Oregon's STEM Plan:

Driving Individual, Community, and State Prosperity

VISION

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 we are flooded by information, where new technologies alter nearly every facet of our lives, and where the pace of global developments have an increasing impact on our communities and our planet. In this shifting context Oregon must prepare its learners for a future that we can't even imagine today, to solve problems that we are just beginning to fathom, using technologies that haven't yet been invented. In their various personal and occupational roles Oregonians will be called upon to understand these complex challenges, find solutions, adjust to change, 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 sources, delivery structures, and societal expectations, they are highly complementary. They share intended outcomes, applied learning approaches, 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 futures.

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 and scientific discoveries in every sector of the business landscape offers unprecedented job and career opportunities to Oregonians who've acquired the talent, 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 biomedical research. But it's also true in more established sectors such as advanced manufacturing, precision agriculture, construction, and food processing.

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

[1] 2015-2017 Oregon Talent Plan: https://www.oregon.gov/EMPLOY/OTC/Documents/OTC_TalentPlanAdopted_11-12-2015.pdf

fastest growing 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, Lane County, the North Coast, Central Oregon, the Gorge, Pendleton-Umatilla, and Southern Oregon. 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 this evolving economy. In 2015, for instance, only 37 percent of our 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 in 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]

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.

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

Let's be clear. The challenge before us is not simply about filling jobs and driving economic growth. Too many of our students do not see the relevance of their schooling, and are underprepared to adapt and contribute to a rapidly evolving, technologically-rich society. Tragically, 26% of Oregon students do not even make it to high school graduation—severely limiting their future prospects and the opportunity to realize their dreams.

Oregon must act now. And, we must act together. We must strive to help *each* student discover and develop their talents and interest, 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, parents, and employers have nearly identical responses. They say that what students need goes far beyond specific content knowledge to include critical thinking, problem solving, creativity, communication, flexibility, perseverance, risk-taking, adaptability, teamwork, and initiative.[8] In a society where information and academic content is readily searchable online, those who are able to analyze, synthesize, and apply that information in unique situations are the ones who will be in the highest demand, and will also be the change-makers of our future.

STEM and CTE education are a critical way that Oregon can fully prepare each student for success. These complementary approaches dramatically increase real-world relevance, have authentic demonstrations of student thinking, and provide opportunities for students to take charge of their learning. In STEM and CTE students become more engaged in the learning process. Engaged learners succeed. They are able to see pathways and opportunities before them, and stay on the path to graduate with a plan.

> ***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.***

The state must continue to transform its student-centered approach to teaching and learning by scaling STEM and CTE education. In its truest form, STEM is a multidisciplinary approach to learning that eliminates the false dichotomies between academic and applied learning, between in-school and out-of-school experiences, and between education and employment. The applied learning approaches of STEM and CTE motivates students, ignites their 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, and Investments

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

[8] Note that most of these are reflected in Oregon's College and Career Readiness Standards: http://education.oregon.gov/wp-content/uploads/2015/09/Adopted-College-and-Career-Readiness-Definition.pdf

access, opportunity, and attainment for historically underserved and underrepresented populations.[9] These two goals were created to increase state productivity, reduce poverty, and meet the talent needs of businesses and communities.

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), which also integrate engineering standards and practices.
- 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.

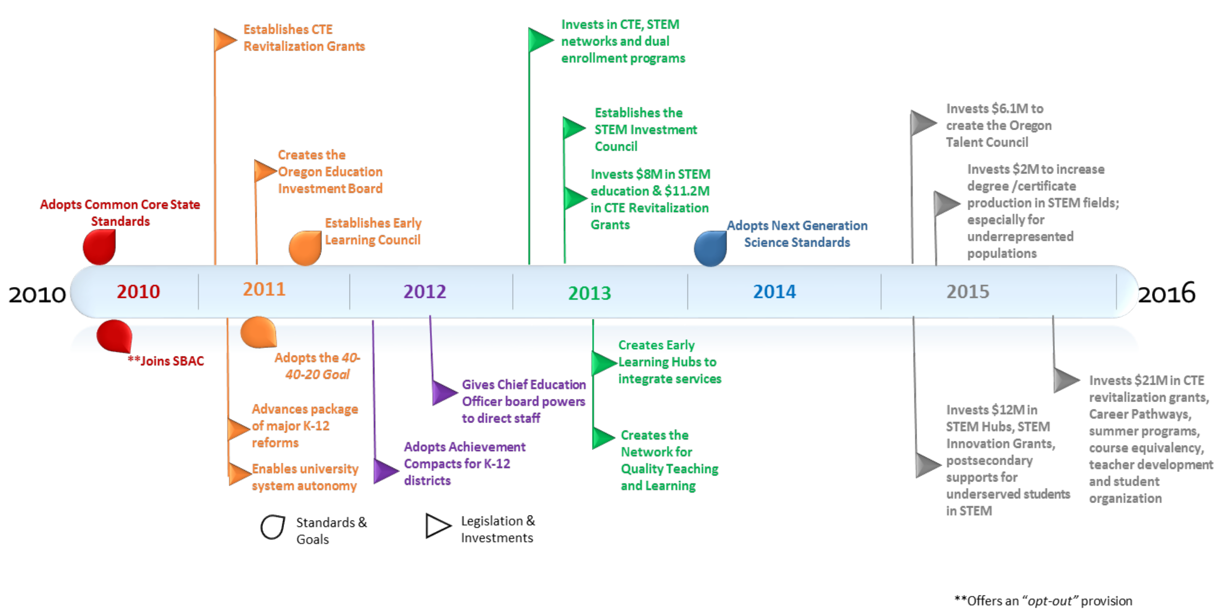
This coherent set of policies and strategic actions seeks to address the state's full education and workforce continuum. In conjunction with its policies and actions, the Legislature has made considerable investments to increase student learning opportunities in CTE and STEM education, to increase degree and certificate production in STEM fields, and to increase participation and degree completion

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 engagement.

The Hubs are multi-sector 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 E.)

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



[9] For the purposes of this plan, "historically underserved and underrepresented" populations in STEM include 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.

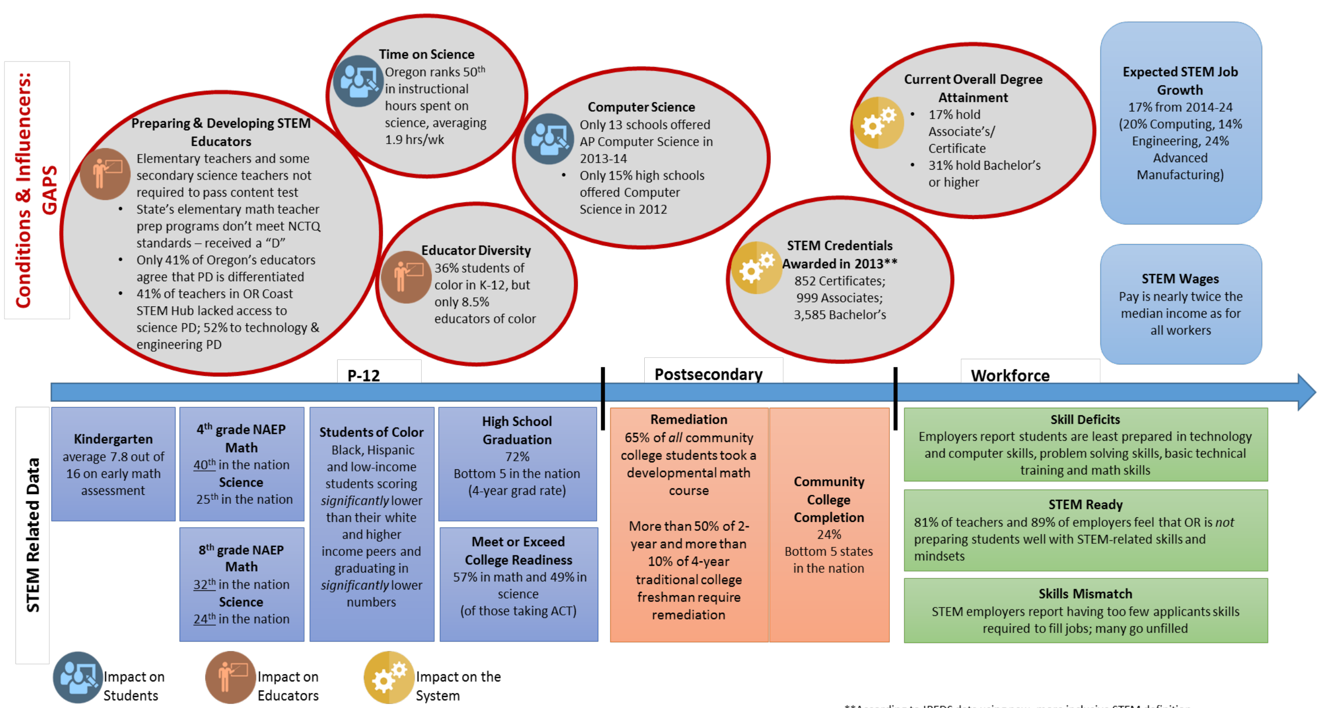
in STEM fields by students of color and women at public colleges and universities. In 2013, in addition to establishing the STEM Investment Council, the Legislature allocated $8.5M to fund six regional STEM Hubs, model STEM Lab Schools, and a suite of STEM/STEAM/CTE grants focused on historically underserved 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 development, and post-secondary support for historically 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.

In 2015 the Oregon Higher Education Coordinating Council (HECC) implemented a new funding model, which incentivizes 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 results indicated in Figure 2, which are currently mediocre at best. Partners must acknowledge that a systemic commitment to STEM and CTE education is a marathon, not a sprint. Investments will likely result in a "hockey stick" growth pattern, where indicators remain flat for four to five years and then increase rapidly as investments start to benefit the first cohorts coming through.

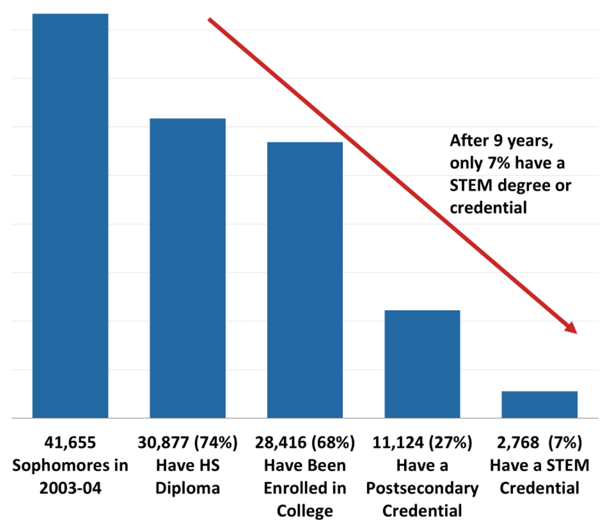
System Gaps and Related Results. Major gaps in Oregon's STEM education ecosystem are identified in the top half of Figure 2. The bottom half of the figure pinpoints Oregon's middling STEM results, which correlate with the gaps. Significant gaps affecting students include the amount of time each week that Oregon elementary students spend on science. Currently, the state ranks 50th. In addition, only 13 schools in the state offered AP Computer Science 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 gave 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). However, according to the Oregon Educator Equity Report, the state is almost on track to meet a goal of increasing the number of diverse teachers by 10 percent compared to the percentage in 2012.[10] National research attributes the lack of diversity in the STEM labor force in part to so few STEM role models of color in education.

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.

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.

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. This plan represents the Council's recommended suite of long-term strategies.

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 several months, the Council and the Chief Education Office have been working with educators, diverse community groups, non-profits, and other partners to articulate a vision, belief statements, and driving goals for STEM education in Oregon. In particular, this vision emphasizes equity of opportunity, access, and attainment for every Oregon student consistent with Oregon's Equity Lens.

STEM, STEAM, What does it all mean?

This strategic plan is acronym agnostic. Whether you call it STEM, STEAM, STREAM, STEMM, METS, i-STEM, e-STEM, TEAMS, S^2TEM, $MESH_T$, or other associated acronym, Oregonians generally agree on the fundamental principles and values put forward in the following STEM Manifesto. This strategic plan and the work of

[10] 2016 Oregon Educator Equity Report: http://education.oregon.gov/portfolio/2016-educator-equity-report/

partners throughout the State strives to create an inclusive renaissance of curiosity, creativity, wonderment, innovation, and the joyful pursuit of life-long learning and talent discovery.

The STEM Manifesto

1. **All people have creative potential.** Our students are not passive consumers of information. Adults must provide the space for them to be active participants in their own learning and construction of knowledge. 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 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 with leaders, institutions, and volunteers in our communities who want to help our students 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 literacy 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 across multiple areas of human knowledge and expression. 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 identify and solve problems that are relevant and meaningful.

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 locations 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

Oregon's STEM Framework

Summarized below are four primary goals to spur interest, 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 initiatives, if implemented, will achieve the targeted 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, support, and the number of formal and informal P-20 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, Oregon's high school completion rates across those schools implementing STEM and CTE applied learning strategies for all students will increase to at least 85%.
2. By 2020, Oregon elementary classrooms will increase time on science and engineering by 50% from 1.9 hours per week to exceed the national average of 2.7 hours per week,[11] using lessons and approaches consistent with the Next Generation Science Standards (NGSS).
3. By 2020, Oregon will adopt computer science standards and increase the number of high school computer science related course offerings by at least 50%.
4. By 2020, Oregon will have expanded participant hours in out-of-school STEM learning programs by at least 25% with a special emphasis on historically underserved and underrepresented students.

Why must Oregon focus on STEM learning opportunities in the early grades? The early years are critical for students to develop authentic interest in and experience with STEM. Through discovery, discourse, inquiry, and play, children learn to observe natural phenomena, become pattern sleuths, shape and defend an argument, and use problem-solving tactics.[12] 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.[13] A landmark 2007 study also showed that early math skills are one of the best predictors of later academic success in both math and language arts.[14] 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.[15] 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.[16] 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, career, and life.

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 academic standards are not simply about what to teach, they also put forward a vision that challenges educators to transform how they teach. Instead of an emphasis on memorization and recall of information, students should be engaging in solving real-world problems and employing the "practices" used by STEM professionals (see Appendix D). It is also important for the public to distinguish between the implementation of these important standards, and the public concerns over high-stakes testing.

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

[12] 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

[13] LASER i3 Validation Study by the Center for Research in Educational Policy (CREP) at the University of Memphis; 2015

[14] Duncan, et al. "School Readiness and Later Achievement," 2007; http://eprints.ioe.ac.uk/5971/1/Duckworth2007SchoolReadiness1428.pdf?origin=public

[15] What Is the Impact of Decline in Science Instructional Time in Elementary School? 2012; http://www.csss-science.org/downloads/NAEPElemScienceData.pdf

[16] Generation STEM: What Girls Say About Science, Technology, Engineering and Math; 2012; https://www.girlscouts.org/research/pdf/generation_stem_full_report.pdf

Why do Oregon students need access to computer science courses? Some of 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.[17] Only 13 schools offered the AP Computer Science in 2013-14.[18]

Why is out-of-school STEM learning important? Informal STEM learning is just as important as formal STEM learning. Only 18.5% of a typical K-12 student's waking hours are spent in a formal classroom setting, and many scientists and engineers point to out of school experiences as being instrumental in shaping their career choices.[19] These community-based learning opportunities have been shown 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]

Key initiatives to achieve Goal #1 include:

- Increase time on science in elementary and middle school, consistent with the Next Generation Science Standards (NGSS) and integrating it with other subject areas.
- Increase student digital literacy skills, use of technology to deepen learning, and their access to applied computer science courses and approved CTE "programs of study."
- Increase access to high quality out-of-school STEM-CTE learning opportunities that inspire student interest and mitigate summer learning losses.
- Engage parents and early learning educators to emphasize playful inquiry approaches that promote multi-sensory, interactive environments involving various forms of both guided and unstructured play and explorations.
- Increase the use of teaching strategies that challenge students to be creative, resourceful, persistent, and collaborative through solving real-world problems.
- Increase the use of culturally relevant, place-based contexts as a basis for student inquiry and applied learning projects.
- Increase interactions of students with STEM professionals and community experts to develop students' aspirations and personal STEM identities as life-long learners.
- Increase the availability and attainment of transferrable college-level STEM credits and industry recognized credentials while in high school.

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[17] Oregon Computer Science Teachers Association, 2012
[18] Code.org, state-facts, OR, 2015: https://code.org/advocacy/state-facts/OR.pdf
[19] Philip Bell, Bruce Lewenstein, Andrew W. Shouse, and Michael A. Feder, Editors; Learning Science in Informal Environments: People, Places, and Pursuits (2009), National Research Council
[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.

- Increase the development and acceptance of industry-recognized credentials based on demonstrated skills, including traditional and nontraditional certifications.
- Increase student interest, understanding, and success in mathematics through applied learning approaches and proficiency-based advancement.

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 2018, work with communities of color to establish a volunteer networks of STEM employees of color to act as role models in and out of school.
2. By 2020, double the number of historically underserved and underrepresented STEM students who are enrolled in post-secondary STEM-related programs.
3. By 2025, double the number of historically underserved and underrepresented students attaining a STEM-related degree or credential.

Why a specific goal on equity? Oregon faces significant opportunity and attainment gaps across its cradle to career education ecosystem, particularly among its students of color and students from families in 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 an asset 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.[22] 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.

Students from rural areas and families in 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.[23]

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 historically 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

[22] National Science Foundation, Women, Minorities, and Persons with Disabilities in Science and Engineering (2009)
[23] Bryant, James A. Jr. (2010). "Dismantling Rural Stereotypes." Educational Leadership, November 2010, Vol 68, No 3, pp. 54-58

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.[24]

Key initiatives to achieve Goal #2 include:

- Increase the number of role models who are female and/or persons of color for students who are underrepresented in STEM, including more STEM and CTE teachers of color.
- Increase access to alumni, professional, and near-peer networks for students of color.
- Increase student and family access to understandable, up-to-date market data regarding high-wage, high-demand career opportunities by improving student advising, career counseling services, and guidance tools.
- Increase the number and quality of support services and pre-college transition programs for students historically underserved and underrepresented in STEM.
- Increase needs-based financial support for first-generation and historically underrepresented students pursuing high-wage, high-demand credentials.
- Increase STEM-related CTE "programs of study" in high-demand fields.
- Increase access to quality, STEM-rich early learning environments for historically underserved and underrepresented families.
- Increase student and family access to culturally relevant, community-based STEM and CTE programs that build upon local assets.
- Increase paid STEM and CTE internships, work-based and service learning opportunities, and undergraduate research opportunities in high-demand fields.

[24] National Alliance for Partnerships in Equity: http://www.napequity.org/resources/role-models/

Goal #3: Continuously improve the effectiveness, support, and the number of formal and informal P-20 STEM educators.

GOAL #3 PRIORITY OUTCOMES

1. By 2018, create and populate an online repository of high-quality instructional resources and concrete examples that engage learners in rich, authentic applications of STEM concepts.
2. By 2018, establish a STEM leadership academy to work with school principals, superintendents, teacher preparation faculty, and teacher leaders.
3. By 2020, provide high-quality professional development opportunities in partnership with local STEM employers to at least 50 percent of Oregon's K-12 STEM educators, leveraging Oregon's Regional STEM Hubs where possible.

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.[25]

Researchers agree strengthening educator 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 educator practices.[26] 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.[27] However, today only 41 percent of Oregon's educators agree that professional development is differentiated to meet their individual needs.[28] 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.[29]

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 classrooms. They drive differentiated, integrated STEM learning experiences, and develop and deliver hands-

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[25] Rivkin, S.G., Hanushek, E.A., and Kain, J.F. "Teachers, Schools and Academic Achievement," Econometrica, Vol. 73, No. 2 (March 2005)
[26] Nurturing Quality Teachers in Oregon, A Profile of Success and Challenges of Six Oregon Districts; ECONorthwest, 2008
[27] 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
[28] 2014 TELL Oregon Survey, Spring 2014
[29] Oregon Coast Regional STEM Hub, *Oregon Coast Regional STEM Hub Partnership Plan,* 2014

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.

Why focus on instructional resources? Most formal educators are faced with tremendous demands on their time and have little to no opportunity to develop curricular units from scratch without support. Furthermore, the kind of instructional units envisioned in this plan—utilization of project-based learning approaches, based in rich community contexts, culturally informed, and making connections with STEM employees—requires time, expertise, and energy well beyond traditional curriculum development. Current publishers have limited, often perfunctory, resources to support this kind of integrated unit that draws connections to multiple disciplines, and empowers students to drive their own learning. Those publishers that do have quality units and materials are often too expensive for districts to afford. However, through the network of Regional STEM Hubs, Oregon educators are working alongside industry volunteers to create such units. There are also several good online sources, but they often require significant effort to determine which are of highest quality and most relevant to the students. These ideas and resources need to be made more readily available to Oregon educators at all levels.

Why focus on school leaders? Leaders determine the culture of their organizations and institutions. The same research that has shown that teachers have the greatest impact on student success in the system, also shows that building principals have the next greatest impact. In schools where high quality STEM is taking place, principals and teacher leaders have worked together to create a positive, student-centered culture where educators work collaboratively and are encouraged to take thoughtful risks in their teaching approaches in order to meaningfully engage students and community members.

Key initiatives to achieve Goal #3 include:

- Increase time and funding for educators to engage in professional learning opportunities regarding effective STEM and CTE teaching strategies, including applied, project-based approaches, and that develop their own positive STEM identities.
- Create a repository of high-quality instructional resources and concrete examples that engage learners in rich, authentic applications of STEM concepts.
- Increase principal and administrator understanding of the nature and importance of quality STEM and CTE programs, and the power to transform learning outcomes for students and educators.
- Increase the effective implementation of Oregon's math and science standards.
- Increase time and resources for educator-to-educator and educator-to-industry collaborations to implement promising STEM and CTE instructional practices.
- Support teacher preparation programs that promote effective, standards-informed, applied and project-based STEM teaching strategies, and interactions with STEM and CTE employers.
- Increase opportunities for STEM and CTE educators to experience STEM in industry and research as part of their ongoing professional development.
- Increase the talent pool of qualified STEM and CTE teachers, and reduce barriers for STEM and CTE professionals to transition into teaching.

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 2020, pass state policies that enact a reliable and sustainable funding mechanism to adequately support the state's STEM and CTE investments and provide flexibility across biennia to enable longer-term investments to the field.
2. By 2018, 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.
3. By 2020, implement common post-secondary mathematics placement measures at public institutions, and realign grades 9-14 mathematics curriculum to better reflect differing degree/certificate program needs.

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 and CTE. 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 definitions of STEM careers[30] and STEM degrees.[31] 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 initiatives to achieve Goal #4 include:

- Develop a sustainable funding and policy environment for STEM and CTE that provides seamless and sufficient support across biennia.
- Create a data dashboard that publicly monitors progress on key STEM indicators of the state's connected STEM and CTE education, economic, and workforce system.
- Create and support a network of Regional STEM Hubs and Regional CTE Coordinators to increase adoption and spread of effective practices, leverage shared resources, and provide critical local feedback to inform policies and investments.

[30] Rothwell, Jonathan, *The Hidden STEM Economy,* pp. 23-25, Brookings, June 2013
[31] Rothwell, Jonathan and Kulkarni, Siddharth, *Beyond College Rankings A Value-Added Approach to Assessing Two- and Four-Year Schools*, pp. 26-28, Brookings, April 2015

- Improve the quality and relevance of postsecondary mathematics placement processes and align course content to relevant degree/certificate program needs.
- Build the capacity, effectiveness, and connectivity of STEM-related professional networks for educators, administrators, community-based non-profits, and other partners.
- Work with STEM and CTE employers to increase the number of employee volunteers engaging in education programs both in, and out of school.
- Partner with private and corporate philanthropy to align investments to shared outcomes, address gaps in services, and increase quality of programs.
- Streamline outcomes-based funding mechanisms—lowering administrative burden of recipients, while increasing accountability to attainment of results.
- Provide "start-up" as well as ongoing institutional funding to incentivize postsecondary programs aligned to high-wage, high-demand industry needs.
- Publicly showcase individuals, classrooms, and organizations that are effective in achieving positive STEM outcomes.
- Create and implement a community engagement campaign to increase interest and support for STEM, particularly among traditionally underrepresented populations.

Operationalizing the Plan

Achieving the changes outlined in this plan will only occur if we are able to harness the collective energy, wisdom, and assets in our educational system, businesses and industry, lawmakers, civic leaders, non-profits, parents and families, private philanthropy, and others. During the vetting of earlier drafts of this plan, we asked a variety of stakeholders what each of these constituents could do to take shared responsibility for operationalizing this plan and transforming outcomes for our students and communities. A summary of these calls to action are included in Appendix F.

Summary:

This strategic plan consists of a comprehensive set of strategies and initiatives to strengthen and transform the STEM education ecosystem in Oregon. It is formally submitted to the Chief Education Officer as partial fulfillment of the statutory duties of the STEM Investment Council. Through the duties of that Office, these recommendations are also made by extension to the Governor, the State Board of Education, the Higher Education Coordinating Commission, the Early Learning Council, the Youth Development Council, and the Teacher Standards and Practices Commission.

Consistent with this plan the Council will continue to monitor the impact of specific investments as well as changes reflected in the indictors identified in Appendix B. This plan will be updated every two years following a thorough assessment of the changing operating environment in Oregon and input from a broad representation of stakeholders. Each biennium, the STEM Investment Council will provide a report to the Legislature on progress against these indicators, as well as specific policy and investment recommendations arising from the vision and priorities of this plan.

The Oregon STEM Investment Council also thanks the Oregon Community Foundation for generously supporting the development of this plan, Oregon Learns and Education First for collaboration on this work, and to all of the participants of focus groups from communities throughout this great state.

Respectfully submitted,

Jim Piro
Chair, STEM Investment Council

OREGON STEM INVESTMENT COUNCIL

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Aubrey Clark, Intel Corp.
Herb Fricke, Akana
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Dwayne Johnson, ScaleUp Partners
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Lindsey Capps, Chief Education Officer
Mark Lewis, STEM & CTE Policy Director
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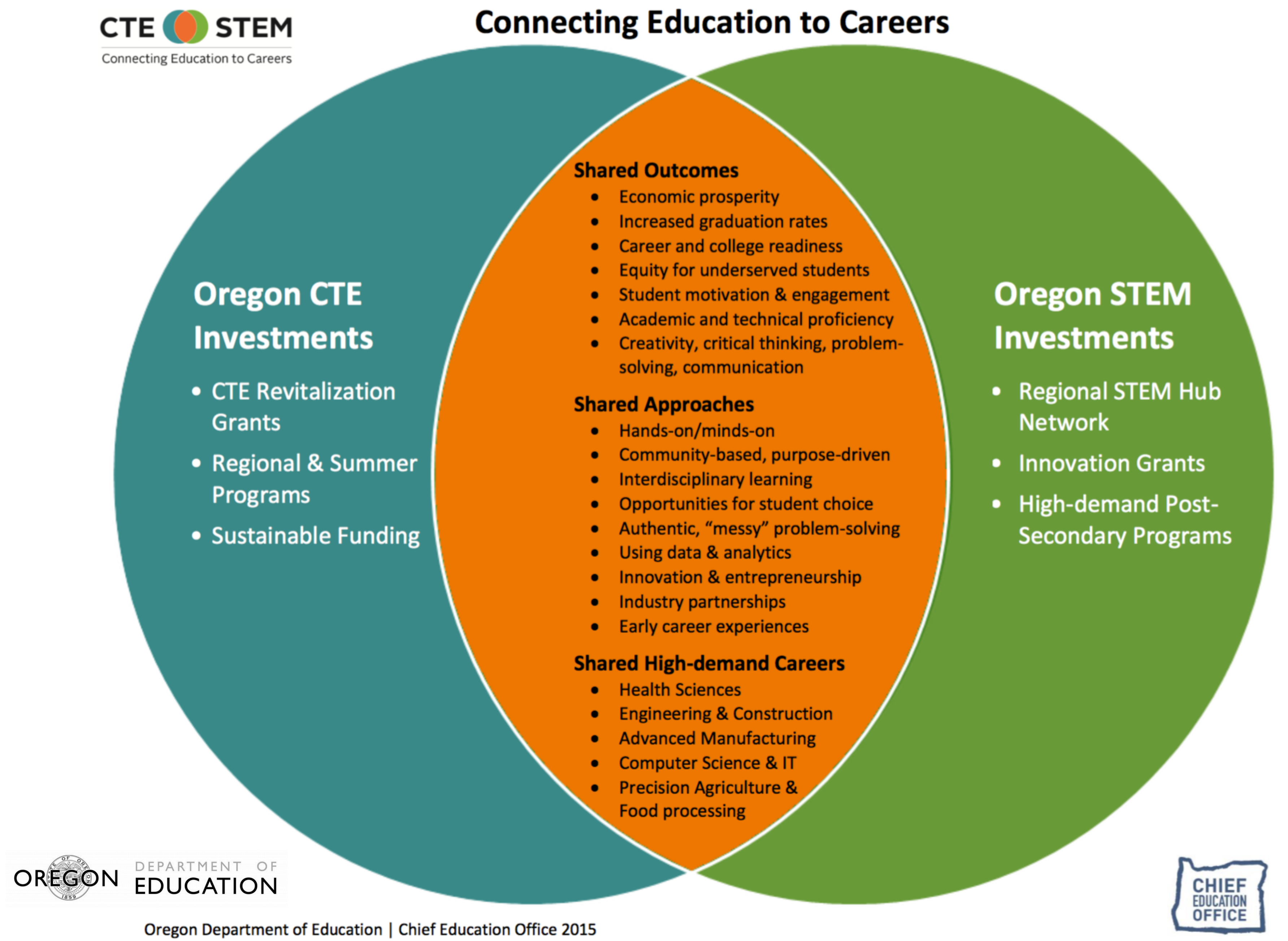
List of Appendices

Appendix A: Relationship of CTE and STEM



Appendix B: Oregon's STEM Indicators

The following table contains overall system metrics that will enable the STEM Investment Council and the State to monitor and communicate relevant outcomes for STEM education. These indicators are not fully inclusive of metrics that relate more specifically to individual investments recommended by the Council. While there are numerous possible indicators to track, this list represents an initial set, which will be reviewed on a 2-year cycle (at a minimum) and modified based on changes to available data or additional analysis. These indicators will form the basis for semi-annual reporting to the Legislature, the State Board of Education (SBE), and the Higher Education Coordinating Committee (HECC). *To the extent possible, each indicator will be disaggregated by* ***race, gender, socio-economic status, and region****.*

Table 1. Proposed STEM indicators to monitor student access, interest, preparedness, and attainment.

Proposed STEM Metric	Rationale	Definition	Possible Source
Elementary time on science (Access)	Between 1988 and 2008, the amount of instructional time devoted to science instruction in elementary schools has dropped to an average of 2.3 hours per week in the U.S. The decreased time spent on science instruction is correlated with lower scores on the science portion of the National Assessment of Educational Progress. The most recent data from 2009 shows that is that 25% of Oregon's 4th grade teachers report spending less than one hour on science a week and 60% report less than 3 hours per week. These figures are the lowest in the country.	Average hours/week at each grade level, aggregated.	Teacher self-report on the NAEP. Expanded TELL survey.
4^{th} Grade math and science achievement scores (Preparedness)	Performance on nationally normed assessments in math and science provide a helpful comparison with other States. This is also a legislative requirement for the STEM Council. While the NAEP assesses mathematics every 2 years and science every four years, Oregon's Smarter Balanced assessment for mathematics will provide an annual indicator to monitor progress and comparison to other Smarter Balanced states.	% of students in 4^{th} grade who are proficient or advanced in mathematics and science	National Assessment of Educational Progress (NAEP). Annual state Smarter Balanced assessments in math will also be used.
Middle school interest in STEM (Interest)	According to developmental research in the field of interest, children in elementary school are more generally interested in new experiences, and a critical phase in interest development in STEM is during middle school years when students' social and academic identity becomes more defined. Research has shown that expressed interest in science at this time is a better predictor of future career trajectories than academic performance or course-taking patterns. It is assumed that this also extrapolates to STEM fields as a whole.	% of students self-reporting interest in STEM futures.	Student interest surveys as part of investment evaluation instruments. Consider including in a statewide survey of student engagement.

Historically underserved and underrepresented students participating in out-of-school STEM experiences and programs (Access)	During the K-12 academic years, students typically spend about 18.5% of their waking hours in a formal school environment. Out-of-school STEM experiences and programs often create more learner-centered and personalized STEM learning experiences that can deepen understanding of STEM phenomena, provide opportunities to think critically, as well as increase interest. Examples include afterschool clubs (e.g., science, Robotics), museums, science centers, aquariums, or field trips to natural areas. A recent study indicates that there is a 6000-hour gap by 6th graded in access to these rich learning contexts between middle class and students in poverty. Equitable access to STEM opportunities is included as one of Governor Brown's main priorities for STEM education.	Ratio of historically underserved and underrepresented students participating compared to total students participating.	Program reporting of student self-declaration through Hubs, state grant recipients, OregonASK, and private philanthropic grantees.
8th grade performance on math and science achievement scores (Preparedness)	Performance on nationally normed assessments in math and science provide a helpful comparison with other States. This is also a legislative requirement for the STEM Council. While the NAEP assesses mathematics every 2 years and science every four years, Oregon's Smarter Balanced assessment for mathematics will provide an annual indicator to monitor progress and comparison to other Smarter Balanced states.	% of students in 8th grade who are proficient or advanced in mathematics and science	National Assessment of Educational Progress (NAEP). Annual state Smarter Balanced assessments in math will also be used.
Students declaring a postsecondary STEM interest at high school (Interest)	Interest indicated in high school provides a sense of "demand" for post-secondary studies in STEM. This may provide valuable interim data when compared with middle school interest, as well as eventual enrollments and completions in post-secondary STEM studies.	% students selecting interest in a STEM-related field compared to total students taking PSAT	Aggregated self-report on PSAT. Additional data from ACT and SAT will also be gathered, but suffer from more selection bias.
STEM-CTE participation in programs of study (Interest)	Students often have several possible pathways to select in high school. If they choose to take at least one credit (usually two semester courses) in a STEM-related CTE program of study, we anticipate that this indicates an interest in a STEM-related career. Thus, this should provide a sense of talent supply upstream of the post-secondary system.	% of total students earning at least one credit in a STEM-related CTE program of study	ODE course data
Number of students taking the AP STEM tests (Access)	While this may provide some indication of interest, it will provide a sense of disparities in access and expectations across demographic groups. Analysis will also include availability of AP courses and enrollments by region using ODE data.	# of students by demographic group taking AP STEM tests	College Board reports. Supplemented by ODE course data.
Success rates on AP STEM exams (Preparedness)	Most students intending to go on to university studies will take at least one AP test if it is offered in their school. Achieving a 3 indicates mastery of the subject area and several universities allow students to earn credit or place out of basic requirements if they score higher than that.	% of students scoring 3 or better on AP STEM tests	College Board reports.

Seniors and juniors meeting benchmark on ACT/SAT for math and science (Preparedness)	While the ACT/SAT have a selection bias toward those intending to pursue university studies, this indicator provides a sense of overall preparedness to be successful in post-secondary STEM disciplines. It may also provide modest indication of the quality of K-12 education.	% student meeting benchmark compared with total participants	ACT/SAT aggregated state reports.
College credits earned in STEM subjects during high school (Interest/Attainment)	Participation in courses that earn college credit during high school has been shown to increase STEM career awareness and college-going rates.	average credit hours earned per student at 9th or 10th grade	HECC databases from community colleges and universities.
High school graduation rates (Attainment)	States with a well-educated work force are more likely to have higher levels of productivity and economic prosperity. Oregon's graduation rate is the worst in the nation; a serious barrier to future talent development. Graduation rates will also be disaggregated by STEM-CTE concentrators (those who earn at least one credit in a state-approved STEM-related CTE program).	5-year graduation rate, plus GED attainment	ODE course data
Postsecondary enrollments in developmental mathematics (Preparedness)	Students who take non-credit bearing math courses in their first year of college are much less likely to continue in a STEM-related field. Students who begin a college career in remedial courses are also less likely to complete a college degree in any field. The need for remedial coursework in the first year of college has additional economic ramifications for students and their families, since remedial courses are typically non-credit bearing. This also provides a quality-related indicator as to the retention of mathematical content learned in K-12.	% of students enrolled in remedial mathematics courses in first year of college	HECC data
Community college STEM certificates, degrees, and industry-recognized credentials awarded (Attainment)	This indicator gives a sense of the supply of STEM-prepared students entering the workforce, or transferring on to further studies. This is a legislative requirement for the STEM Council under HB 2636 (2013).	Number and % of students earning STEM certificates, degrees, and industry-recognized credentials	Institutional reporting? STEM Hubs?
University STEM certificates and degrees (Attainment)	In an IES study of longitudinal data from 2003 – 2009, 48% of bachelor's degree students and 69% of associate's degree students between 2003 and 2009 who entered a STEM-related degree field left by the spring of 2009. Women and students of color are more highly represented in biological sciences, but in other STEM fields (especially computer science) there is less diversity and representation, thus providing a less welcoming environment where an individual can see others of his/her background succeeding. Reasons why students leave STEM degrees: uninviting atmosphere, difficult introductory sorting classes (in both math and science), STEM courses do not seem relevant. This is a legislative requirement for the STEM Council under HB 2636 (2013).	Number and % of students earning STEM degrees from public and private Oregon universities	HECC and IPEDs data

Full-time employment rates of post-secondary STEM completers within one year (Attainment)	One of the primary purposes of our STEM efforts is to ensure that supply of high-quality talent meets the demands of our STEM-related businesses and industries. In general, Oregon graduates must compete with out of state transfers for employment in STEM occupations. This indicator should provide some insights into the value of STEM credentials from Oregon post-secondary institutions.	% of Oregon completers (industry credential, 2-year, or 4-year degree) employed full time in Oregon within 12 months, adjusted for unemployment rate.	Employment department data. Cohort data provided by HECC.
Oregon completers participation in STEM workforce (Attainment)	One of the primary purposes of our STEM efforts is to ensure that supply of high-quality talent meets the demands of our STEM-related businesses and industries. In general, Oregon graduates must compete with out of state transfers for employment in STEM occupations. This indicator should provide some insights into the value of STEM credentials from Oregon post-secondary institutions.	% of Oregon completers employed in Oregon STEM occupations	Employment department data. Cohort data provided by HECC.
STEM business start ups (Attainment)	Oregon's STEM initiatives are intended to spur business innovations, not just fill jobs. New business start-ups in STEM fields should provide an indicator of the rate of innovation.	# new STEM-related business registrations annually compared over time	Oregon Corporation Division

Appendix C: Baseline Data

Goal 1

Double the percentage of students in 4th and 8th grade who are proficient in Math and Science.

Notes

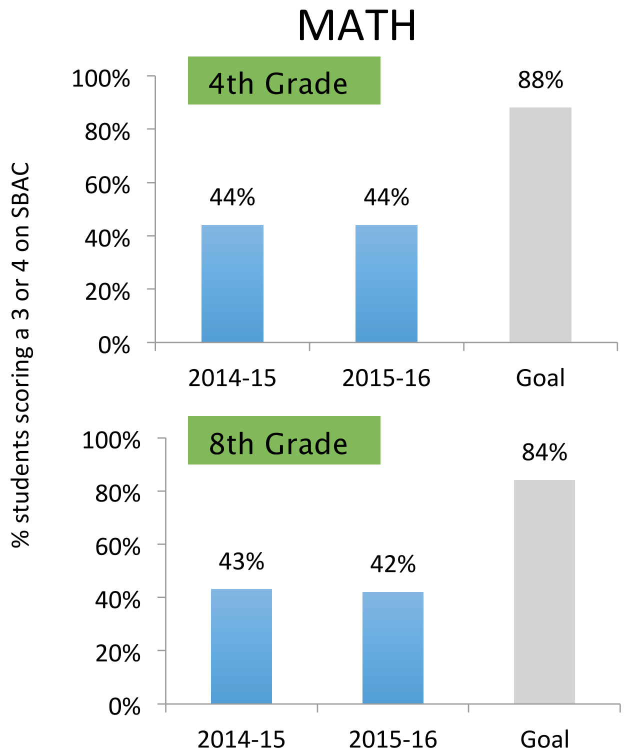
In ***Math****, the Smarter Balanced Assessment (SBAC) is administered at 4th and 8th grade. This assessment is aligned to Common Core State Standards with a score of 3 or 4 indicating students on-track for college. In* ***Science****, the OAKS is administered at 5th and 8th grades. This assessment is aligned to Oregon state standards that are in the process of conversion to the Next Generation Science Standards.*

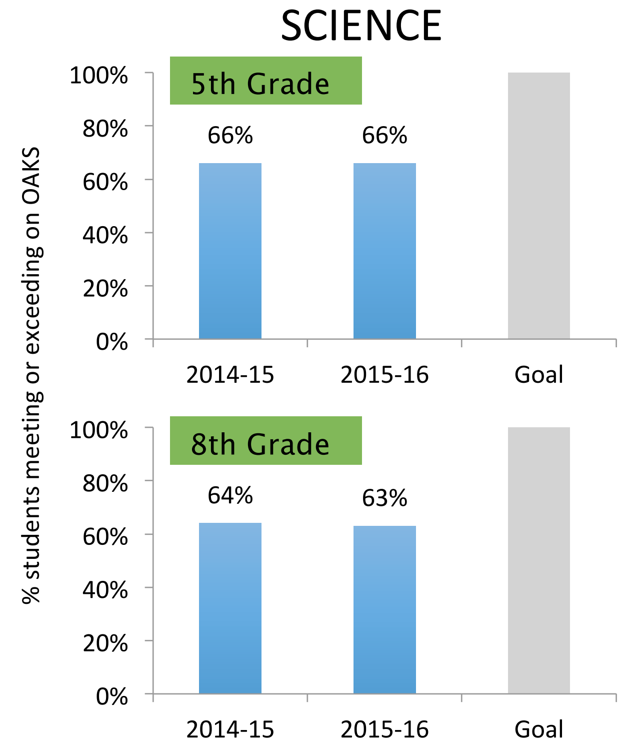
Goal 2

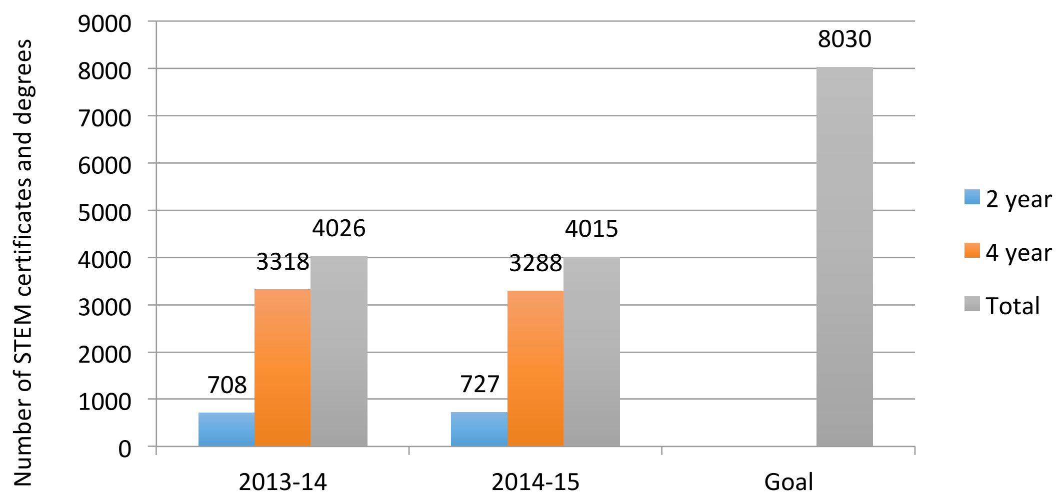
Double the number of students who earn a post-secondary degree requiring proficiency in science, technology, engineering or mathematics.

Notes

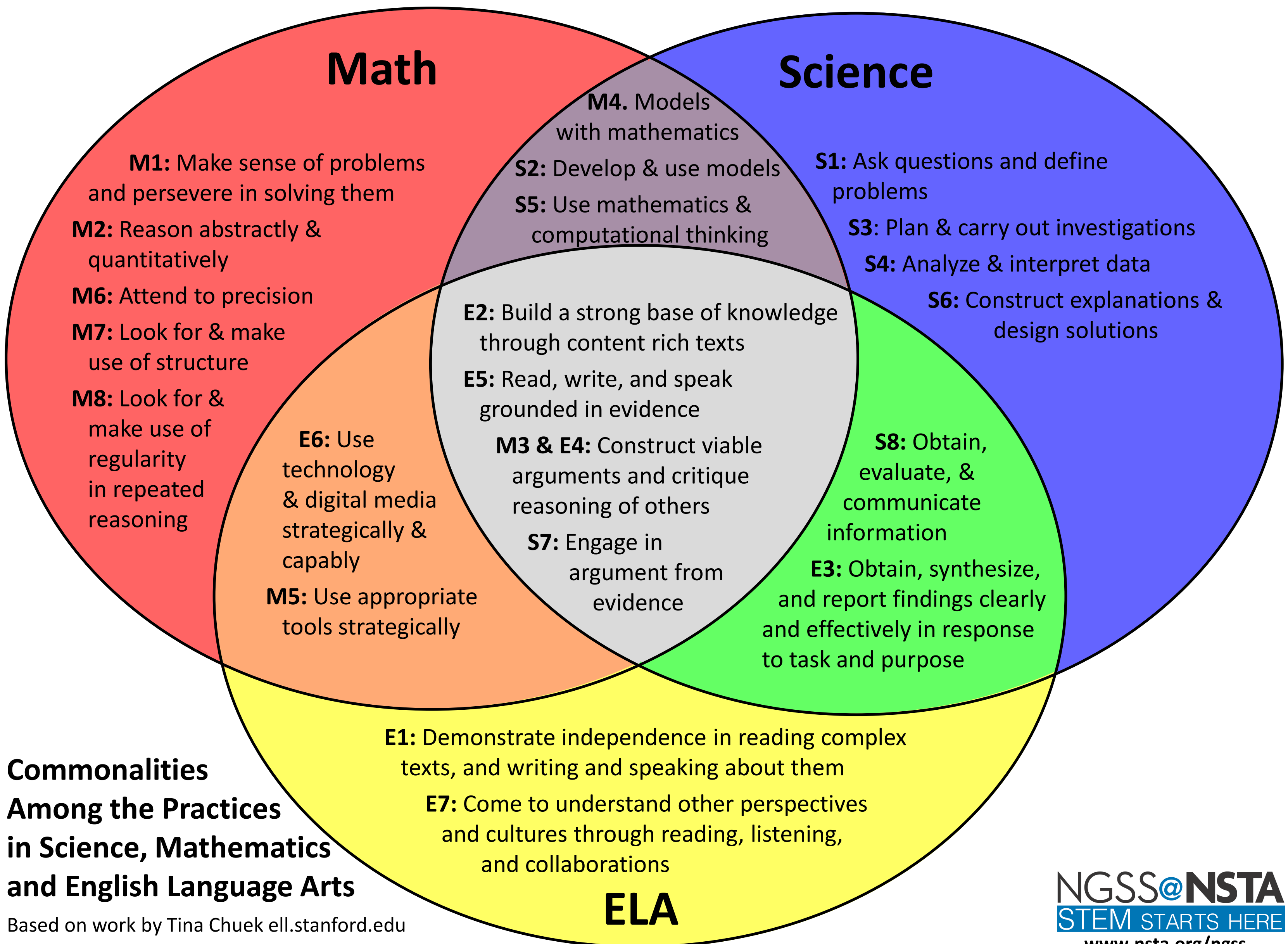
Post-secondary STEM degrees were counted using methodology from the Brookings Institute (Rothwell, Jonathan and Kulkarni, Siddharth, Beyond College Rankings A Value-Added Approach to Assessing Two- and Four-Year Schools, pp. 26-28, Brookings, April 2015). Students are defined as those who ever attended an Oregon public K-12 school and then earned a 2- or 4-year certificate or degree in an Oregon public institution of higher education.



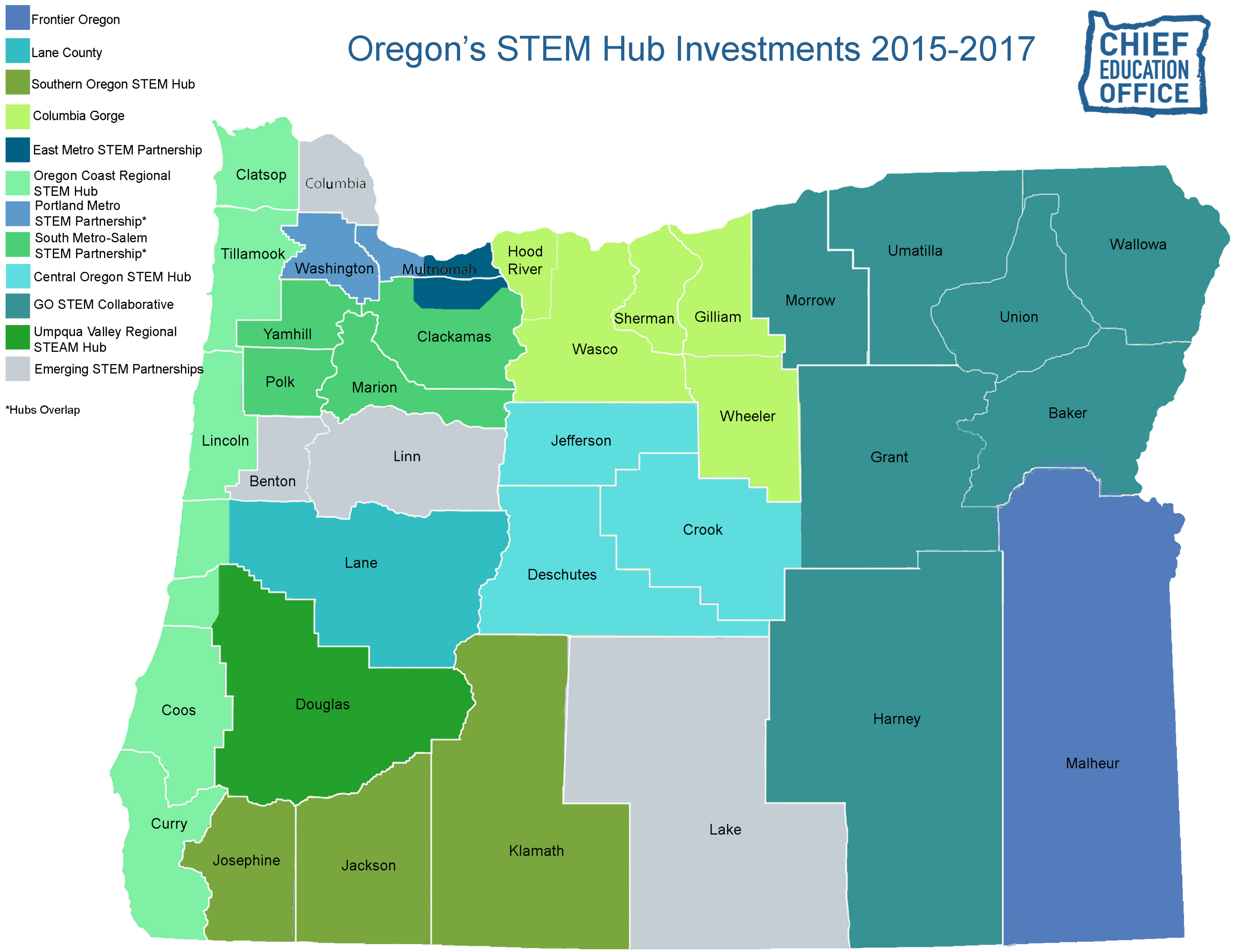




Appendix D: Commonalties in the "practices" across Math, Science, and Language Arts standards



Appendix E: Oregon's STEM Hubs 2015-17



Appendix F: Calls to Action

Implementing the Plan: Calls to Action

The following items are summarized from several different regional community forums, focus groups with communities of color, input from Regional STEM Hub partners, leaders from K-12 school districts, and business partners.

K-12 Classroom Educators:

- Use project-based approaches to situate content within the context of "driving questions" arising from the real world.
- Value and reinforce sense-making, reasoning, curiosity, connections, and application over getting "the right answer."
- Reduce the consequences of "failing" and build in opportunities for students to "iterate" and improve their understanding.
- Visit local STEM businesses and organizations to understand STEM careers and how content is applied in authentic settings.
- Release the fear of "not being the expert in the room" and allow students the space to be agents of their own learning.
- Encourage connections to other discipline areas as much as possible.
- Take learning into the community and bring the community into the classroom through local examples, issues, and volunteers.
- Foster individual student talent and curiosity. Find out what "lights them up."
- Partner with volunteers who are STEM employees both in and out of the classroom.
- Invite diverse role models into your classroom for women and students of color.
- Be extremely wary of perpetuating STEM stereotypes and negative feelings, especially about math.
- Collaborate with peers from other subject areas and/or grade levels.
- Feed your own curiosity and remain playful.

K-12 Administrators:

- Prioritize STEM skills and dispositions as essential skills and not just "add on" or "enrichment."
- Ensure at least two hours of inquiry-based science in ALL elementary classrooms year round, integrating with other subject areas wherever possible.
- Partner with community-based after school and summer STEM programs, and allow them to use district facilities.
- Create school and district cultures that support risk-taking and (sometimes messy) applied learning approaches.
- Encourage more teachers to partner with STEM professionals and incorporate this into their professional development.
- Engage in regional collaborations with other community leaders.
- Ensure students of color, students in poverty, and girls have equitable participation in STEM-related activities and programs.
- Expose counselors, principles, and other leaders to local STEM businesses and organizations.
- Reach out to parents, explaining to them how STEM-related careers could be a benefit to their kids.

- Prioritize CTE programs that are aligned to high-wage, high-demand areas such as biomedical sciences, manufacturing and engineering, and computer science.
- Engage with local and regional policy makers and encourage them to visit your STEM and CTE programs.

Post-secondary Faculty:

- Increase mentoring, internships, and undergraduate research opportunities in STEM for students of color, women, and students in poverty.
- Incorporate experiential learning, collaboration, and "flipped" classroom approaches.
- Foster a culture based on student success, not "weeding out."
- Ensure content is situated within rich contexts and arises from fundamental questions and phenomena.
- Educator prep programs should provide opportunities to experience STEM in industries and research.
- Educator prep programs should work more closely with K-12 for quality teacher candidate practicums and mentoring.

Out of school STEM program providers:

- Increase marketing and program outreach to communities and students of color.
- Continue to focus on experiential and playful learning that fosters curiosity, creativity, problem-solving, critical thinking, and develops positive STEM identities.
- Incorporate STEM content and practices consistent with the Common Core Math and Next Generation Science Standards.
- Collaborate with schools and formal educators to reinforce learning in and out of school.
- Draw upon culturally informed practices and community-based assets.
- Implement the State's "common measures" STEM instruments to assess impact on participants.
- Contribute event information to a statewide database of community-based STEM programs.
- Cooperate with statewide data collection and assessment efforts.
- Utilize the Youth Program Quality Assessment or some other research-based instrument to guide continual improvement.
- Connect program activities to potential career exploration.

Policy Makers and elected officials:

- Dedicate adequate and sustainable funding for transforming STEM and CTE educational outcomes. Provide sufficient time and patience for initiatives to have impact.
- Focus on systems change, not one-off special interest programs.
- Elevate the importance of quality science learning and instruction alongside reading, mathematics, and CTE.
- Provide ongoing funding for afterschool STEM programs and intermediary organizations, especially for those historically underserved and underrepresented.
- Provide financial incentives for more STEM teachers of color, career-changers, and those working in hard to fill regions.
- Ensure broader representation of diverse stakeholders in decision-making.
- Continue to provide scholarships for post-secondary studies, especially targeting high-wage, high-demand STEM fields.

Business and Industry:

- Incentivize (pay) employees—especially those of color—to volunteer with education programs both in, and out of, school.
- Join other business leaders to advocate for increased legislative, county, and city support for STEM and CTE programs.
- Partner with local schools to provide student (paid) and teacher internships, job shadows, and tours.
- Participate in Regional STEM Hub efforts to transform education and meet workforce needs.
- Invest in both local and statewide STEM programs.
- Prioritize diversity in recruiting and hiring employees, and in selecting interns.

State Agencies

All/Other:

- Modernize Oregon's Career Information System to be more accessible to students and parents, with real-time market data on jobs and salaries.
- Address unique issues in rural communities related to funding, professional learning structures, educator workforce incentives, etc.
- Ensure representation of diverse stakeholders during policy-making discussions.
- Increase recruitment and promotion of the STEM and CTE teaching profession.

Chief Education Office:

- Partner with businesses and State Chamber of Commerce to develop promotional materials, showcasing opportunities for Oregon's innovation economy.
- Continue to work with communities of color and communities in poverty to champion issues around Equity of access and opportunity.
- Work to bring greater coherency across multiple regional initiatives and various state districting boundaries.
- Create repository of STEM educational resources and curricula.
- Create a one-stop website for parents and students about regional afterschool STEM programs and events.
- Advocate for support of out-of-school STEM programs and increase capacity of provider networks and intermediaries.
- Work with ODE to advocate for extensive professional development and pre-service funding, especially in mathematics.

Early Learning:

- Professional development for early childcare providers emphasizing playful inquiry
- Promote multi-sensory, interactive environments over worksheets and content in math and science.
- Parental outreach and messaging regarding the importance of play and interactive experiences — particularly unstructured, outside nature play.

Department of Education:

- Time on science — Work with the State Board of Education to recommend increased time on inquiry-based science of at least 3 hours per week in elementary school. Encourage elementary educators to integrate math and language arts with those science experiences.
- Computer Science Standards — Use Code.org or other national framework to rapidly develop statewide computer science standards and have them adopted by the State Board by 2018. These should be part of a more comprehensive digital literacy plan, but should not be delayed while that broader plan is being developed.
- Math – Eliminate or reduce timed testing in mathematics, even for fluency of math facts. Place emphasis on applied, contextual math.
- CTE programs of study — Create exemplars or "pre-approved" programs of study in high-wage, high-growth areas that align to CC/University pathways. Initial areas should be: 1) biomedical and health sciences, 2) computer science, 3) manufacturing and engineering.
- Streamline grants processes to reduce administrative burden on grantees and applicants and move more toward "outcomes-based" funding for STEM Hubs.
- Provide parent "briefs" on how to support their student in math and science.
- Work with COSA (administrators) and OSBA (school boards) to prioritize focus on applied learning in STEM and CTE.
- Communicate opportunities for districts to support quality STEM education using ESSA funding.
- Work with Regional STEM Hubs to provide quality professional development for K-12 teachers and principals consistent with Math and Science standards and emphasizing applied learning connected to careers.
- Integrate STEM and CTE priorities into other statewide plans for educational improvement such as ESSA plan and increasing graduation rates.

Higher Education Coordinating Commission:

- Establish outcomes-based funding incentives with community colleges for students attaining credentials in high-wage, high-growth STEM and CTE programs, with additional incentive for students of color and first-generation college-goers.
- Increase % university funding incentives in high-wage, high growth program areas
- Improve cross-institution consistency and effectiveness of math placement.
- Implement changes in math developmental education courses to increase student success and appreciation of math.
- Redesign cross-institutional math course sequencing geared toward applied program needs.
- Work with ODE and educator preparation programs to increase focus on applied learning/teaching in math and science.
- Equity – continue to increase the availability of effective support programs for students of color and first-gen college goers.
- Work with institutions and industry to increase undergraduate research opportunities and internships.
- Endorse and use the Brookings definition of STEM degrees and certificates.

- Adopt common course numbering and reciprocity in crediting across state institutions with particular emphasis on consistency in transferring from community college to university.
- Increase diversity in hiring STEM faculty.

Teacher Standards and Practices Commission:

- STEM/CTE Teacher supply & demand – Develop a report anticipating retirements and regional shortages, applicant pools, etc.
- CTE teacher certificates – enable them to roll into permanent certificates after demonstrated educator effectiveness.
- Career changers – streamline requirements for those with significant content experience in STEM and CTE industries.
- Increase recruitment and promotion of the STEM and CTE teaching profession.