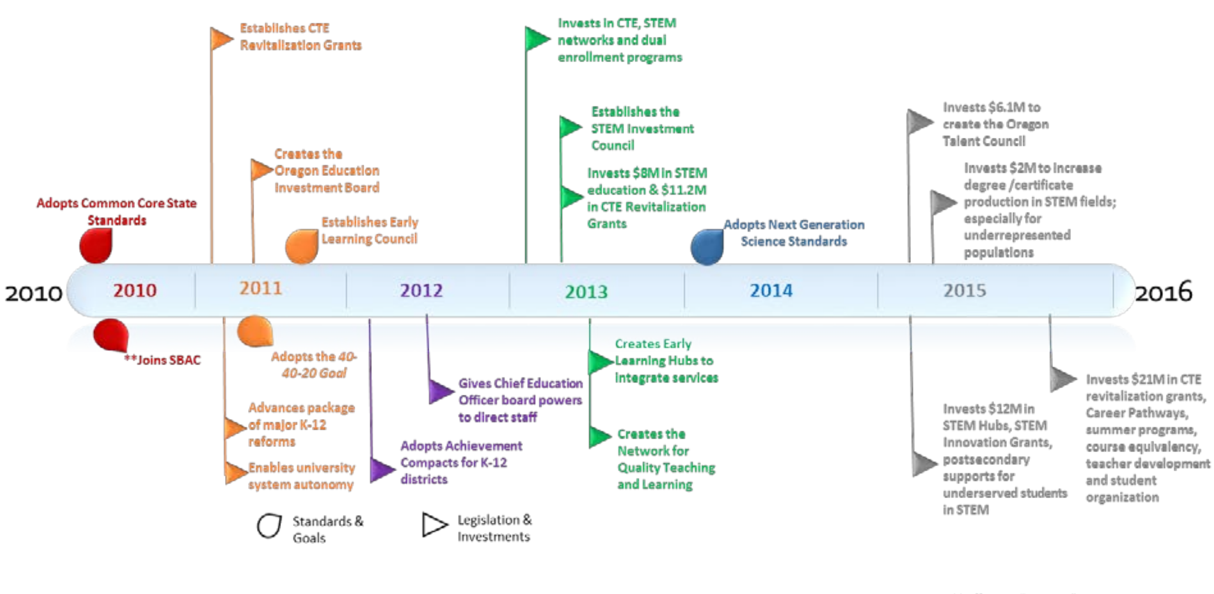
OREGON'S REGIONAL STEM HUBS

As a key strategy to accelerate improved outcomes across the state, the Legislature created a statewide network of Regional STEM Hubs. These hubs devise local solutions to local needs. They coordinate regional communication and partnerships, improve key student outcomes, build capacity and sustainability for change, and encourage and support local and statewide multisector engagement.

The Hubs are multisector partnerships that link local P-20 educators with representatives from workforce and economic development, community-based organizations and business to transform STEM teaching and learning. (See STEM hub map, Appendix B.)

In conjunction with its policies and actions, the Legislature has made considerable investments to increase student learning opportunities in CTE and STEM education, to increase degree and certificate production in STEM fields, and to increase participation and degree completion in STEM fields by students of color and women at public colleges and universities. In 2013, in addition to establishing the STEM Investment Council, the Legislature allocated $8.5M to fund six regional STEM Hubs, model STEM Lab Schools, and a suite of STEM/STEAM/CTE grants focused on historically underserved and underrepresented students. In 2015 the Legislature doubled funding for CTE and STEM education, increasing its investment from $17M to nearly $35M, including investments for regional STEM Hubs, STEM innovation grants, CTE revitalization grants, Career Pathways, CTE summer programs, teacher

FIGURE 1: OREGON'S STEM GOALS, POLICIES AND INVESTMENTS



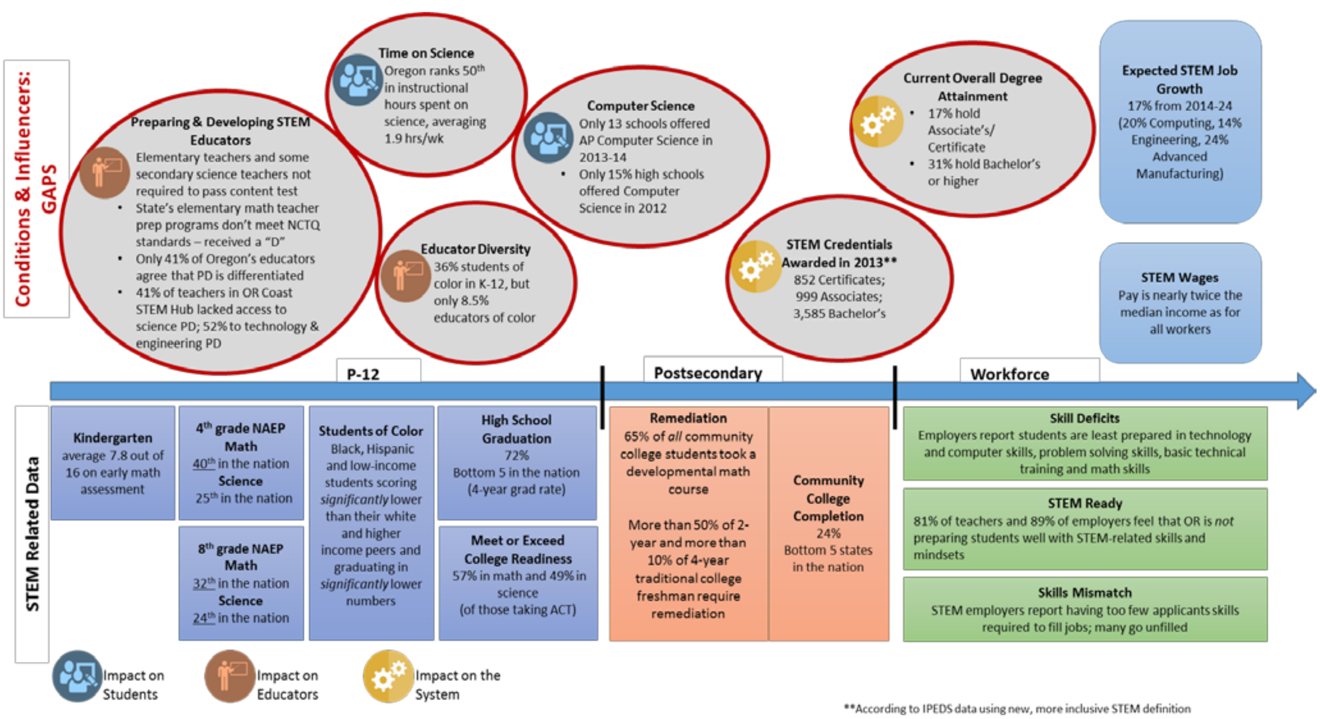
development, and post-secondary support for underserved and underrepresented students. It also invested $6.1 million in the Oregon Talent Council to support start-up programs at post-secondary institutions aligned with high-wage, high-growth sectors.

Earlier this year, the Oregon Higher Education Coordinating Council implemented a new funding model, known as the Student Success and Completion Model, which focuses on successful student completion of degrees with special emphasis on historically underserved students and degrees in high-priority fields. The Legislature also invested $10M to create the Oregon Promise, which offsets tuition payments for Oregon's recent high school graduates who attend and pursue a certificate or degree at one of the state 17 community colleges.

Oregon is on the right track with its robust STEM goals, policies, and investments. But, it will take time for them to bear fruit and impact the state's STEM results indicated in Figure 2, which are currently mediocre. Partners must acknowledge that a systemic commitment to STEM education is a marathon, not a sprint. Legislative investments will likely result in a "hockey stick" growth pattern, where indicators remain flat for four to five years and then increase as investments start to benefit the first cohort coming through.

System Gaps and Related Results. Major gaps in Oregon's STEM education ecosystem are identified in the top half of Figure 2. The bottom half of the figure pinpoints Oregon's middling STEM results, which correlate with the gaps. Significant gaps affecting students include the amount of time each week that Oregon elementary students spend on science. Currently, the state ranks 50th. In addition, only 13 schools in the state offered the AP Computer Science course in 2013-14.

FIGURE 2: STEM GAPS AND DATA

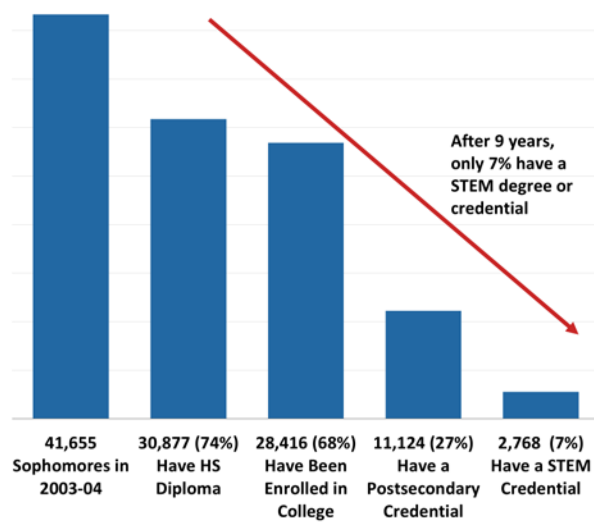


Gaps that impact educators include Oregon's low expectations for STEM teacher preparation and low quality professional development. The National Council on Teacher Quality gives Oregon a "D" for preparing its mathematics educators. Although Oregon places a premium on equity for its students, it has a small share of teachers of color (8.5 percent) relative to students of color (36 percent). According to the recently released

Oregon Educator Equity Report, the state is almost on track to meet a 2015 goal of increasing the number of diverse teachers by 10 percent compared to the percentage in 2012.[9] National research attributes the lack of diversity in the STEM labor force to a lack of diverse STEM role models in education.

The state's mediocre STEM outcomes reflect the system gaps cited here. For instance, as shown in Figure 3, only 7 percent of Oregon's class of 2006 (41,655 sophomores in the 2003-04 school year) had achieved a STEM postsecondary credential by the spring of 2013. This example highlights a gap between the state's STEM degree production and STEM jobs that are available in Oregon.

FIGURE 3: CLASS OF 2006 STEM OUTCOMES BY SPRING 2013



Source: ECONorthwest analysis of ODE and National Student Clearinghouse data. STEM credential outcomes based on Brookings Institution definition of STEM fields.

If Oregon is to reach its laudable statewide 40-40-20 goal and its STEM-specific goals then it must stay the course to advance its previously enacted STEM policies and investments and expand efforts to target and close its gaps.

The Oregon STEM Investment Council

Created in 2013, Oregon's STEM Investment Council has a legislative mandate to assist the Chief Education Officer with the development and implementation of a long-term strategy to advance the state's STEM goals.

To jumpstart its work, the STEM Investment Council convened a statewide STEM Leadership Summit in 2014 to determine systemic STEM barriers across the state's P-20 education and workforce system and identify solutions to remove those barriers. The STEM Investment Council used those findings to inform its recommendations for the Governor's STEM budget for fiscal years 2015-17. Over the last 18 months, the Council and the Chief Education Office have been working with educators and other representatives to articulate a vision, belief statements, and driving goals for STEM education in Oregon:

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- Improve the prosperity of all individuals and communities across the state
- Become creative life-long learners who can adapt to changing social and economic conditions
- Fully contribute to an increasingly complex and technologically rich global society
- Address high-demand, competitive workforce and industry needs

This vision emphasizes equity of opportunity, access, and attainment for every Oregon student.

[9] 2015 Oregon Educator Equity Report, accessed on December 8, 2015: http://www.ode.state.or.us/superintendent/priorities/2015-final-educator-equity-report.7.10.15.pdf

The Council has also adopted the following belief statements, which have guided the development of goals and how the work should progress:

BELIEFS

1. **All people have creative potential.** We must view our students not as passive consumers of knowledge, but as active participants in their learning. Their inherent talents, interests, and creativity have only to be unleashed.
2. **Each student deserves an opportunity to prosper.** Too many students who reflect the racial and ethnic diversity of Oregon, too many from families navigating poverty, too many from rural communities, and too many young women are not afforded a path into high-wage, high-demand STEM professions. No student's potential, nor dreams, should be left unrealized.
3. **Diversity is our strength.** Differences of gender, ability, race, ethnicity, and culture provide critical and diverse perspectives and voices to address today's complex challenges. Innovation and solutions emerge where different ideas and cultures interconnect.
4. **Engaged learners succeed.** How we teach our students is as important as what we teach them. We must create meaningful learning experiences that empower all students to embrace their curiosity, take ownership of, and joy in their learning, and become lifelong learners.
5. **Education is a collective responsibility.** Effective STEM learning takes place both in and outside of classrooms. Everyone in our community is a potential educator. We need to engage leaders, institutions, and volunteers in our communities who want to help our young succeed.
6. **Innovation is the cornerstone of prosperity.** STEM education is not just about filling jobs, but also about creating jobs. Building an innovation-based economy is essential for the long-term competitiveness and prosperity of Oregon and its people
7. **Learning takes courage, persistence, and humility.** Pushing the boundaries of one's understanding requires us to value curiosity, risk failure as a stepping stone to success, prize questions over answers, and see learning as an unending journey
8. **STEM skills are essential skills.** Advancements in science, technology, engineering, and mathematics are transforming nearly every facet of life and work. Not only is STEM knowledge integral to the requirements of daily life, civic engagement, and employment, so are STEM capabilities in analyzing needs, taking initiative, organizing effort, and solving problems.
9. **STEM learning is cross disciplinary.** It is the interconnectedness of ideas that enables people to integrate new learning with their prior experiences. STEM by its nature synthesizes analytical and creative thinking. It is a powerful tool that sits at the crossroads of the sciences, arts, and humanities.
10. **The best way to learn STEM, is to DO it.** STEM education is not about retaining facts or disconnected bits of information. Purpose-driven learning challenges students to pursue deeper questions and to solve problems that are relevant and meaningful.

Oregon's STEM Framework

Summarized below are four goals identified by the STEM Investment Council to expand achievement, attainment, and opportunities for learners through STEM education. Each of these is detailed more fully in terms of measurable priority outcomes, a narrative rationale for each area of focus, and a summary of strategies to achieve the outcomes.

GOALS

1. **Inspire and empower our students to develop the knowledge, skills, and mindsets necessary to thrive in a rapidly changing, technologically rich, global society.**

2. **Ensure equitable opportunities and access for every student to become a part of an inclusive innovation economy.**

3. **Continuously improve the effectiveness, access to resources, and the number of formal and informal STEM educators.**

4. **Create sustainable and supportive conditions to achieve STEM outcomes aligned to Oregon's economic, education, and community goals.**

Legend:

Impact on students Impact on educators Impact on system

Goal #1: Inspire and empower our students to develop the knowledge, skills, and mindsets necessary to thrive in a rapidly changing, technologically rich, global society.

GOAL #1 PRIORITY OUTCOMES

1. By 2020, increase Oregon's graduation rates to at least 80 percent across those schools implementing STEM and CTE applied learning strategies for all students.
2. By 2020, increase the time Oregon elementary students spend on science to exceed the national average of 2.7 hours per week.[10] That same year, Oregon should have fully implemented the Next Generation Science and Engineering Standards.
3. By 2020, 75 percent of K-12 classroom teachers will regularly employ the deeper learning strategies of Oregon's mathematics standards and the application of math to complex, real-world problems.
4. By 2020, Oregon will adopt computer science standards and ensure that each student has access to computer science and digital literacy coursework.

[10] Change the Equation, Vital Signs; http://vitalsigns.changetheequation.org/state/oregon/curriculum

Why must Oregon focus on STEM learning opportunities in the early grades? The early years are critical for students to develop authentic interest and knowledge in STEM. Through experience, discourse, inquiry, and play, children learn to observe natural phenomena, shape and defend an argument, and use problem-solving tactics.[11] A recent random assignment study by the Center for Research in Educational Policy supports the claim that strong inquiry-based science experiences strengthen K-8 science outcomes, even for students who are typically underrepresented in the STEM fields.[12] A landmark 2007 study also showed that early math skills are one of the best predictors of later academic success in both math and literacy.[13] Early STEM experiences are also vital because students get hooked on STEM early. Recent research suggests that students who ultimately decide to take advanced science classes and pursue postsecondary STEM fields tend to get interested in STEM and make their choices as early as middle school, or even before.[14] For girls and culturally and linguistically diverse students, early exposure to STEM experiences proves to be a key factor in deciding to pursue STEM coursework and careers.[15] Providing students with project-based, hands-on, and career-influencing science experiences takes teacher expertise, resources, and time. Oregon must ensure that all of its students receive strong STEM education early so they are prepared for college and career.

Why are math and science standards important? The applied and interdisciplinary nature of STEM learning is a powerful means for fully implementing the Next Generation Science Standards (NGSS) and the Common Core State Standards in Mathematics (CCSS-M) through integrated approaches. These new academic standards are not simply about what to teach, they also put forward a vision that encourages educators to emphasize the "practices" used by STEM professionals in solving real-world problems (see Appendix C).

Why do Oregon students need access to computer science courses? The state's fastest growing job clusters are in technology and software. Currently, Oregon has 8,058 open computing jobs, with average salaries of $81,000 – significantly higher than the average salary in the state. In 2013, Oregon had only 355 computer science graduates (and only 11 percent of those were female). In 2015, Oregon had 290 high school students take the AP Computer Science exam. Of those students, 18 percent were female, 11 students were Latino, and four students were African American. Only 15 percent of Oregon's high schools offered at least one coding course in 2012.[16] Only 13 schools offered the AP Computer Science in 2013-14.[17]

Key strategies to achieve Goal #1 include:

a. Promoting the development of new teaching approaches that challenge students to be creative, resourceful, persistent, and collaborative in developing knowledge and skills to solve real-world problems

b. Increasing the interactions of students with STEM professionals who can help students develop aspirations and personal identities as life-long learners and inspired innovators utilizing STEM skills

[11] TIES STEM Education Monograph Series: Attributes of STEM Education; Aug 2006; http://stemeast.org/pdf/what_is_stem/National_STEM_Attributes/TIES_STEM_Attributes.pdf
[12] LASER i3 Validation Study by the Center for Research in Educational Policy (CREP) at the University of Memphis; 2015
[13] Duncan, et al. "School Readiness and Later Achievement," 2007; http://eprints.ioe.ac.uk/5971/1/Duckworth2007SchoolReadiness1428.pdf?origin=public
[14] What Is the Impact of Decline in Science Instructional Time in Elementary School? 2012; http://www.csss-science.org/downloads/NAEPElemScienceData.pdf
[15] Generation STEM: What Girls Say About Science, Technology, Engineering and Math; 2012; https://www.girlscouts.org/research/pdf/generation_stem_full_report.pdf
[16] Oregon Computer Science Teachers Association, 2012
[17] Code.org, state-facts, OR, 2015: https://code.org/advocacy/state-facts/OR.pdf

c. Developing new opportunities for students to enhance their critical thinking and problem-solving skills in afterschool or summer programs that are focused on solving complex challenges

d. Increasing the availability of early college credits in STEM courses by strengthening local partnerships and articulation agreements between high schools, community colleges, and 4-year institutions

e. Increasing the development and acceptance of industry-recognized credentials based on demonstrated skills, including traditional and nontraditional certifications

f. Providing program "start-up" or retooling funds to incentivize postsecondary programs aligned to high-wage, high-demand industry needs

g. Increasing student interest, understanding and success in mathematics through solving real-world problems

h. Improving the quality and relevance of postsecondary mathematics placement processes and align course offerings to relevant degree/certificate program needs

i. Transforming P-20 STEM teaching and learning by supporting the spread of effective approaches and connecting research to practice

Goal #2: Ensure equitable opportunities and access for every student to become a part of an inclusive innovation economy.

GOAL #2 PRIORITY OUTCOMES

1. By 2020, double the number of historically underserved and underrepresented STEM students who participate in informal, out-of-school STEM learning opportunities.
2. By 2020, double the number of historically underserved and underrepresented STEM students who are enrolled in post-secondary STEM-related pathways.
3. By 2025, double the number of underrepresented students attaining a STEM-related degree or credential.

Why a specific goal on equity? Oregon faces significant opportunity and attainment gaps across its P-20 education ecosystem, particularly among its students of color and students from families navigating poverty. The state must close these gaps.

Increasing diversity in the STEM labor force is both a moral and economic imperative. As indicated in our beliefs statement, diversity is a plus in addressing today's complex challenges. Yet persons of color and women account for far fewer of the country's STEM job holders than their percentage of the general population. Nationally, just 2.7 percent of African Americans, 3.3 percent of Native Americans and Alaska Natives and 2.2 percent of Hispanics and Latinos who are 24 years old have earned a first university degree in natural sciences or engineering.[18] These students face an expectation gap, an opportunity gap, an information gap, and an inspiration gap. Key systemic inequities include insufficient access to school programs such as computer science, AP courses, and CTE in and out of classrooms; limited student exposure to diverse STEM faculty and out-of-school role models; and biased messaging and expectations.

[18] National Science Foundation, Women, Minorities, and Persons with Disabilities in Science and Engineering (2009)

Students from rural areas and families navigating poverty also often experience limited access to STEM opportunities. Over 38 percent of Oregon's school districts are classified as rural. Rural students are also less likely to enroll in and achieve a postsecondary education. In the 2010 ASCD Educational Leadership issue, author James A. Bryant, Jr. reported that over 60 percent of residents in rural areas live below or just above the poverty line and 68 percent of rural schools face significant achievement gaps in mathematics.[19]

Why is Informal STEM learning important? Informal STEM learning is just as important as formal STEM learning. It is proven to raise student confidence and classroom achievement in STEM and generate student interest in pursuing STEM studies and careers.[20] Types of informal STEM learning programs include those that provide students after school, weekend and summer activities over multiple years at institutions such as science museums, zoos, local universities and research centers. Unfortunately, good, objective data that differentiate those programs having the greatest impact do not exist at the state and national levels.[21]

Why do quality P-20 support services and pre-college transition/bridge programs matter? Targeted strategies and supports increase the likelihood of success for students traditionally underrepresented in STEM studies. At the postsecondary level, those STEM specific strategies include exposure to STEM courses in conjunction with a combination of advising, co-requisite remediation and gateway-course redesign. To persist to a STEM certificate or degree, students must see how their coursework applies to the real world. Research shows that one of the most effective strategies is access to undergraduate research and/or internships during the freshman and sophomore years of postsecondary. To help bridge this gap, postsecondary institutions must forge authentic partnerships with business and industry. Employers can influence programs and curriculum, provide technology and equipment or participate on advisory boards.

Why are diverse STEM role models important? One of the most effective ways to encourage students to consider nontraditional careers is to introduce them to diverse role models, particularly role models with whom they are able to relate. Providing diverse role models challenges stereotypes around careers where some groups may traditionally be underrepresented. Women and people of color are underrepresented in most STEM fields, including engineering, physics, and computer science. But when students are introduced to female engineers, or black computer scientists, their perceptions of who "belongs" in STEM are transformed.[22]

Key strategies to achieve Goal #2 include:

a. Improving student advising by strengthening career counseling services and tools, increasing access of students to alumni, professional and near-peer networks, and increasing student access to up-to-date market data about high-wage, high-demand jobs

b. Increasing STEM internships, work-based and service learning opportunities and undergraduate research opportunities in high-demand fields

c. Increasing the number and quality of P-20 support services and pre-college transition/bridge programs for students who are historically underserved and underrepresented in STEM

[19] Bryant, James A. Jr. (2010). "Dismantling Rural Stereotypes." Educational Leadership, November 2010, Vol 68, No 3, pp. 54-58
[20] National Governors Association, The Role of Informal Science in the State Education Agenda, http://www.nga.org/files/live/sites/NGA/files/pdf/1203INFORMALSCIENCEBRIEF.PDF.
[21] Ibid.
[22] National Alliance for Partnerships in Equity: http://www.napequity.org/resources/role-models/

d. Increasing the number of STEM role models and access to professional networks for students who are underrepresented in STEM

e. Increasing needs-based financial support and access to flexible, micro-loan/funds for first-generation and historically underrepresented students pursuing high-wage, high-demand credentials

Goal #3: Continuously improve the effectiveness, access to resources, and the number of formal and informal **STEM educators**.

GOAL #3 PRIORITY OUTCOME

1. By 2020, leverage Oregon's Regional STEM Hubs to provide high-quality professional development opportunities in partnership with local STEM employers to at least 50 percent of Oregon's STEM educators – including P-12 teachers and administrators, postsecondary faculty, STEM-focused out-of-school program providers.

Why focus on educators? Educators have the greatest impact on student success across the education continuum, both inside and outside of classrooms. In P-12, for instance, research indicates that a classroom teacher's effectiveness is more important—and has more impact on student achievement—than any other factor controlled by school systems, including class size or the school a student attends.[23]

Researchers agree strengthening teacher effectiveness is the most efficient way to boost academic achievement and they believe rigorous, cutting-edge professional development can play a key role in improving teacher practices.[24] This type of professional learning is job-embedded (integrated into the work teachers do on a day-to-day basis), collaborative, incorporates coaching and technology, and takes into account the school context.[25] However, today only 41 percent of Oregon's educators agree that professional development is differentiated to meet their individual needs.[26] In addition, access to high-level professional development is often lacking across the state. For instance, 41 percent of surveyed teachers in Oregon's Coast STEM Hub lacked adequate access to professional development in science teaching. Fifty-two percent lacked adequate access to professional development in technology and engineering education.[27]

Oregon's Regional STEM Hubs are currently engaging partners from business and higher education to expand and improve professional development offerings. For instance, a STEM-related business might open its laboratories to local teachers and given them an opportunity to work alongside laboratory technicians, helping them better understand the culture of applied STEM disciplines and transfer that back to the classroom. The goal is to leverage STEM Hubs and their partnerships to reach 50 percent more of Oregon's teachers over the next five years.

Thoughtful, skillful teachers who have contextual knowledge of how STEM knowledge and skills are applied in the workplace are the backbone to delivering innovative STEM instruction across elementary and secondary

[23] Rivkin, S.G., Hanushek, E.A., and Kain, J.F. "Teachers, Schools and Academic Achievement," Econometrica, Vol. 73, No. 2 (March 2005)
[24] Nurturing Quality Teachers in Oregon, A Profile of Success and Challenges of Six Oregon Districts; ECONorthwest, 2008
[25] Education First: Common Core State Standards & the Transformation of Professional Development; http://www.education-first.com/files/CCSS_PD_Brief_1_-_Essential_Elements_of_PD.pdf
[26] 2014 TELL Oregon Survey, Spring 2014
[27] Oregon Coast Regional STEM Hub, *Oregon Coast Regional STEM Hub Partnership Plan,* 2014

classrooms. They drive differentiated, integrated STEM learning experiences, and develop and deliver hands-on, project-based instruction for learners of all ages. Teachers must be supported by strong instructional leaders who understand the benefits of STEM education beyond content knowledge. Principals need to establish cultural and environmental conditions to take risks and to shift toward more applied, integrated, and place-based learning.

Key strategies to achieve Goal #3 include:

a. Building, strengthening, and supporting statewide partnerships for STEM education through our STEM hubs and linking them with existing professional networks

b. Providing time and resources for educator-to-educator and educator-industry collaborations to implement promising STEM instructional practices

c. Creating opportunities for STEM educators to experience STEM in industry and research as part of their professional development

d. Providing incentives to teacher preparation programs to develop, evaluate, and disseminate effective STEM preservice teaching strategies including experiences with STEM employers, and continued support during the first three years of teaching

e. Increasing career transitions of STEM professionals into teaching CTE, math, and science

Goal #4: Create sustainable and supportive conditions to achieve STEM outcomes aligned to Oregon's economic, education, and community goals.

GOAL #4 PRIORITY OUTCOMES

1. By 2017, increase the state's STEM investment to at least $25 million in order to follow through on STEM structural shifts, including specific program opportunities that provide pathways to grow careers and drive a robust, inclusive economy.
2. By 2017, create a data dashboard that publicly monitors Oregon's progress in key STEM indicators that comprise the state's connected STEM, CTE, and workforce ecosystem.

Oregon must continue to stay the course and build upon the good work it has done since 2011. This calls for continued strategic investments in STEM. This strategic plan is designed to serve as a guide for targeting future investments in key initiatives.

Additionally, Oregon must continue to identify key metrics and use consistent definitions for STEM across its education ecosystem. The STEM Investment Council believes in holding itself and the system accountable for making progress and using data to spur stakeholder dialogue and continually drive improvement.

State agencies that comprise the education and workforce ecosystem must also fully implement the Brookings definition of STEM. Brookings calls attention to two STEM economies: the professional STEM economy that is linked to graduate school education and the second STEM economy that draws from high schools, workshops, vocational schools, and community colleges. The second STEM economy will hold half of all STEM jobs – and pay 10 percent more than non-STEM jobs with similar education requirements.

With the STEM goals, policies, and investments Oregon has already pursued, the state is poised to move the needle on its STEM results.

Key strategies to achieve Goal #4 include:

a. Developing a sustainable funding and policy environment for STEM and CTE that provides seamless support across biennia.

b. Building public awareness and demand for improved STEM outcomes and programs

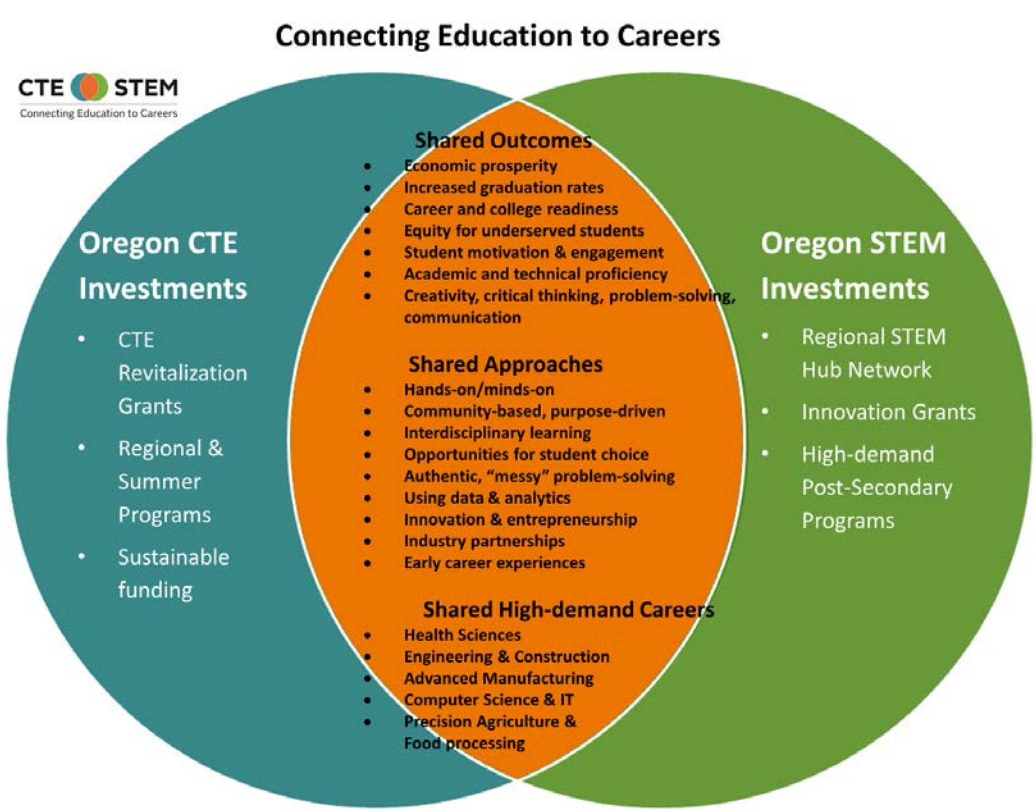
c. Creating and supporting an implementation network of Regional STEM Hubs to increase adoption and spread of effective practices, leverage resources and provide critical feedback to inform policies and investments

d. Producing promotional materials that connect STEM learning opportunities to high demand industry sectors, and which convey the exciting career and research opportunities that exist amongst Oregon business, organizations and institutions

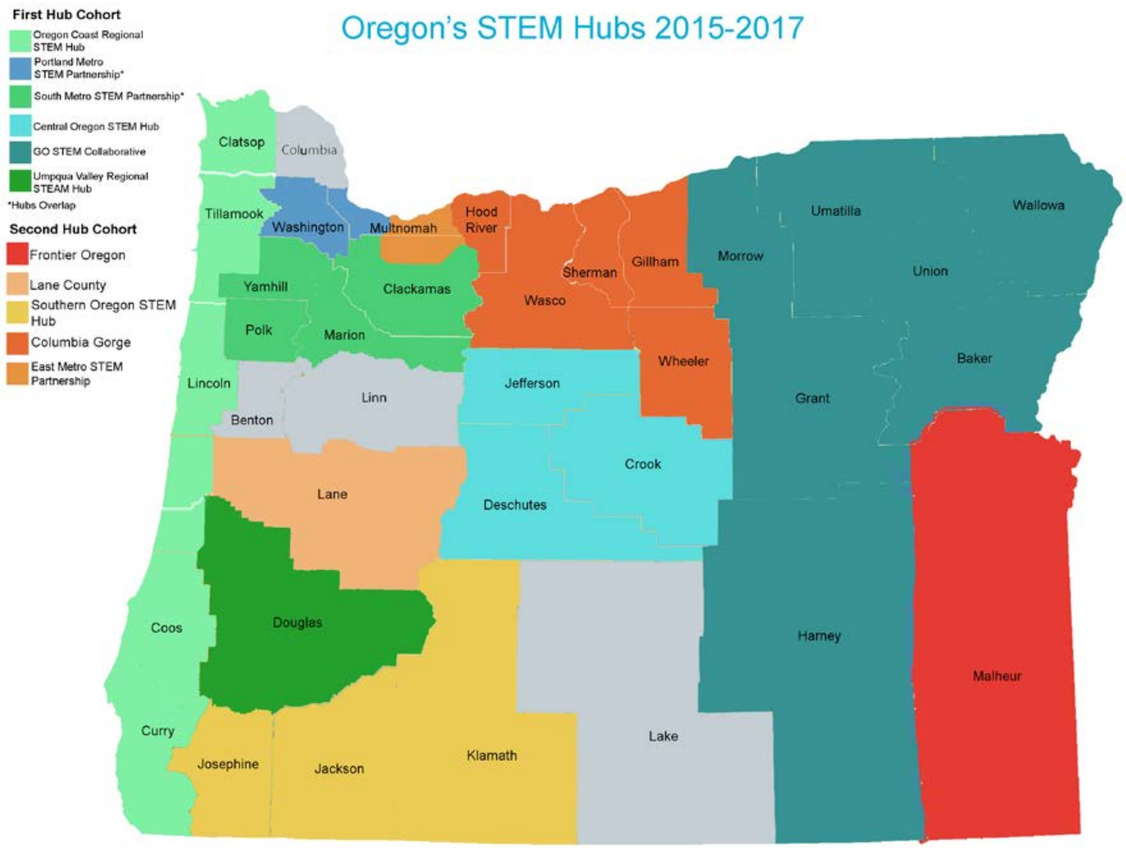
e. Publicly showcasing individuals, classrooms and organizations that are effective in achieving positive STEM outcomes

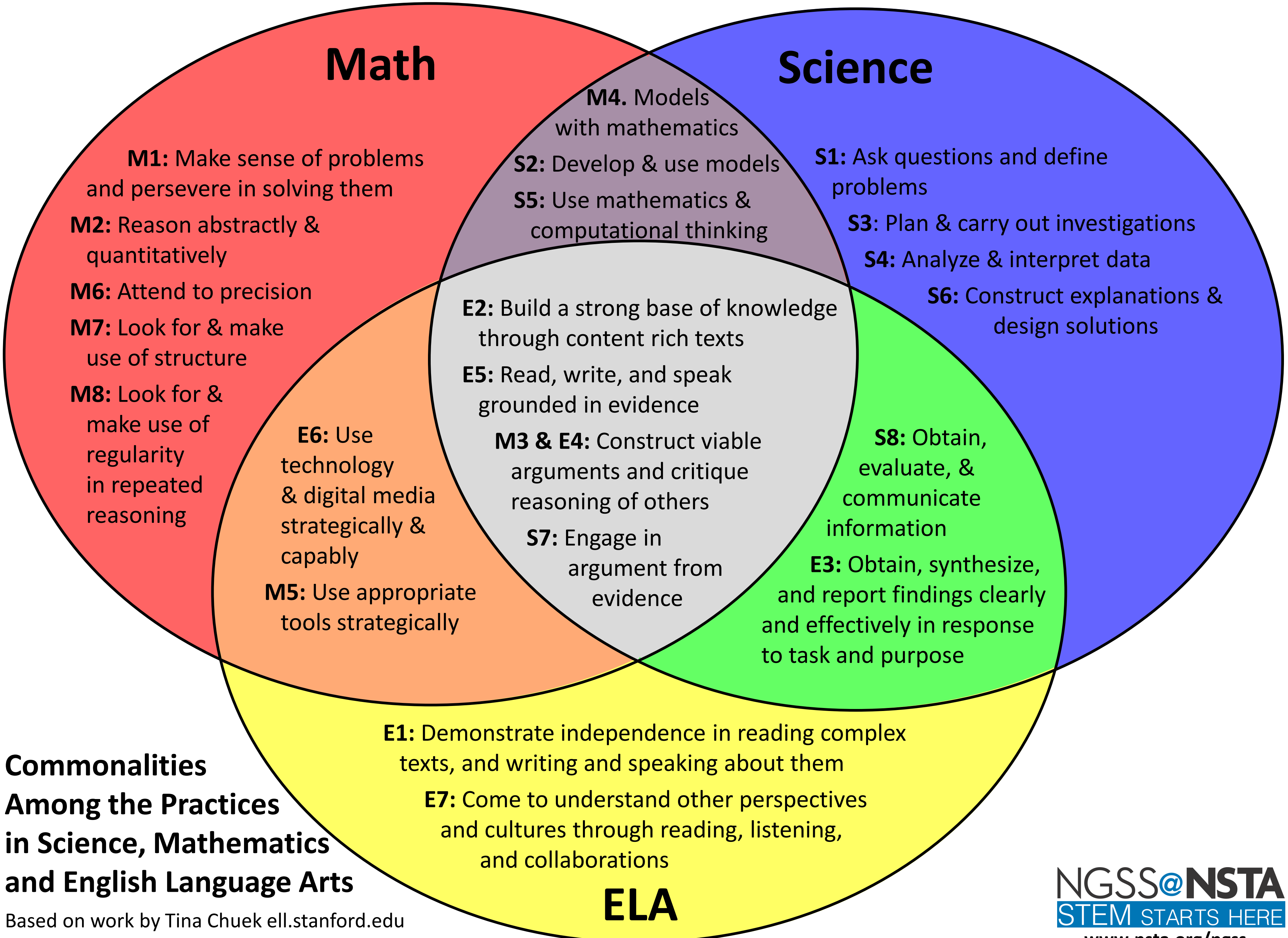
f. Creating and implementing a community engagement campaign to increase STEM interest and access amongst traditionally underrepresented populations

APPENDIX A



APPENDIX B


Oregon's STEM Hubs 2015-2017
First Hub Cohort
Oregon Coast Regional STEM Hub
Portland Metro STEM Partnership*
South Metro STEM Partnership*
Central Oregon STEM Hub
GO STEM Collaborative
Umpqua Valley Regional STEAM Hub
*Hubs Overlap
Second Hub Cohort
Frontier Oregon
Lane County
Southern Oregon STEM Hub
Columbia Gorge
East Metro STEM Partnership
Clatsop
Columbia
Tillamook
Washington
Multnomah
Hood River
Sherman
Gillham
Morrow
Umatilla
Wallowa
Union
Yamhill
Clackamas
Wasco
Polk
Marion
Wheeler
Baker
Lincoln
Jefferson
Linn
Grant
Benton
Crook
Lane
Deschutes
Coos
Douglas
Harney
Malheur
Curry
Lake
Josephine
Jackson
Klamath



Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Chuek ell.stanford.edu

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APPENDIX D

OREGON STEM INVESTMENT COUNCIL
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ADVISORS
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Kimberly Howard, Portland General Electric
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Beth Unverzagt, Oregon Afterschool for Kids

CHIEF EDUCATION OFFICE
Lindsey Capps, Chief Education Officer
Mark Lewis, STEM & CTE Policy Director
Krissi Hewitt, STEM Research Analyst

WITH THANKS
The Oregon STEM Investment Council thanks the Oregon Community Foundation for generously supporting the development of this plan. Thanks also to the Oregon Business Council and Education First for collaboration on this work.