INNOVATING OREGON'S FUTURE

A Targeted STEM Strategic Plan

December 2015

STEM INVESTMENT COUNCIL VISION

Build an inclusive, sustainable, innovation-based economy by reimagining and transforming how we educate and empower individuals and communities. Oregonians of all races, economic status and locations will develop the fundamental STEM-enabled innovation skills and mindsets necessary to:

- Fully contribute to an increasingly complex and technologically rich global society
- Address high-demand workforce and industry needs
- 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

Oregonians relentlessly seek to explore and shape their future. Today, that spirit fuels innovation and has shifted the state's economy into overdrive. From the Silicon Forest to the state's clean energy and high-tech manufacturing sectors to the cutting-edge cancer and brain research underway at Oregon Health & Science University, Oregon is on the move. In 2013, Oregon companies added more than 220,000 jobs – the majority of which were STEM-related – and that number is expected to increase in 2015.[1] This year, the state boosted job growth above 3 percent, making it the nation's 8th fastest growing economy.[2] One major driver of this job growth: Oregon's high-technology sector, led by software development, which ushers in average wages of $100,000 per year. Additionally, Oregon's small-business innovators and entrepreneurs continue to change the landscape of Portland, the North Coast, the Gorge and the East Cascades. The state's wages continue to increase at nearly 8 percent per year.[3] And, every region of the state is experiencing accelerated population growth due to regional economic growth. Highly-skilled and educated newcomers are attracted to the state's quality of life and innovative economy. The state's workforce benefits from a "brain gain."

RELATIONSHIP OF STEM & CTE

The Oregon STEM Investment Council agrees that STEM and CTE have an interlocking relationship and are keys to preparing *each* student for success in postsecondary and beyond. While this report primarily focuses on STEM, the Council acknowledges that both STEM and CTE occur best in the context of applied learning.

Oregon's people are its greatest asset. But despite its leading economic indicators, Oregon's greatest asset faces an imminent threat: uncultivated, untapped and unrealized talent. *Each and every* one of Oregon's students possess the creative potential to drive the state to new levels of innovation. Yet, important student performance benchmarks indicate that Oregon students are not being prepared to capitalize on opportunities that are sure to accompany tomorrow's highly-dynamic and rapidly-changing society and job market. This year, for instance, only 37 percent of Oregon fourth graders – a critical measure of the health of an education ecosystem – scored at or above the NAEP proficiency level in mathematics, and that is three percentage points *lower* than 2013. A bigger problem yet: students of color and low-socioeconomic status significantly trail their peers – a trend that is headed in the wrong direction. African

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

American students scored an average of 26 points lower than White students; Hispanic students scored an average of 18 points lower than White students; and students of low-socioeconomic status scored an average of 20 points lower than other students.[4]

The future health of Oregon's economy is reliant upon the current health of its education system, particularly in science, technology, engineering and mathematics (STEM) and Career and Technical Education (CTE). The reality, however, is that Oregon's current education indicators predict that the state cannot sustain its current economic growth trajectory. The state's economic future depends on a healthy education and workforce ecosystem where *each* student is prepared for success beyond high school, where performance and equity gaps among students are closed and where stakeholders – including schools, universities, governments, businesses and communities – rally around a collective set of goals and commit to the long-term follow through necessary to achieve those goals.

Oregon cannot afford to leave any talent on the table. By 2020, Oregon will have almost 40,000 new job openings per year in STEM, 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). All are STEM related. 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 future high-wage STEM jobs. And, while the state's economy continues to grow, there were still more than 117,000 unemployed workers in August 2015.[7] Despite this level of unemployment, Oregon companies indicated that they cannot find qualified talent. This mismatch of talent and available jobs will only intensify in the future if the skills and preparation gaps are not addressed.

Oregon must act now. It must strive to help *each* student reach his/her full potential and achieve the individual prosperity necessary to thrive as a citizen of Oregon and of the world. Each student must be equipped with the cross-cutting skills—creative thinking, problem solving, communicating, collaborating, adapting and self-starting—they will need to succeed in almost every sector of tomorrow's marketplace. Oregon would be selling its students short if it did not help them reach and apply their creative potential.

How can Oregon ensure that it fully prepares *each* student for success in tomorrow's economy? One answer is STEM and CTE. Both increase the relevance of teaching and learning for both educators and students. Students, in turn, become more engaged in the learning process. Engaged learners succeed and graduate. The state must continue to transform its approach to teaching and learning by amplifying, spreading and scaling STEM education. In its truest form, STEM is a multidisciplinary approach to learning that embeds the arts and humanities and eliminates the walls between academic and applied learning, in-school and out-of-school learning and educators and employers. STEM education equips Oregon students with the knowledge, skills and mindsets that will help them thrive in a rapidly-changing, technologically-rich world. The applied learning of STEM and CTE engages and motivates students, ignites curiosity and creativity, encourages problem solving and instills strong work habits.

This STEM strategic plan outlines the steps Oregon should take to continue to innovate its STEM future. It recognizes the substantial STEM groundwork the state has already put in place and builds on it to identify

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[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

and prioritize levers, based on key gaps, to drive state investments in STEM initiatives and supports. The beneficiaries of this plan – Oregon's learners and workers – will lead Oregon into its new, unexplored future.

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

In 2011, Oregon state 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 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 populations and underrepresented populations, and has set a goal to increase opportunities and achievement of students from underrepresented groups. These goals, driven by a legislative mandate, were put in place to achieve higher per capita income, reduce poverty and increase revenues for public services. The goals serve as building blocks for this STEM strategic plan.

OREGON'S REGIONAL STEM HUBS

The Oregon Education Investment Board funded several collaborative partnerships including a statewide network of six Regional STEM Hubs. The hubs – organized under STEM Oregon – 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.

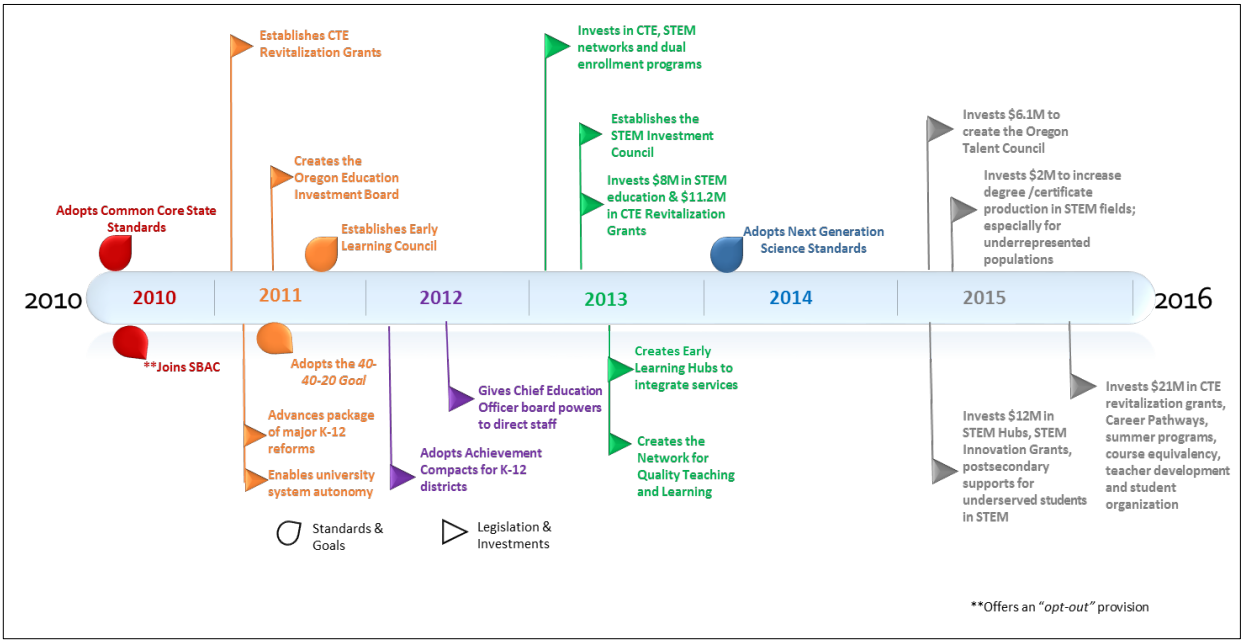
Current Regional STEM Hubs include:

- Oregon Coast Regional STEM Hub
- Portland Metro STEM Partnership
- South Metro STEM Partnership
- Central Oregon STEM Hub
- GO STEM Collaborative
- Umpqua Valley Regional STEM Hub

To reach these goals, Oregon has aggressively identified, implemented and invested in STEM policies and initiatives. Early on, the state adopted and implemented college- and career-readiness standards to increase expectations and the quality of teaching and learning for *each* Oregon student. This policy ensures that Oregon students dig deep into mathematical concepts that are the bedrock of long-term STEM literacy. In 2011, to better serve students and create a seamless system, particularly across institutional transitions, the Oregon legislature created the Oregon Education Investment Board, now known as the Chief Education Office.

In 2012, the legislature created the Joint Interim Task Force on STEM Access and Success (HB 4056), which called for the creation of the STEM Investment Council; created a statewide network of regional STEM Hubs; enhanced education and infrastructure improvements; and forged stronger industry partnerships. In 2013, the Legislature established the STEM Investment Council (HB 2636) to advance goals related to STEM. In 2014, Oregon was one of only 17 states, plus the District of Columbia, to adopt and implement the Next Generation Science Standards (NGSS) – another policy that touches the learning experience of every Oregon student. Through the NGSS, students are immersed in the engineering design process, which cuts across the science standards. To bring education and workforce more tightly together, the legislature created the Oregon Talent Council in 2015 and charged it to "advise and be a resource for state agencies and education institutions on issues of talent development and promote the growth and competiveness 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.

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



In conjunction with its policies and actions, the Oregon Legislature has made considerable investments to increase student learning opportunities in STEM education; increase degree and certificate production in STEM fields; and increase participation and successful 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 underserved and underrepresented students. This year, the legislature (HB 3072) 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 underserved and underrepresented students. It also established the Oregon Talent Council and invested $6.1M 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.

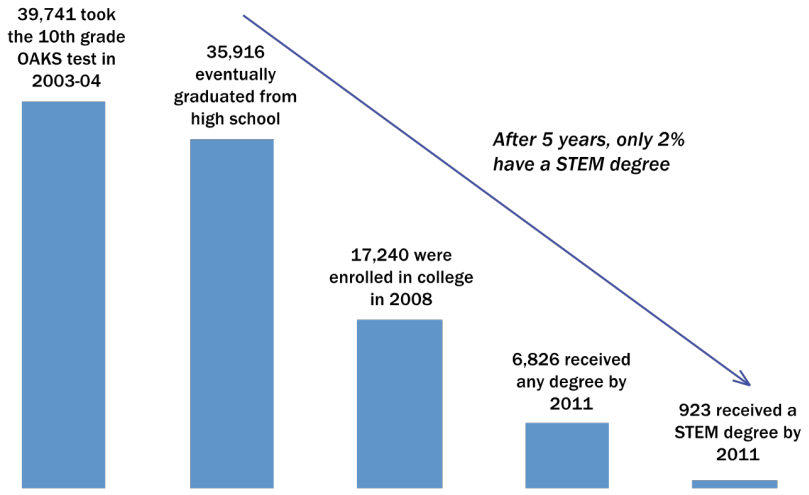
Oregon is blazing the right trail with its robust STEM goals, policies and investments. But, it will take time and patience before those goals, policies and investments bear fruit and begin to significantly impact the state's STEM results, which are currently mediocre. Partners must acknowledge that 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 – until the first cohort benefitting from the full suite of investments graduates – and will likely increase in the fifth year. Stakeholders must recognize that it will take time to move the needle. At the same time, they must march toward continued improvement and use the state's current STEM gaps to inform both short-term and long-term policies and investments. The goal is to systemically close STEM learning and achievement gaps – which have an impact on students, educators and the education system – and ultimately hinder student opportunity.

Major gaps in Oregon's STEM education ecosystem are identified in the top half of Figure 3. The bottom half of the figure pinpoints Oregon's middling STEM results, which correlate to the major gaps in the education ecosystem. Significant ecosystem gaps that have an impact on students include the amount of time Oregon elementary students spend on science. Currently, the state ranks 50th, spending less time each week on science than any other state in the nation. In addition, only 13 schools in the state offered the AP Computer Science course in 2013-14.

Gaps that have an impact on 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. Oregon also places a premium on equity for its students, yet statewide only 8.5 percent of its teachers are of color – when students of color comprise 36 percent of the total student population. According to the recently released Oregon Educator Equity Report, the state is almost on track to meet a 2015 goal of increasing the percentage of diverse teachers by 10 percent as compared to the percentage in 2012.[8] National research attributes the lack of diversity in the STEM labor force to a lack of diverse STEM role models.

These gaps correlate with the state's mediocre STEM results. For instance, outcomes of Oregon's class of 2005 indicate that 39,714 students took the 10th grade OAKS test in 2003-04. Of those students, 35,916 students graduated from high school and 17,240 went on to enroll in college. Only 6,826 students earned a degree by 2011, and of those, only 923 students received a STEM degree. This example highlights a gap between the state's STEM degree production versus STEM jobs that are available in Oregon.

FIGURE 2: STEM OUTCOMES FOR THE CLASS OF 2005

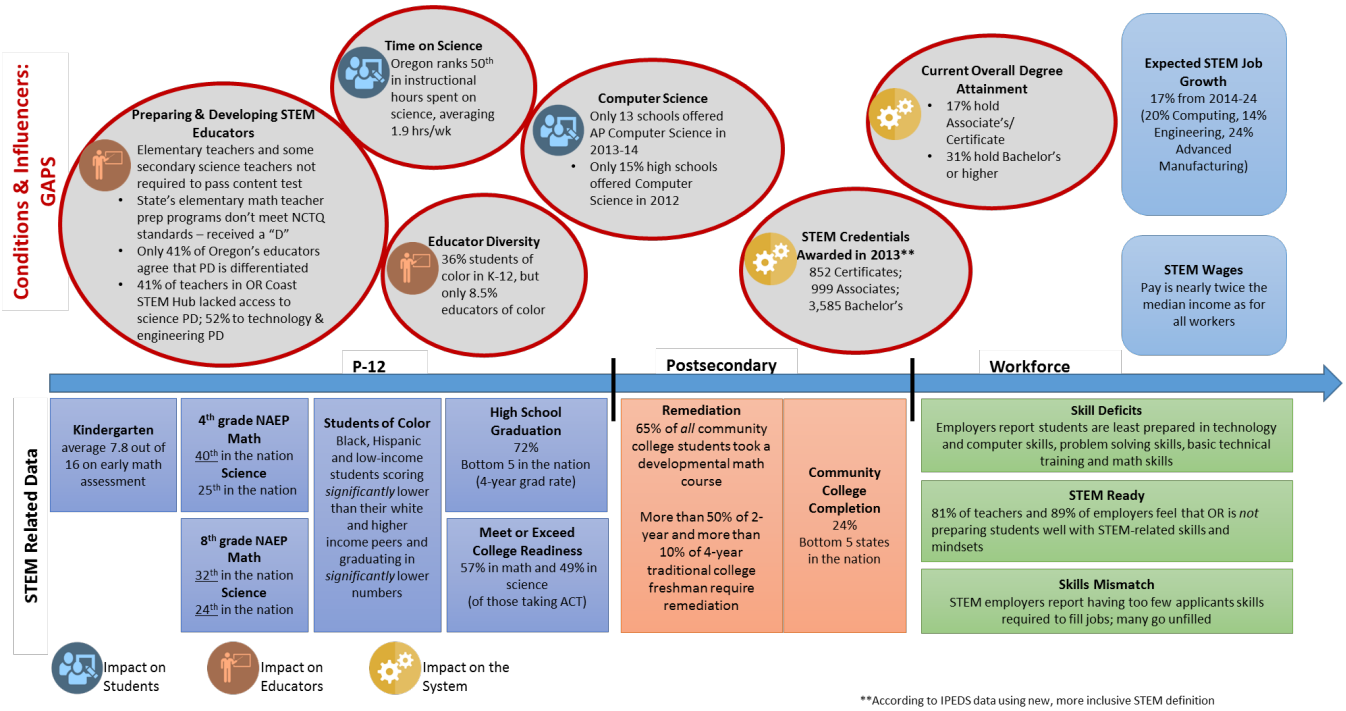


Source: ECONorthwest analysis of ODE and National Student Clearinghouse data.

If Oregon is to reach its laudable statewide 40-40-20 and STEM-specific goals of doubling the number of 4th and 8th grade students proficient in math and science by 2025; doubling the number of CTE-STEM degrees and certificates by 2025; and increasing participation of students from underrepresented groups, then it must stay the course to advance its previously enacted STEM policies and investments and expand efforts to target and close its gaps.

[8] 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

FIGURE 3: STEM GAPS AND DATA



Maximizing the Work of the STEM Investment Council

Created in 2013, along with a series of education improvement initiatives including Oregon's Regional STEM Hubs, 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 the Governor's STEM budget proposal for fiscal years 2015-16. Over the last 18 months, the Council has 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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- Fully contribute to an increasingly complex and technologically rich global society
- Address high-demand workforce and industry needs
- 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

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

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

BELIEFS

1. **All people have creative potential.** Our students should not just be consumers of knowledge, they need to be creators of it in a way that unleashes their creative genius, interests and talents.
2. **Each student deserves an opportunity at prosperity.** There continues to be persistent inequities in race, ethnicity, gender, and educational background in high-wage, high-demand professions. Many students in poverty and from rural areas are being left behind. No one's talents should be left behind.
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 emerges 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 and we need to build solutions that develop partnerships with all of the human capital in our communities.
6. **Innovation is the cornerstone of prosperity.** STEM is not just about filling jobs but creating jobs to address challenges and opportunities. Building an innovation-based economy is essential for long-term prosperity resulting in competitive advantage in a global marketplace.
7. **Learning takes courage, persistence, and humility.** Pushing the boundaries of one's understanding requires us to embrace ambiguity and to take intellectual risks. What we do with what we don't know is as important as what we do know. We should prioritize questions over answers.
8. **STEM skills are essential skills.** Advancements in STEM are transforming every industrial and service sector, from agriculture to energy, medicine to manufacturing, forestry to nanotechnology.
9. **All learning is cross disciplinary.** It is the interconnectedness of ideas that enable 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.** Education is not about retaining facts or disconnected bits of information. Utilizing purpose-driven learning challenges students to pursue deeper questions and to solve problems that are relevant and meaningful.

Finally, the Council has identified four targeted goals for advancing STEM education opportunities in Oregon:

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 each and 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

Prioritizing Oregon's STEM Action Steps

The STEM Investment Council has paved the way for Oregon to take a series of targeted actions that will impact STEM teaching and learning and student success. This plan prioritizes goals that will have an impact on educators, students and the system based on an assessment of Oregon's current STEM education gaps and research to help identify the most effective next levers for change.

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 2017, increase time Oregon elementary students spend on science to exceed the national average of 2.7 hours per week.[9] That same year, Oregon should have fully implemented the Next Generation Science Standards, which integrate the engineering design process and the STEM disciplines.
2. By 2017, follow through on implementing mathematics standards which requires students to solve real-world problems, transforming mathematics instruction across the state.
3. By 2017, adopt computer science standards and ensure that each Oregon student has access to computer science coursework.

[9] 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.[10] 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.[11] 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.[12] 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.[13] For girls and underrepresented minorities, early exposure to STEM experiences proves to be a key factor in deciding to pursue STEM coursework and careers.[14] 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 do Oregon students need access to Computer Science courses? Because 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 Hispanic and four students were African American. Only 15 percent of Oregon's diploma granting high schools offered at least one coding computer course in 2012.[15] Only 13 schools offered the AP Computer Science in 2013-14.[16]

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
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

[10] 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
[11] LASER i3 Validation Study by the Center for Research in Educational Policy (CREP) at the University of Memphis; 2015
[12] Duncan, et al. "School Readiness and Later Achievement," 2007; http://eprints.ioe.ac.uk/5971/1/Duckworth2007SchoolReadiness1428.pdf?origin=public
[13] What Is the Impact of Decline in Science Instructional Time in Elementary School? 2012; http://www.csss-science.org/downloads/NAEPElemScienceData.pdf
[14] Generation STEM: What Girls Say About Science, Technology, Engineering and Math; 2012; https://www.girlscouts.org/research/pdf/generation_stem_full_report.pdf
[15] Oregon Computer Science Teachers Association, 2012
[16] Code.org, state-facts, OR, 2015: https://code.org/advocacy/state-facts/OR.pdf

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 each and every student to become a part of an inclusive innovation economy.

GOAL #2 PRIORITY OUTCOMES

1. Determine baseline data for and double the number of underserved and underrepresented STEM students who participate in informal, out-of-school STEM learning opportunities.
2. Determine baseline data for and double the number of underserved and underrepresented STEM students who have access to quality P-20 support services and pre-college transition/bridge programs.
3. Determine baseline data for and increase the number of STEM role models and access to professional networks for students who are underrepresented in STEM.

Why a specific goal on equity? As noted in the beginning of this report, Oregon faces significant achievement and attainment gaps across its P-20 education ecosystem, particularly among its students of color. The state must constantly keep an eye focused on closing these gaps.

Increasing diversity in the STEM labor force is a national imperative. 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.[17] Key systemic factors include: access to high-quality learning opportunities in and out of classrooms, limited diversity of STEM role models, and biased social messaging and expectations.

Rural populations, too, often have 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.[18]

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.[19] Types of informal STEM learning programs include those that provide students afterschool, weekend and summer activities over multiple years at institutions such as

[17] National Science Foundation, Women, Minorities, and Persons with Disabilities in Science and Engineering (2009)
[18] Bryant, James A. Jr. (2010). "Dismantling Rural Stereotypes." Educational Leadership, November 2010, Vol 68, No 3, pp. 54-58
[19] 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.

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.[20]

Why do quality P-20 support services and pre-college transition/bridge programs matter? Targeted strategies and supports increase the likelihood of success for underrepresented STEM students. 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 a diverse representation of 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, the status quo is shifted and their perceptions of who "belongs" in STEM are transformed.[21]

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 traditionally underserved and underrepresented in STEM
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 underrepresented students pursuing high-wage, high-demand credentials

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

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

GOAL #3 PRIORITY OUTCOME

1. Over the next five years, leverage Oregon's Regional STEM Hubs to provide high-quality, diverse and industry-led professional development opportunities to at least 50 percent of Oregon's STEM educators – including P-12 teachers and leaders, postsecondary faculty and staff and quality out-of-school educators.

Why focus on educators? Because educators have the greatest impact on student success across the education continuum. 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.[22]

Researchers agree strengthening teacher effectiveness is the most efficient way to boost academic achievement and believe rigorous, cutting-edge professional development can play a key role in improving teacher practices.[23] 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.[24] However, today only 41 percent of Oregon's educators agree that professional development is differentiated.[25] In addition, access to high-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 science professional development. Fifty-two percent lacked adequate access to technology and engineering professional development.[26]

Oregon's Regional STEM Hubs are currently engaging partners from business and higher education to enhance innovative 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 and transfer that back to the classroom. The goal is to leverage 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 content is applied 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-on, project-based instruction for learners of all ages. Teachers must be supported by strong instructional leaders who "get" STEM education. 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:

[22] Rivkin, S.G., Hanushek, E.A., and Kain, J.F. "Teachers, Schools and Academic Achievement," Econometrica, Vol. 73, No. 2 (March 2005)
[23] Nurturing Quality Teachers in Oregon, A Profile of Success and Challenges of Six Oregon Districts; ECONorthwest, 2008
[24] 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
[25] 2014 TELL Oregon Survey, Spring 2014
[26] Oregon Coast Regional STEM Hub, *Oregon Coast Regional STEM Hub Partnership Plan,* 2014

a. Creating opportunities for STEM educators to experience STEM in industry and research as part of their professional development
b. Build, strengthen and support statewide partnerships for STEM education through our STEM hubs
c. Providing incentives to teacher preparation programs to develop, evaluate and disseminate effective STEM preservice teaching strategies including continued support during the first three years of teaching
d. Increase career transitions of STEM professionals into teaching for CTE, math and science
e. Providing time and resources for educator-to-educator and educator-industry collaborations around implementation of promising STEM instructional practices and materials

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. In the next biennial budget, increase the state's STEM investment by 50 percent and continue to follow through on STEM structural shifts, including specific program opportunities that provide pathways to grow careers – so that Oregon can benefit from its previous policy moves in the future.
2. By 2017, create a data dashboard that shows 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 started in 2011. This means 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 higher than non-STEM jobs with similar educational requirements.

With the STEM goals, policies and investments Oregon has already pursued, it is poised to move the needle on its STEM results. With the prioritization of these goals, in addition to continued investments in key STEM initiatives and supports, Oregon will ensure its stake as a national leader in STEM.

Key strategies to achieve Goal #4 include:

a. Building public awareness and demand for improved STEM outcomes and programs
b. Developing a sustainable funding and policy environment for STEM and CTE

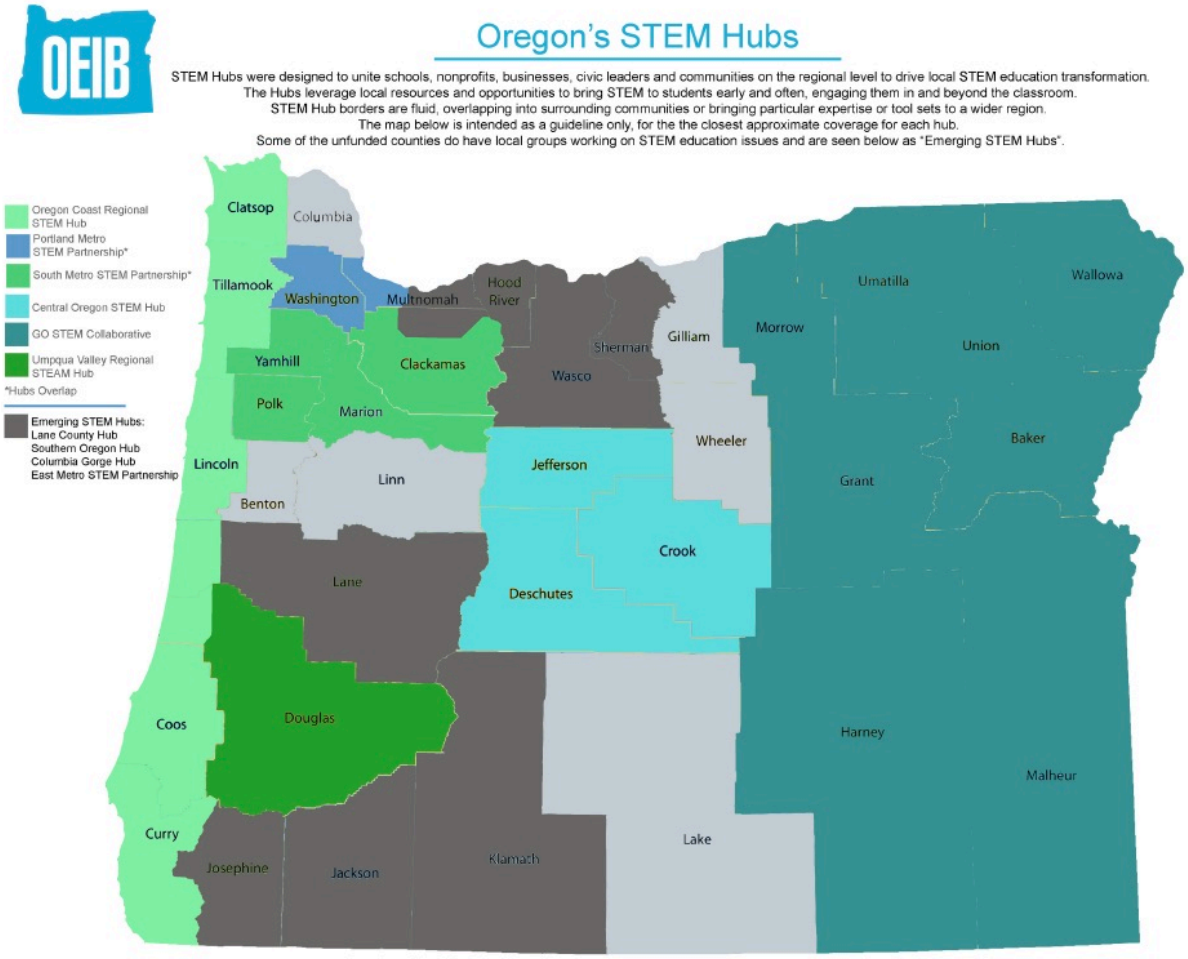
c. Creating and supporting an implementation network of Regional STEM Hubs to increase adoption and spread of effective practices, leverage resources and provide critical feedback to inform policies and investments

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 STEM INVESTMENT COUNCIL
Jim Piro, Portland General Electric (Council Chair)
Aubrey Clark, Intel Corp.
Herb Fricke, Akana
Lisa Graham, Black Canyon Woodworks
Dwayne Johnson, ScaleUp Partners
Eric Meslow, Timbercon, Inc.
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Leslie Garcia, Oregon Health Sciences University
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Kyle Ritchey-Noll, Oregon Business Council
Terrel Smith, Oregon Computer Science Teachers Association
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