STEM Investment Council

June 17, 2016
9:00am – 12:00pm
2 World Trade Center
Mezzanine 3 & 4
121 SW Salmon St., Portland

Call-In Information:
Dial (877) 309 2070
Code 995-477-629

JIM PIRO, Chair

HERB FRICKE

LISA GRAHAM

DWAYNE JOHNSON

ERIC MESLOW

THOMPSON MORRISON

Staff:
MARK LEWIS

AGENDA

1. **Welcome & Introductions**

2. **Chief Education Officer Updates**
   Lindsey Capps, Chief Education Officer, CEdO

3. **STEM Director Updates**
   Mark Lewis, STEM Education Director, CEdO

4. **Southern Oregon STEM Hub**
   Steve Thorpe, Interim Dean, Professor of Education, SOU

5. **STEM Hub Investments**
   Krissi Hewitt, Regional Education Partnership Policy Advisor, CEdO
   Debbie Bailey, Applied Science Specialist, ODE

6. **Considerations of STEM School Designations**
   Council Discussion

7. **STEM Workforce Trends**
   Brenda Turner, Economist, Oregon Employment Department

8. **STEM Education Metrics**
   Peter Tromba, Research and Policy Director, CEdO

9. **Public Comment**
   Members of the public wanting to give public testimony must sign in.
   There will only be one speaker from each group.
   Each individual speaker or group spokesman will have three (3) minutes.

All meetings of the Chief Education Office are open to the public and will conform to Oregon public meetings laws. The upcoming meeting schedule and materials from past meetings are posted online. A request for an interpreter for the hearing impaired or for accommodations for people with disabilities should be made to Angela Bluhm at 503-378-5152 or by email at angela.bluhm@state.or.us. Requests for accommodation should be made at least 48 hours in advance.

Target Partnership Backbone Effectiveness Indicators for Statewide Collection*

Prioritized Backbone Indicators	Strength of Leadership & Diversity of Partners Involved in Governance	Degree of Partner Engagement	Data Driven Organization	Visibility in the Community	Funding Sources
Metrics	Decision-makers and influencers from a diversity of different sectors and cultures are championing the effort and engaged in governance of the collaborative	Staff/partner satisfaction with partnership	Current disaggregated data are shared publicly	Positive press coverage	Ratio of state dollars to collective-leveraged resources (in-kind and funds)
Data Collection Method	List of partner organizations/attendance and Partner Survey	Partner Survey	Partner Survey and public documents	Interim State reporting of media	Online consistent Excel spreadsheets

*Note: The stage of the partnership and development over time will be taken into account in assessing progress at the state-level.

Timeline with Critical Information for Cohort 2 STEM Hubs

Dates	Activities
July 1, 2016	ODE will begin to accept Partnership Plans for review
July 21st – Dec. 21st 2016	Receive feedback and comment on Partnership Plan
One month after receiving feedback	Resubmit Partnership Plan for review
Nov. 30, 2016	Last day to submit Partnership Plans for review in order to apply for programming dollars
July 1, 2016	Request for Proposals (RFP) available
Three weeks after submission	Programming Proposals reviewed
By third week after submission	Notified of programming award
August 8th and 9th, 2016 January 2017, and May 2017 (Tentative dates)	Statewide Grant Convening
Monthly Communication	Ongoing Regional STEM Hub Phone/webinar Meeting
Nov. 30, 2016	Interim Report on programming proposal due to support the 2017 legislative session
April 1, 2017	Notice of intent to use programming funds during summer of 2017
June 30, 2017	Last day to expend programming funds
August 15, 2017	Last date to draw programming funds (note: EGMS system shutdown approx. two weeks to update index numbers in late July – early August)
August 31, 2017	Final programming grant report due (for awardees not delivering programs July 1 – September 30, 2017)

Cohort 1 STEM Hubs

The Regional STEM Hub – Program Expansion Grant of 2015-2017

Fiscal Agency	Hub	Project Name	Amount Awarded
Eastern Oregon University	Greater Oregon STEM Hub	Educator Professional Learning	$193,599
Portland State University	Portland Metro STEM Partnership	Educator Professional Learning	$195,000
Oregon Institute of Technology	South Metro-Salem STEM Partnership	Systemic Alignment	$106,721
Oregon Institute of Technology	South Metro-Salem STEM Partnership	Educator Professional Learning	$194,777
Lincoln County School District	Oregon Coast STEM Hub	Educator Professional Learning	$194,959
Lincoln County School District	Oregon Coast STEM Hub	Instructional Resources	$194,999
High Desert Education Service District	Central Oregon STEM Hub	Systemic Alignment	$194,278
Umpqua Community College	Umpqua Valley Regional STEAM Hub	Educator Professional Learning	$127,490

Cohort 2 STEM Hubs

Emerging Regional STEM Hub Backbone Grant

Fiscal Agency	Hub	Project Name	Amount Awarded
Columbia Gorge ESD	Columbia Gorge STEM Hub	Emerging Regional STEM Hub Backbone	$124,031
Lane ESD	Lane STEM Hub	Emerging Regional STEM Hub Backbone	$124,979
Malheur ESD Region 14	Frontier STEM Hub	Emerging Regional STEM Hub Backbone	$51,272
Mt. Hood Community College	East Metro STEM Hub	Emerging Regional STEM Hub Backbone	$124,882
Southern Oregon ESD	Southern Oregon STEM Hub	Emerging Regional STEM Hub	$125,000

Total Grant Funding to Cohort 1 STEM Hubs

Fiscal Agency	Hub	Project Name	Amount Awarded
Eastern Oregon University	Greater Oregon STEM Hub	2013-2015 STEM Hub	$194,588
		Cont. Backbone Grant	$215,000
		Educator Professional Learning	$193,599
		Total to Region	**$603,187**
Portland State University	Portland Metro STEM Partnership	2013-2015 STEM Hub	$750,000
		Cont. Backbone Grant	$315,000
		Educator Professional Learning	$195,000
		Total to Region	**$1,260,000**
Oregon Institute of Technology	South Metro-Salem STEM Partnership	2013-2015 STEM Hub	$749,916
		Cont. Backbone Grant	$370,000
		Systemic Alignment	$106,721
		Educator Professional Learning	$194,777
		Total to Region	**$1,421,414**
Lincoln County School District	Oregon Coast STEM Hub	2013-2015 STEM Hub	$737,967
		Cont. Backbone Grant	$265,000
		Educator Professional Learning	$194,959
		Instructional Resources	$194,999
		Total to Region	**$1,392,925**
High Desert Education Service District	Central Oregon STEM Hub	STEM Hub 2013-2015	$123,848
		Cont. Backbone Grant	$165,000
		Systemic Alignment	$194,278
		Total to Region	**$483,126**
Umpqua Community College	Umpqua Valley Regional STEAM Hub	STEM Hub 2013-2015	$433,644
		Cont. Backbone Grant	$165,000
		Educator Professional Learning	$127,490
		Total to Region	**$726,134**

STEM Smart Brief

STEM Smart: Lessons Learned From Successful Schools

Specialized STEM Secondary Schools

THE PROBLEM

STEM is not just for scientists anymore. In today's economy, almost any job with decent pay requires STEM skills, and many jobs require advanced STEM abilities. But far too many U.S. residents are unprepared for the occupational demands of the 21st century. Formerly a world leader in math and science achievement, the United States now can't keep up. Fewer students enroll in STEM courses and master STEM content than young people in other countries. The problem is no mere point of pride; the lack of knowledge undermines the nation's economic productivity and global competitiveness.

Striking Statistics: Poor STEM Performance in U.S. Schools

Math[1]

* About 75% of U.S. students fail to become proficient in math by grade 8.
* More than 75% of U.S. students are behind in math by grade 12.

Science[2]

* Only 10% of U.S. 8th graders reach the advanced science level on the international TIMSS exam.
* By contrast, 25% of 8th graders in China and 32% of 8th graders in Singapore reach the advanced science level on the TIMSS.

The vast majority of U.S. students receive STEM education in traditional public high schools. Some do an excellent job, but the overall quality of STEM secondary education is mixed. Educators everywhere are struggling with how to improve STEM literacy and how to encourage more students to pursue college and careers in STEM fields.

Specialized schools still represent a tiny fraction of U.S. public education. However, they may not only produce better results than traditional programs; they also can serve as models for schools seeking to improve.

A growing number of states and districts are responding to this challenge with the creation of specialized STEM high schools and secondary programs. Such schools typically offer more rigorous curricula, more qualified teachers, more instructional time, and more resources than traditional high schools. Specialized schools still represent a tiny fraction of U.S. public education. However, they may not only produce better results than traditional programs; they also can serve as models for schools seeking to improve.

KEY RESEARCH

Research funded by the National Science Foundation has identified three categories of STEM-focused schools that possess the potential to meet U.S. educational goals in STEM areas:

- *Selective schools*, which enroll small numbers of highly motivated students with demonstrated talent and interest in STEM areas.
- *Inclusive schools*, which serve students from all backgrounds, focusing on low-income, minority, and other traditionally underrepresented youth.
- *Career and technical education programs*, which help a broad range of students explore the practical applications of STEM subjects and prepare for STEM-related jobs.

Selective Schools

These small, elite public schools are known for selecting—and producing—the cream of the STEM crop. Admission usually requires a written exam, and only top performers get in. A prominent, longstanding example is Stuyvesant High School, the New York City powerhouse whose graduates include four Nobel Prize winners and countless other STEM leaders.

Today, the United States has an estimated 90 selective public STEM high schools, many created in the wake of the 1983 warnings of *A Nation at Risk*.[3] Focusing on one or more STEM disciplines, selective schools aim to prepare gifted students to earn ambitious postsecondary STEM degrees and succeed in STEM careers. They typically provide expert teachers, advanced curricula, sophisticated lab equipment, and apprenticeships with scientists.

Most selective public STEM schools are self-contained programs in urban areas, drawing top students from across a district. Fifteen states offer residential schools attracting accomplished youth statewide. Virginia and Michigan bus students from low-income rural areas to regional half-day centers.

Example: Illinois Mathematics and Science Academy (IMSA)

The state pays tuition and most student expenses at the Illinois Mathematics and Science Academy, an internationally acclaimed three-year residential program near Chicago, in Aurora, Illinois. A rigorous admissions process requires math, science, and world language testing, consistently high grades, stellar recommendations, intense demonstrated interest in STEM, and potential for significant contributions in STEM fields.

IMSA offers more than 100 advanced courses in mathematics, science, the arts, and the humanities. Its 650 students all have personalized learning plans, geared to their individual interests and future goals and designed to help maximize their academic experiences. High-level research is a cornerstone of the program, and students routinely collaborate with other students, scholars, and scientists throughout the world. Many publish studies and present at professional conferences.

More than 99% of IMSA's 4,350 graduates since 1985 have enrolled in college.[4] Nearly two-thirds earn degrees in math or science—significantly more than the general population and more than four times higher than average for women. Alumni include leading researchers, engineers, teachers, and entrepreneurs, with accomplishments ranging from improving cancer detection devices to helping to start YouTube.

Results

Research studies show that specialized STEM schools can make a difference. Their graduates pursue STEM fields in college at a rate nearly 50% higher than that of other students.[5] Compared with the national average, nearly 20% more selective STEM school graduates earn a STEM-related postsecondary degree within four years of graduating from high school.[6]

Studies identify these key factors: Talented high schoolers interested in math and science are more likely to pursue STEM college study when provided with challenging curricula, expert instruction, and peer stimulation. Participating in original research is perhaps the most powerful tool, particularly for young women. Internships and mentors also are critical. While no single factor may have a profound impact, programs

combining these features can open up postsecondary STEM pathways for students.

However, teens who attend STEM specialty programs not because of a deep STEM interest, but for the general academic challenge, do not earn STEM degrees in greater numbers.[7] Other studies have emphasized the importance of early interest in earning STEM degrees. In fact, students who indicated an interest in biology in the 8th grade were 1.9 times as likely to major in biology than those who did not express early interest; students who expressed an interest in physical sciences and engineering in the 8th grade were 3.4 times as likely to eventually major in these areas.[8] This shows the importance of developing early interest and ability in STEM subjects.

Inclusive Schools

While selective STEM schools play an important role in cultivating top talent, interest is growing rapidly in expanding intensive STEM education to a much broader population. This is the role of inclusive STEM schools, which are open to all. They aim to provide similar educational experiences as selective schools, but focus on youth from low-income families and racial/ethnic groups historically underrepresented in STEM fields.

Based on the idea that math and science talent can be developed—rather than being an innate ability people simply have or do not have—inclusive schools typically select students by lottery and build in supports for those with weaker academic backgrounds. Tutoring, advisories, and other services help prepare students for STEM majors in college.

Several states are developing networks to spur the creation of inclusive STEM schools and to share best practices with each other and with traditional public schools. The T-STEM initiative in Texas, for example, has opened more than 50 secondary schools since 2006 following the same guiding blueprint. The Ohio STEM Learning Network—which originated with Columbus-based Battelle, a national laboratory manager, the Ohio Business Roundtable, and the Bill and Melinda Gates Foundation—has opened 10 inclusive STEM schools geared to various economic regions of the state. With assistance from Battelle and the Gates Foundation, states including California, New York, and North Carolina are replicating Ohio's work.

Example: Delta High School, Tri-Cities area, Washington State

Among the new crop of inclusive public STEM schools is Delta High School in southeastern Washington State. The idea of local business leaders, the school opened in 2009 with about 100 freshmen—chosen by lottery—reflecting the demographics of the Kennewick, Richland, and Pasco School Districts it serves. By the fall of 2012, there will be 400 students in grades 9–12.

Delta is one of the first STEM-focused schools in the state and is a pilot project of the Washington State STEM Education Foundation. Funding comes from each of the three home school districts, supplemented with grants from the foundation and numerous other partners, including Battelle, Washington State University Tri-Cities, and Columbia Basin College, which provides campus space.

The core of Delta's program weaves together science, technology, engineering, mathematics, and humanities concepts through hands-on, problem-based instruction. The design features 90-minute classes, advisories to support academics and postsecondary transitions, career mentoring from STEM professionals, as well as internships, job shadows, and senior seminars. The school is highly personalized, emphasizing individual student-faculty interaction and building on student strengths and interests, with close monitoring of student progress.

The inaugural class graduates in 2013, but early outcomes look promising. Delta students outperformed Washington averages in reading and writing, scored 20% higher in math, and 30% higher in science in its first round of state-mandated testing in spring 2011.[9]

Results
There is still little broad evidence about the effectiveness of inclusive STEM schools, though early test scores in several states show some positive effects. T-STEM students, for example, score slightly higher on state math and science tests, are less likely to be absent, and take more advanced courses than their peers in comparison Texas schools.[10]

Clearly, more research is crucial to evaluation efforts as these schools mature. A key question is whether students retain interest in STEM fields to pursue STEM college work and careers—a subject under exploration with funding from the National Science Foundation.

Meanwhile, descriptive research reveals other useful information: Inclusive STEM schools are more likely than selective schools to serve large proportions of African American, Hispanic, and low-income students. Moreover, inclusive schools offer a greater level of personalization through strategies such as "looping" a teacher with the same students for multiple years and connecting students with professional mentors who mirror their racial and ethnic backgrounds. While inclusive schools are less likely than selective schools to offer a broad range of AP courses, they are just as likely to provide students with opportunities to take college courses while in high school.[11]

STEM-Focused CTE Schools
The purpose of career and technical education (CTE) is to motivate student learning through real-life applications related to jobs and to develop technologically proficient workers. It can be difficult to distinguish between STEM-focused CTE schools and other STEM programs. The reality today is that all CTE is related in some way to STEM fields.

STEM subjects can be incorporated into any CTE delivery model, including regional career technical centers, CTE high schools, or career academies in comprehensive high schools. Most address STEM-related work, ranging from auto-technology to nursing to financial management. Fewer focus specifically on engineering.

Example: Sussex Technical High School, Georgetown, Delaware

A model for other STEM-focused CTE programs, Sussex Technical High School is a national-award-winning school for the rural county of Sussex, in southern Delaware. Founded in 1961 as a part-time school, Sussex now serves about 1,300 full-time students chosen by lottery. Almost one-third come from low-income families. Among its achievements, the school has the state's highest rating—"superior"—based on test scores in math, reading, science, and social studies. Another important data point: approximately 98% of students graduate.[12]

The school provides a comprehensive educational program integrating technical education with core academic courses, referred to as "techademics."[13] Each student receives training in one of 15 technical areas aligned with local business needs in automotive technologies, health/human services technologies, communications/information technologies, and industrial/engineering technologies.

During freshman year, students take core academic courses and explore a variety of technical fields to help choose a career path. Students then select one program of study for grades 10–12. Senior year culminates with a STEM "exhibition of mastery," where each student creates a significant technical product, prepares a research paper, and makes a formal presentation for administrators, teachers, and business/industry representatives to evaluate. Seniors also have many opportunities for work-based learning in their trade.

Results
There are many examples of highly regarded CTE schools and programs, but little research to support broad conclusions about their effectiveness, particularly in comparison with alternatives. As with other expanding STEM models, the few studies show some positive findings, though preliminary and qualified, about each type of CTE program.

For example, a rigorous study of mathematics content found positive effects: "There is evidence that integrating math in CTE courses can increase the STEM knowledge of CTE

participants. Using a contextual approach, students who learn to use math to solve authentic work-based problems improve their understanding of mathematics."[14] The study found no loss in occupational knowledge, suggesting that CTE need not conflict with academic achievement.

RECOMMENDATIONS

It is clear that there are many more interesting models of specialized STEM secondary education than just a decade ago. While the field awaits the results of effectiveness research underway, it would be worthwhile for educators to visit a variety of STEM programs and seek to replicate in their own schools what appears to be working best so far. These include:

- Grounding STEM education in "real-life" practical problems, especially related to the workplace
- Student participation in original research projects
- Student internships and mentorships with STEM professionals
- Tutoring, advisories, and other individualized supports for students with weaker academic preparation

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[1] National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: U.S. Department of Education.

[2] Gonzales, P. et al. (2008). *Highlights from TIMMS 2007: Mathematics and science achievement of U.S. fourth- and eighth-grade students in an international context*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

[3] National Commission on Excellence in Education. (1983). A Nation at Risk: The Imperative for Education Reform. *U.S. Department of Education*, Washington, D.C. Retrieved March 29, 2012 from: http://www2.ed.gov/pubs/NatAtRisk/index.html

[4] See www3.imsa.edu/about.

[5] National Research Council. (2011). *Successful STEM education: A workshop summary*. Alexandra Beatty, Rapporteur. Committee on Highly Successful Schools or Programs for K-12 STEM Education, Board on Science Education and Board on Testing and Assessment. Washington, DC: The National Academies Press.

[6] Rena Subotnik et al. (2001). *Study of the impact of selective SMT high schools: Reflections on learners gifted and motivated in science and mathematics*. Paper presented at the National Research Council's Workshop on Successful STEM Education in K–12 Schools, Washington, DC, May 10–12, 2011.

[7] Ibid.

[8] Ibid.

[9] Test results available at http://washingtonstemeducation.org/organization/our_projects/. For more information on Delta High School, see http://www.thedelthahighschool.com.

[10] Young, V. et al. (2011). *Inclusive STEM schools: Early promise in Texas and unanswered questions*. Paper presented at the National Research Council's Workshop on Successful STEM Education in K–12 Schools, Washington, DC, May 10–12, 2011.

[11] Means, B. et al. (2008). *STEM High schools: Specialized science technology engineering and mathematics secondary schools in the U.S.* Menlo Park, California: SRI International.

[12] Delaware Department of Education, Sussex Technical High School Profile: http://profiles.doe.k12.de.us/SchoolProfiles/District/Default.aspx?checkSchool=0&districtCode=40&district=Sussex%20Technical

[13] See http://www.sussexvt.k12.de.us/hs/.

[14] Stone III, J. R., et al. (2008). Rigor and relevance: Testing a model of enhanced math learning in career and technical education. *American Education Research Journal*, *45*, 767–795.

Community for Advancing Discovery Research in Education

This brief is one in a series to bring research to practice. STEM Smart briefs are funded by the National Science Foundation, grant # 0822241, and prepared by the Community for Advancing Discovery Research in Education (CADRE) at the Education Development Center, Inc. Any opinions, findings, and conclusions or recommendations expressed in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. Many examples in the briefs are taken from the National Research Council's *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics (2011).*

STEM SCHOOL STUDY

The 8 Elements of Inclusive STEM High Schools

Findings from the STEM School Study

This work is supported by the National Science Foundation, Study #1238552

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INTRODUCTION

WHAT DEFINES A STEM SCHOOL?

The STEM School Study (S3) team sat down with inclusive STEM school leaders from over 25 inclusive STEM schools and asked them to describe the parts of their schools that are essential to their school models. We found that while STEM schools vary in many ways, there are eight major Elements common to them all. Each Element is comprised of a number of components and together, they illustrate what STEM schools are and lay the groundwork for understanding how STEM schools work to achieve their goals.

The 8 Elements include six core Elements that we equate with the STEM schools' key educational goals:

1) Rigorous Learning;
2) Problem-Based Learning;
3) Personalization of Learning;
4) Career, Technology, and Life Skills;
5) School Community and Belonging; and
6) External Community.

The remaining two are supporting and contributing Elements:

7) Staff Foundations and
8) Essential Factors.

In this report, read about the 8 Elements, how we developed this framework, and how it can be useful to you. For additional information and findings, please visit our website at http://www.outlier.uchicago.edu/S3.

LaForce, M., Noble, E., King, H., Holt, S., & Century, J. (2014). The 8 Elements of Inclusive STEM High Schools. Chicago, IL: Outlier Research & Evaluation, CEMSE | The University of Chicago.

HOW TO USE THE ELEMENTS

If you are a practitioner at a non-STEM school who is interested in bringing STEM to your school or district...

As someone new to STEM, you might be asking yourself "What is a STEM school anyway?" Explore the Elements to see how STEM school leaders describe the components that are fundamental to meeting their educational goals. You can also explore how schools enact these Elements with the Infographic on the S3 website.

If you are a practitioner at a new or emerging STEM school...

In working with STEM schools across the country, we've found that while STEM schools often have different goals and focus, there are 8 common themes across them. The 8 Elements of STEM Schools can help give schools and leaders context for how they focus energy and resources. By exploring how components map onto these 8 Elements through the Infographic on the S3 website, practitioners at emerging STEM schools can reflect on their practices and strategies and the underlying educational goals they serve.

If you are a practitioner at an established STEM school...

Practitioners in established STEM schools may be confident in their school models after years of refinement. Leaders in these schools can use the 8 Elements and their components to articulate their school model to others. Additionally, like new and emerging STEM schools, established STEM schools can utilize the Elements for reflection and to consider how the current model components work together to achieve the STEM school's goals.

PROBLEM-BASED LEARNING

The components of this element address the goal of problem and project-based learning. Examples include:

INTERDISCIPLINARY INSTRUCTION

Students identify ways that disciplines are interrelated, and how they reinforce and complement one another.

"PBL ties across the entire curriculum. It's integrated throughout everything we're doing in the whole day. When we designed the gaming platform, the English teacher said I'm going to work on prose and poetry… The product at the end was that they had to produce a prose to market their game on. In robotics unit, they had to do a lot of technical reading and writing. So that's what she focused on. And they had to write a technical manual."

STUDENT AUTONOMY

Students have independence in and ownership of their learning. Students set goals for their learning and make choices about how to accomplish them.

"The big thing is learner-centered education. It's one of the main components of our mission statement as well; that we really think students should be driving their own instruction. So that's kind of the basis where all of our problem-based learning, project-based learning comes from as well. We want self-discovery happening. Research, all research points to better-prepared students, better problem-solvers, from students who are able to address situations themselves, and solve problems themselves."

STUDENTS REFLECT ON THEIR LEARNING

Students consider the strengths and weaknesses of their learning approaches and ways they can improve them.

"We want a reflection built in. Students are metacognitive on the process. We figure out how it's going, how they can change and do better next time. This is a great process. It's built into the work they do in a daily basis."

OTHER PROBLEM-BASED LEARNING COMPONENTS:

Interdisciplinary Teams

Intersession

Problem-Solving Projects

Staff-Created Curriculum

Partners Support Instruction

Teacher Facilitation of Teamwork and Collaboration Among Students

Teacher Facilitation of Students Making Interdisciplinary Connections

Teacher Facilitation of Student Interest

They are Learning, the Real World, and Their Lives

Teacher Facilitation of Students Engaging in an Engineering Design Process

Teacher Facilitation of Students Engaging with Real-World Content

Students Cooperate and Work with One Another as Teams

Students Make Connections Between the Content They are Learning, the Real World, and Their Lives

RIGOROUS LEARNING

The components of this element address rigorous and challenging learning, including cognitive demand.

REAL-WORLD CONTENT

Students make connections between what they are learning and real-world experiences, current events, and/or their daily lives.

"We want to see our learning environments across curriculum areas in authentic problems. Students are empowered to solve them because there are many solutions."

STAFF-CREATED CURRICULUM

Teachers and/or administrators create all or parts of the school's curriculum; this includes creating specific projects.

"We respect teachers as professionals. We let them use their data to create projects. I trust my teachers to cover standards in the way that they want. This takes teaching to another level. Projects become a teacher's hobby. Teachers are always thinking about projects."

STUDENTS REFLECT ON THEIR LEARNING

Students use thinking and process skills. This includes considering alternative arguments or explanations, making predictions, interpreting their experiences, analyzing data, explaining their reasoning, and supporting their conclusions with evidence.

"The habits are the first that come to mind. They were identified as work habits that anyone in the 21st century will be looking for in employees. Those habits should result in higher test scores. If you teach a kid how to think, the standards take care of themselves. The PBL model gets kids to dig deep- research, critical thinking, will this work?"

OTHER RIGOROUS LEARNING COMPONENTS:

Core Course Sequence
Mastery Learning
Partners Support Instruction
Teacher Facilitation of Students Making Interdisciplinary Connections
Teacher Use of Assessment to Inform Instruction
Students Make Interdisciplinary Connections
Students Participate in Tutoring
Students Participate in Early College Activities
Students Take Risks

SCHOOL COMMUNITY AND BELONGING

The components of this element are central to school culture but are non-instructional.

STUDENTS TREAT EACH OTHER WITH TRUST AND RESPECT

Students have an established sense of trust with one another and exhibit respectful behavior.

"Culture is so important. We want them to respect themselves and others. We push this. It sinks in, and I see it when the freshmen come in and the older students complain that the new students don't get the culture. We hope they leave with a desire to further their education and those 21st century skills."

EXTRACURRICULAR ACTIVITIES

Students participate in sports and clubs that take place outside of regular school hours.

"We also encourage all of our students to be as involved as possible outside the classroom. So while we want our students to be successful academically, we understand that to create a holistic student that's going to be successful beyond high school, that they need to be flexible, they need to be well rounded. So all of our teachers are asked to offer clubs or extra-curricular activities beyond school hours."

STUDENT INDUCTION PROCESS

Program or activities that support new students' transition to the school

"It's for our incoming 9th grade students, students who will be new to our school. We run it for two weeks… We use it as an orientation time for our school, because our students come from every section of town… We want them to get to know each other a little bit so that when school starts, they're not coming in as strangers. So they'll know their classmates. We also use that time to go over the core values."

OTHER SCHOOL COMMUNITY AND BELONGING COMPONENTS:

Small School and/or Classes
Student Access to School Throughout the Day
Teacher Facilitation of a Positive Social and Emotional Learning Environment
Staff Emphasizes Code of Behavior and Values
Staff Supports Needs of Whole Student
Students Contribute to School Decision-Making
Students Demonstrate Code of Behavior and Values

CAREER, TECHNOLOGY, AND LIFE SKILLS

The components of this element are related to the development of skills that students will use in future careers and life.

EARLY COLLEGE ACTIVITIES

Students participate in early college activities such as college courses.

"We try to incorporate college readiness standards throughout 9-12, doing activities that will help with our pathways. Students don't have to apply to be in a pathway, but we do have pathways that are outlined within our course descriptions that students can follow to make sure that they're preparing themselves for whatever course of study they may choose at the college level."

STUDENTS USE TECHNOLOGY

The teacher uses current and emerging technologies in instruction; students use technology as intended for learning purposes.

"Currently all of our students have personal laptops that run on Chrome. So they have access to that technology in every single one of their classes, without necessarily using it in every single one of their classes. But they have access. There are some classes of course that rely very heavily on their technology. There are other classes in which the technology acts as a resource and a support system for the curriculum."

STUDENTS USE WORKPLACE AND LIFE SKILLS

Students use the skills of communication, creativity, collaboration, leadership, critical thinking, and technological proficiency.

"All of our students do have to do presentations in all of their subject areas. One of the pieces of research that we found really interesting a couple years ago, is that a lot of students who graduate with really high abilities in science and math typically are very introverted, and they're not necessarily communicating with their peers as much as students who are not really focusing on those areas. So that's something that's really important to us as well… Because we live in a global society, so our students need to be able to communicate with all facets of that society."

OTHER CAREER, TECHNOLOGY, AND LIFE SKILLS COMPONENTS:

- Instructional Themes
- Partners Support Instruction
- Teacher Facilitation of Student Autonomy
- Teacher/Partner Facilitation of Students Engaging in Career-Readiness Activities
- Teacher Facilitation of Students Learning Skills Specifically Related to the Workplace and Life
- Teacher Facilitation of Teamwork and Collaboration Among Students
- Teacher Models Use of New and Current Technologies
- Students Cooperate and Work with One Another as Teams
- Students Demonstrate Autonomy
- Students Engage and Participate in Career Readiness
- Students Engage and Participate in Service Learning
- Students Participate in Demonstrations of Learning
- Students Participate in Early College Activities
- Students Participate in Higher Education Exposure Activities

PERSONALIZATION OF LEARNING

The components of this element center around the idea that learning should be customized for each student's ability and interests. Examples include:

TEACHER DIFFERENTIATION OF INSTRUCTION BASED ON LEARNING NEEDS

The teacher customizes instruction based on ability, learning styles, and developmental levels of the students.

"Research, all research points to better-prepared students, better problem-solvers, from students who are able to address situations and solve problems themselves. So one of our big goals is to have as much learner-centered education going on as possible. Differentiation is huge for us; we want to make sure we're meeting the needs of all of our students regardless of their levels."

TEACHER FACILITATION OF STUDENT INTEREST

The teacher develops interest by relating students' lives and experiences to a lesson or unit. This also includes differentiation of the learning experience based on student interest.

"It's important that we build relationships with every student and family so we know what their interests are. The goal is to get kids to understand the world in which we live. I learned that students pay more attention to the world if they care".

TEACHER USE OF ASSESSMENT TO INFORM INSTRUCTION

The teacher uses information on current student understanding to inform and plan future instruction.

"We use a system in which our students are given diagnostic tests at the beginning of the year to see what their levels are. From that data we can then group the students according to their instructional level to really try to individualize their education a little bit more."

OTHER PERSONALIZATION OF LEARNING COMPONENTS:

- Advisory
- Small School and/or Classes
- Flexible Schedule
- Student Access to School Throughout the Day
- Teacher/Partner Facilitation of Students Engaging in Career-Readiness Activities
- Teacher Facilitation of Student Autonomy
- Staff Supports Needs of Whole Student
- Students Engage and Participate in Career Readiness
- Students Demonstrate Autonomy

EXTERNAL COMMUNITY

The components of this element reflect a connection between STEM schools and the broader and external community, from neighborhood to state level.

SCHOOL ESTABLISHES AND MAINTAINS A COMMUNITY PRESENCE

Staff creates and develops partnerships with organizations external to the school.

"The most important thing is our deep and enduring connection to our community. We do a lot of community involvement. We actually have people from STEM disciplines and beyond to work with kids and build ongoing professional and sustainable relationships. We want the STEM jobs in our community to be filled by people that come from our community. Community is definitely a general border- if people are willing to come here; they are part of our community. We will extend this invite to anyone who is willing to show up and work with students."

STUDENTS PARTICIPATE IN SERVICE LEARNING

Students participate in service learning or volunteer activities.

"We work very hard on community type of projects. For example, not just during the holidays, but you're going to hear -- well, all right, we're going to collect coats because -- they're collecting coats. Or "our students are going to do that." But we also do recycling. Right now, I don't know the exact count, but we have about -- I'm going to say near 30 students, let's say 25, 30 students, from our senior class, that have taken the accounting training where they are actually helping our community. They volunteer hours to help our -- they help our community people with their income tax."

STAFF SPREADS PRACTICES

Staff shares with others practices they enact in their classrooms and school.

"Two of our teachers are working with [another school], so they go over to teach those teachers about the project-based program. We're looking at expanding that next year… maybe even sharing one of our teachers throughout the year to go over and work with teachers over there… One of the best things that we can do is that we can share information."

OTHER EXTERNAL COMMUNITY COMPONENTS:

Staff Establishes and Maintains Partnerships
Partners Facilitate Spread of Practices
Partners Help Establish and Maintain Community Presence
Teacher Leaders Facilitate Communication Across Campuses

STAFF FOUNDATIONS

The components of this element enable and/or support desired school staff interactions and instructional behaviors.

STAFF COLLABORATE

Staff work through problems and develop ideas together.

"Brand new teachers are great. We can form their early teaching practices. We put new teachers with more experienced teachers. Our teachers are hardworking and good-natured. The teachers collaborate and support one another succeed."

STAFF REFLECT ON WORK

Staff consider the strengths and weaknesses of their practices and ways they can improve them.

"It's important that teachers are experts in data. Teachers determine their students' needs. Then they build projects around students' gaps. It's good because you don't have to rely on the central office. This does create a sense of ownership. We look at state assessments. And every 3 weeks teachers create a short 10-question assessment based on standards. We use this information. We run district assessments. We do formative assessment all the time in the classroom. We are also looking at student work- we are reflective as a staff on their work. We use this to reflect on our instruction, so we can help students be more successful."

SCHOOL LEADERS FACILITATE STAFF GROWTH AND DEVELOPMENT

School leaders ensure that staff members have opportunities to grow in their roles as STEM school teachers and leaders.

"As a leader it's important to understand what you're asking teachers to do, and help facilitate project design and critical thinking things to help teachers create stronger practices and support students when they are struggling with things."

OTHER STAFF FOUNDATIONS:

Common Planning Time
Individual Planning Time
Non-Instructional Staff
School Leaders Model Instructional Practice
School Leaders Model and Support Risk-Taking and Autonomy for Staff
Staff Engages in Relevant Professional Development/Growth Activities
Staff Has a Sense of School Ownership
Staff Participates in Decision Making
Staff Treat One Another with Trust and Respect
Staff Works with Autonomy

Essential Factors

The components of this element are environmental factors, staff attitudes, and other situations external to the school model itself that STEM school staff identify as essential.

STAFF ARE FLEXIBLE AND OPEN TO CHANGE

Staff are willing to engage in new practices and adjust what they do for the greatest benefit for students.

"Things do change and we change. We are able to morph the program as needed. We adapt as necessary. We have a flexible approach because the world has changed in the 4 years since we've been open. We want to stay on the leading edge to give them a world-class experience."

REPRESENTATIVE POPULATIONS

School recruits and enrolls students with a focus on reflecting a population representative of the community/area the school serves.

"We aren't a magnet- we take whoever we get. It wouldn't be uncommon to hear a kid say that they hate technology. It's our job to turn them on to it and expose them to it. You are better off as a result of exposing them. We do have those kids who are super geeked out and they create apps and stuff. We are just trying to turn people on if they are off and push them further if there are already into it."

PROFESSIONAL DEVELOPMENT RESOURCES

Resources available to help teachers and staff develop and further their skills.

"We have a PD institute in the summer. It's paid through our grant funds. We are looking to sustain that with other funds. It's a 4-5 day PD that is led by teachers in facilitation with others as needed- Partners at the U of Washington. We have good support and researchers that help us with information."

OTHER ESSENTIAL FACTORS:

Family Involvement
Online Management System
Open Physical Space
Regional School
Partners Provide Money/Material Resources
Standards
Staff Believe All Students Can Learn
Staff are Flexible and Open to Change
STEM Instructional Leaders Support Instruction

WHERE IS THE S.T.E.M. IN STEM?

As you look through the eight Elements and the STEM school components, you may notice what seems like a lack of items that relate specifically to the S.T.E. and M. (science, technology, engineering, and math) disciplines. In our conversations with STEM school leaders and teachers, it has become increasingly evident that when they say STEM, they don't just mean these disciplinary subjects. When we ask about the missions and goals of their schools, most often they describe the importance of things like engaging students with real-world problems, preparing them for the workforce, and developing them as critical thinkers and active citizens.

The STEM disciplines themselves manifest in a variety of ways in the inclusive STEM high schools that participate in the S3 study. In some of the schools, the school model focuses heavily on STEM subjects, often providing more rigorous courses in science and math than what is required at the state level, and/or integration of engineering or technology courses. However, instructional practices and culture in these schools are often equally, if not more, important to their STEM identity. In many inclusive STEM high schools we work with, the STEM disciplinary focus is more subtle, and their self-identification as "STEM School" comes more directly from their focus on pedagogy and the school culture. In all cases, it is clear that some of the most valued components of STEM schools are not STEM-discipline specific, but relate to broader, transferrable, lifelong skills.

Many of the ideas and instructional approaches employed by STEM schools predate the STEM movement. Educational philosophers such as Dewey, Piaget, Vygotsky, and Bruner have advocated for inquiry and constructivist approaches for over a century. They argued for student autonomy, relevance, collaboration with peers, and learning-by-doing. They encouraged educators to view students as active participants in their own learning, and considered citizenship and creative and inventive thinking to be important student outcomes. None of them called it "STEM," but approaches and end-goals for students advocated by such philosophers are strikingly similar to what STEM school leaders mean when they talk about STEM today.

The STEM school Elements reflect these ideas, as identified by inclusive STEM school educators themselves: embracing problem- and project-based approaches; personalizing students' learning; creating a sense of community and family; equipping students with the skills necessary for college and for the workplace; and connecting with the community. STEM schools work to meet these goals through an integrated approach to learning and rigorous coursework in all disciplines.

Thus, while there may seem at first glance to be a lack of STEM discipline-related components in the S3 framework, this is a reflection of the broader definition of STEM that many school leaders have adopted. These schools certainly focus on giving their students high quality and challenging coursework in STEM subjects, but also in all of the disciplines they teach, and in the context of all of the other things they are working to accomplish. The STEM disciplines are there, but STEM is more than the sum of its S. T. E. and M. parts.

METHODS

The 8 S3 Elements emerged from four years of research with over 25 inclusive STEM high schools across the nation. This research took a "ground-up" approach in that rather than beginning with a definition of what we thought a STEM school should be, we asked the STEM schools to tell us what they are.

Outlier interviewed individuals in each STEM school to identify and describe the most important components, or building blocks, which contribute to the success of their school. We then coded the interviews establishing common themes, and identified 78 components. These components include structural components, such as specified time set aside for Advisory or cross-departmental collaboration, and behavioral components, such as students participating in early college activities or teachers facilitating a positive social and emotional learning environment. These components allow us to look at what STEM schools are and what they are doing in a very concrete, detailed, and measurable way-however, we also wanted to describe what STEM schools are more generally.

Working with the interview data and informed by appropriate literature, we organized the components into categories that emerged across the schools. Ultimately, these categories became the 8 Elements.

The Element descriptions, above, and the Infographic of the S3 STEM school components, found on the S3 website, illustrate the goals of inclusive STEM high schools, the contexts and conditions that support them, and the 78 components that comprise them. In the STEM School Study Roadmap Findings, also available at http://www.outlier.uchicago.edu/S3, we describe how we believe these components work together to achieve STEM school goals.

STEM Oregon Employment Projections by Detailed SOC, 2014-2024

Oregon Employment Department, Workforce and Economic Research

Standard Occupational Classification Code and Title		2014 Employment	2024 Employment	Employment Change	Percent Change	Growth Openings*	Replacement Openings	Total Openings	Typical Entry Level Education	Competitive Education
Total, STEM Occupations		**410,096**	**475,552**	**65,456**	**16.0%**	**65,690**	**84,688**	**150,378**		
Management, Business, and Financial		**86,601**	**100,111**	**13,510**	**15.6%**	**13,510**	**17,344**	**30,854**		
Management Occupations		**45,698**	**52,468**	**6,770**	**14.8%**	**6,770**	**9,411**	**16,181**		
11-1011	Chief Executives	2,780	2,943	163	5.9%	163	473	636	Bachelor's degree	Bachelor's degree
11-3021	Computer and Information Systems Managers	4,545	5,601	1,056	23.2%	1,056	536	1,592	Bachelor's degree	Bachelor's degree
11-3031	Financial Managers	6,308	7,275	967	15.3%	967	1,494	2,461	Bachelor's degree	Bachelor's degree
11-3051	Industrial Production Managers	2,663	2,972	309	11.6%	309	755	1,064	Bachelor's degree	Bachelor's degree
11-3061	Purchasing Managers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Bachelor's degree
11-3071	Transportation, Storage, and Distribution Managers	1,850	2,097	247	13.4%	247	407	654	Bachelor's degree	Bachelor's degree
11-3111	Compensation and Benefits Managers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Bachelor's degree
11-9013	Farmers, Ranchers, and Other Agricultural Managers	5,427	6,552	1,125	20.7%	1,125	925	2,050	HS diploma or equivalent	Bachelor's degree
11-9021	Construction Managers	4,625	5,297	672	14.5%	672	647	1,319	Associate's degree	Bachelor's degree
11-9039	Education Administrators, All Other	678	764	86	12.7%	86	197	283	Master's degree	PhD or professional degree
11-9041	Architectural and Engineering Managers	2,992	3,429	437	14.6%	437	917	1,354	Bachelor's degree	Bachelor's degree
11-9061	Funeral Service Managers	113	122	9	8.0%	9	25	34	Associate's degree	Associate's degree
11-9121	Natural Sciences Managers	1,003	1,065	62	6.2%	62	208	270	Bachelor's degree	Master's degree
11-9161	Emergency Management Directors	87	92	5	5.8%	5	10	15	Bachelor's degree	Bachelor's degree
11-9199	Managers, All Other	11,135	12,532	1,397	12.6%	1,397	2,457	3,854	Bachelor's degree	Bachelor's degree
Business Operations Specialists		**21,412**	**24,257**	**2,845**	**13.3%**	**2,845**	**3,245**	**6,090**		
13-1041	Compliance Officers	2,615	2,858	243	9.3%	243	368	611	Bachelor's degree	Bachelor's degree
13-1051	Cost Estimators	3,731	4,543	812	21.8%	812	1,062	1,874	Bachelor's degree	Bachelor's degree
13-1081	Logisticians	969	1,123	154	15.9%	154	135	289	Bachelor's degree	Bachelor's degree
13-1199	Business Operations Specialists, All Other	14,097	15,733	1,636	11.6%	1,636	1,680	3,316	Bachelor's degree	Bachelor's degree
Financial Specialists		**19,491**	**23,386**	**3,895**	**20.0%**	**3,895**	**4,688**	**8,583**		
13-2011	Accountants and Auditors	12,623	15,328	2,705	21.4%	2,705	3,369	6,074	Bachelor's degree	Bachelor's degree
13-2021	Appraisers and Assessors of Real Estate	898	920	22	2.5%	22	144	166	Postsecondary (non-degree)	Postsecondary (non-degree)
13-2031	Budget Analysts	771	840	69	9.0%	69	192	261	Bachelor's degree	Bachelor's degree
13-2051	Financial Analysts	2,309	2,751	442	19.1%	442	475	917	Bachelor's degree	Master's degree
13-2052	Personal Financial Advisors	1,433	1,857	424	29.6%	424	360	784	Bachelor's degree	Bachelor's degree
13-2099	Financial Specialists, All Other	1,457	1,690	233	16.0%	233	148	381	Bachelor's degree	Bachelor's degree
Professional and Related		**119,457**	**138,480**	**19,023**	**15.9%**	**19,074**	**24,660**	**43,734**		
Computer Operations		**46,506**	**56,493**	**9,987**	**21.5%**	**9,987**	**6,627**	**16,614**		
15-1111	Computer and Information Research Scientists	266	372	106	39.9%	106	34	140	PhD or professional degree	PhD or professional degree
15-1121	Computer Systems Analysts	5,112	6,552	1,440	28.2%	1,440	658	2,098	Bachelor's degree	Bachelor's degree
15-1122	Information Security Analysts	388	469	81	20.9%	81	50	131	Bachelor's degree	Bachelor's degree
15-1131	Computer Programmers	3,090	3,189	99	3.2%	99	761	860	Bachelor's degree	Bachelor's degree
15-1132	Software Developers, Applications	7,662	9,844	2,182	28.5%	2,182	1,095	3,277	Bachelor's degree	Bachelor's degree
15-1133	Software Developers, Systems Software	4,847	5,779	932	19.2%	932	693	1,625	Bachelor's degree	Bachelor's degree

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15-1134	Web Developers	3,408	4,847	1,439	42.2%	1,439	439	1,878	Bachelor's degree	Bachelor's degree
15-1141	Database Administrators	1,150	1,361	211	18.4%	211	248	459	Bachelor's degree	Bachelor's degree
15-1142	Network and Computer Systems Administrators	3,874	4,427	553	14.3%	553	499	1,052	Bachelor's degree	Bachelor's degree
15-1143	Computer Network Architects	1,223	1,432	209	17.1%	209	157	366	Bachelor's degree	Bachelor's degree
15-1151	Computer User Support Specialists	7,963	9,505	1,542	19.4%	1,542	1,025	2,567	Postsecondary (non-degree)	Bachelor's degree
15-1152	Computer Network Support Specialists	1,781	2,013	232	13.0%	232	229	461	Bachelor's degree	Bachelor's degree
15-1199	Computer Occupations, All Other	5,742	6,703	961	16.7%	961	739	1,700	Postsecondary (non-degree)	Bachelor's degree
Mathematical Science Occupations		**1,651**	**2,250**	**599**	**36.3%**	**602**	**317**	**919**		
15-2011	Actuaries	198	253	55	27.8%	55	59	114	Bachelor's degree	Master's degree
15-2021	Mathematicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Master's degree	PhD or professional degree
15-2031	Operations Research Analysts	821	1,160	339	41.3%	339	146	485	Bachelor's degree	Master's degree
15-2041	Statisticians	562	766	204	36.3%	204	99	303	Bachelor's degree	Master's degree
15-2091	Mathematical Technicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Bachelor's degree
15-2099	Mathematical Science Occupations, All Other	39	42	3	7.7%	3	7	10	Bachelor's degree	Master's degree
Architects, Surveyors, and Cartographers		**3,123**	**3,740**	**617**	**19.8%**	**617**	**613**	**1,230**		
17-1011	Architects, Except Landscape and Naval	1,969	2,430	461	23.4%	461	324	785	Bachelor's degree	Master's degree
17-1012	Landscape Architects	445	542	97	21.8%	97	73	170	Bachelor's degree	Master's degree
17-1022	Surveyors	542	571	29	5.4%	29	168	197	Bachelor's degree	Bachelor's degree
17-2011	Aerospace Engineers	167	197	30	18.0%	30	48	78	Bachelor's degree	Master's degree
Engineers		**21,973**	**25,593**	**3,620**	**16.5%**	**3,620**	**5,752**	**9,372**		
17-2021	Agricultural Engineers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
17-2031	Biomedical Engineers	284	363	79	27.8%	79	75	154	Bachelor's degree	Master's degree
17-2041	Chemical Engineers	241	289	48	19.9%	48	66	114	Bachelor's degree	Master's degree
17-2051	Civil Engineers	4,552	5,414	862	18.9%	862	1,344	2,206	Bachelor's degree	Master's degree
17-2061	Computer Hardware Engineers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
17-2071	Electrical Engineers	1,520	1,768	248	16.3%	248	335	583	Bachelor's degree	Master's degree
17-2072	Electronics Engineers, Except Computer	1,889	2,118	229	12.1%	229	416	645	Bachelor's degree	Master's degree
17-2081	Environmental Engineers	658	793	135	20.5%	135	186	321	Bachelor's degree	Master's degree
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	222	247	25	11.3%	25	65	90	Bachelor's degree	Master's degree
17-2112	Industrial Engineers	3,560	4,296	736	20.7%	736	1,044	1,780	Bachelor's degree	Master's degree
17-2121	Marine Engineers and Naval Architects	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
17-2131	Materials Engineers	436	473	37	8.5%	37	154	191	Bachelor's degree	Master's degree
17-2141	Mechanical Engineers	2,734	3,227	493	18.0%	493	866	1,359	Bachelor's degree	Master's degree
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
17-2161	Nuclear Engineers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Master's degree	PhD or professional degree
17-2171	Petroleum Engineers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
17-2199	Engineers, All Other	2,336	2,714	378	16.2%	378	469	847	Bachelor's degree	Master's degree
Drafters, Engineering Technicians, and Mapping Technicians		**12,257**	**13,336**	**1,079**	**8.8%**	**1,079**	**2,481**	**3,560**		
17-3011	Architectural and Civil Drafters	1,641	1,792	151	9.2%	151	194	345	Postsecondary (non-degree)	Postsecondary (non-degree)

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17-3012	Electrical and Electronics Drafters	318	382	64	20.1%	64	38	102	Postsecondary (non-degree)	Postsecondary (non-degree)
17-3013	Mechanical Drafters	750	789	39	5.2%	39	89	128	Postsecondary (non-degree)	Postsecondary (non-degree)
17-3019	Drafters, All Other	437	472	35	8.0%	35	52	87	Postsecondary (non-degree)	Postsecondary (non-degree)
17-3021	Aerospace Engineering and Operations Technicians	200	209	9	4.5%	9	49	58	Associate's degree	Bachelor's degree
17-3022	Civil Engineering Technicians	949	1,032	83	8.8%	83	232	315	Associate's degree	Associate's degree
17-3023	Electrical and Electronics Engineering Technicians	2,866	3,135	269	9.4%	269	701	970	Associate's degree	Associate's degree
17-3024	Electro-Mechanical Technicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Associate's degree	Associate's degree
17-3025	Environmental Engineering Technicians	198	217	19	9.6%	19	48	67	Associate's degree	Associate's degree
17-3026	Industrial Engineering Technicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Associate's degree	Associate's degree
17-3027	Mechanical Engineering Technicians	449	512	63	14.0%	63	110	173	Associate's degree	Associate's degree
17-3029	Engineering Technicians, Except Drafters, All Other	976	1,036	60	6.2%	60	239	299	Associate's degree	Associate's degree
17-3031	Surveying and Mapping Technicians	920	948	28	3.0%	28	104	132	HS diploma or equivalent	Postsecondary (non-degree)
Life, Physical, and Social Science Scientists and Related Worke		**10,353**	**11,394**	**1,041**	**10.1%**	**1,051**	**2,934**	**3,985**		
19-1011	Animal Scientists	33	34	1	3.0%	1	11	12	Bachelor's degree	Master's degree
19-1012	Food Scientists and Technologists	255	314	59	23.1%	59	88	147	Bachelor's degree	Master's degree
19-1013	Soil and Plant Scientists	776	871	95	12.2%	95	269	364	Bachelor's degree	Master's degree
19-1021	Biochemists and Biophysicists	125	128	3	2.4%	3	33	36	Master's degree	PhD or professional degree
19-1022	Microbiologists	127	137	10	7.9%	10	34	44	Bachelor's degree	Master's degree
19-1023	Zoologists and Wildlife Biologists	990	1,059	69	7.0%	69	265	334	Bachelor's degree	Master's degree
19-1029	Biological Scientists, All Other	761	752	-9	-1.2%	0	204	204	Bachelor's degree	Master's degree
19-1031	Conservation Scientists	581	682	101	17.4%	101	253	354	Bachelor's degree	Master's degree
19-1032	Foresters	766	841	75	9.8%	75	334	409	Bachelor's degree	Master's degree
19-1041	Epidemiologists	31	33	2	6.5%	2	10	12	PhD or professional degree	PhD or professional degree
19-1042	Medical Scientists, Except Epidemiologists	1,455	1,510	55	3.8%	55	450	505	PhD or professional degree	PhD or professional degree
19-1099	Life Scientists, All Other	157	172	15	9.6%	15	49	64	Bachelor's degree	Master's degree
19-2011	Astronomers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Master's degree	PhD or professional degree
19-2012	Physicists	76	81	5	6.6%	5	14	19	Master's degree	PhD or professional degree
19-2021	Atmospheric and Space Scientists	75	76	1	1.3%	1	14	15	Bachelor's degree	Master's degree
19-2031	Chemists	609	716	107	17.6%	107	134	241	Bachelor's degree	Master's degree
19-2032	Materials Scientists	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
19-2041	Environmental Scientists and Specialists, Including Health	1,145	1,347	202	17.6%	202	352	554	Bachelor's degree	Master's degree
19-2042	Geoscientists, Except Hydrologists and Geographers	343	420	77	22.5%	77	106	183	Bachelor's degree	Master's degree

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19-2043	Hydrologists	198	215	17	8.6%	17	61	78	Bachelor's degree	Master's degree
19-2099	Physical Scientists, All Other	575	613	38	6.6%	38	55	93	Bachelor's degree	Master's degree
19-3011	Economists	263	293	30	11.4%	30	70	100	Bachelor's degree	Master's degree
19-3022	Survey Researchers	120	146	26	21.7%	26	14	40	Bachelor's degree	Master's degree
19-3032	Industrial-Organizational Psychologists	26	30	4	15.4%	4	6	10	Master's degree	PhD or professional degree
19-3041	Sociologists	12	12	0	0.0%	0	1	1	Master's degree	PhD or professional degree
19-3091	Anthropologists and Archeologists	404	435	31	7.7%	31	48	79	Bachelor's degree	Master's degree
19-3092	Geographers	32	31	-1	-3.1%	0	4	4	Bachelor's degree	Master's degree
19-3099	Social Scientists and Related Workers, All Other	368	394	26	7.1%	26	44	70	Bachelor's degree	Master's degree
Life, Physical, and Social Science Technicians		**8,506**	**9,243**	**737**	**8.7%**	**737**	**3,086**	**3,823**		
19-4011	Agricultural and Food Science Technicians	666	758	92	13.8%	92	217	309	Associate's degree	Associate's degree
19-4021	Biological Technicians	2,720	2,863	143	5.3%	143	759	902	Associate's degree	Bachelor's degree
19-4031	Chemical Technicians	290	337	47	16.2%	47	87	134	Associate's degree	Bachelor's degree
19-4041	Geological and Petroleum Technicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Associate's degree	Associate's degree
19-4051	Nuclear Technicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
19-4061	Social Science Research Assistants	547	569	22	4.0%	22	229	251	Postsecondary (non-degree)	Bachelor's degree
19-4091	Environmental Science and Protection Technicians, Including Health	303	334	31	10.2%	31	127	158	Associate's degree	Bachelor's degree
19-4092	Forensic Science Technicians	207	257	50	24.2%	50	87	137	Bachelor's degree	Master's degree
19-4093	Forest and Conservation Technicians	2,116	2,297	181	8.6%	181	887	1,068	HS diploma or equivalent	Associate's degree
19-4099	Life, Physical, and Social Science Technicians, All Other	1,627	1,797	170	10.5%	170	682	852	Associate's degree	Bachelor's degree
Postsecondary Teachers		**8,559**	**9,319**	**760**	**8.9%**	**760**	**1,514**	**2,274**		
25-1011	Business Teachers, Postsecondary	856	879	23	2.7%	23	151	174	Master's degree	PhD or professional degree
25-1021	Computer Science Teachers, Postsecondary	284	293	9	3.2%	9	50	59	Master's degree	PhD or professional degree
25-1022	Mathematical Science Teachers, Postsecondary	699	763	64	9.2%	64	124	188	Master's degree	PhD or professional degree
25-1031	Architecture Teachers, Postsecondary	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Master's degree	PhD or professional degree
25-1032	Engineering Teachers, Postsecondary	482	516	34	7.1%	34	85	119	Master's degree	PhD or professional degree
25-1041	Agricultural Sciences Teachers, Postsecondary	232	233	1	0.4%	1	41	42	Master's degree	PhD or professional degree
25-1042	Biological Science Teachers, Postsecondary	622	677	55	8.8%	55	110	165	Master's degree	PhD or professional degree
25-1043	Forestry and Conservation Science Teachers, Postsecondary	126	128	2	1.6%	2	22	24	Master's degree	PhD or professional degree
25-1051	Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary	190	195	5	2.6%	5	34	39	Master's degree	PhD or professional degree

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25-1052	Chemistry Teachers, Postsecondary	280	304	24	8.6%	24	50	74	Master's degree	PhD or professional degree
25-1053	Environmental Science Teachers, Postsecondary	62	64	2	3.2%	2	11	13	Master's degree	PhD or professional degree
25-1054	Physics Teachers, Postsecondary	168	183	15	8.9%	15	30	45	Master's degree	PhD or professional degree
25-1063	Economics Teachers, Postsecondary	195	202	7	3.6%	7	34	41	Master's degree	PhD or professional degree
25-1064	Geography Teachers, Postsecondary	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Master's degree	PhD or professional degree
25-1071	Health Specialties Teachers, Postsecondary	3,189	3,602	413	13.0%	413	564	977	Master's degree	PhD or professional degree
25-1072	Nursing Instructors and Teachers, Postsecondary	643	731	88	13.7%	88	114	202	Master's degree	PhD or professional degree
25-1193	Recreation and Fitness Studies Teachers, Postsecondary	378	392	14	3.7%	14	67	81	Master's degree	PhD or professional degree
Librarians, Curators, and Archivists		**106**	**115**	**9**	**8.5%**	**9**	**33**	**42**		
25-4013	Museum Technicians and Conservators	106	115	9	8.5%	9	33	42	Bachelor's degree	Master's degree
Other Education, Training, and Library Occupations		**1,635**	**1,846**	**211**	**12.9%**	**211**	**158**	**369**		
25-9011	Audio-Visual and Multimedia Collections Specialists	69	73	4	5.8%	4	7	11	HS diploma or equivalent	Associate's degree
25-9021	Farm and Home Management Advisors	211	252	41	19.4%	41	20	61	Bachelor's degree	Bachelor's degree
25-9031	Instructional Coordinators	1,355	1,521	166	12.3%	166	131	297	Bachelor's degree	Master's degree
Art and Design Workers		**1,610**	**1,877**	**267**	**16.6%**	**267**	**314**	**581**		
27-1011	Art Directors	1,348	1,582	234	17.4%	234	252	486	Bachelor's degree	Bachelor's degree
27-1021	Commercial and Industrial Designers	262	295	33	12.6%	33	62	95	Bachelor's degree	Bachelor's degree
Entertainers and Performers, Sports and Related Workers		**2,183**	**2,303**	**120**	**5.5%**	**120**	**669**	**789**		
27-2012	Producers and Directors	1,152	1,243	91	7.9%	91	370	461	Bachelor's degree	Bachelor's degree
27-2041	Music Directors and Composers	1,031	1,060	29	2.8%	29	299	328	Bachelor's degree	Master's degree
Media and Communication Equipment Workers		**995**	**971**	**-24**	**-2.4%**	**14**	**162**	**176**		
27-4012	Broadcast Technicians	258	222	-36	-14.0%	0	49	49	Postsecondary (non-degree)	Postsecondary (non-degree)
27-4014	Sound Engineering Technicians	138	149	11	8.0%	11	26	37	Postsecondary (non-degree)	Postsecondary (non-degree)
27-4031	Camera Operators, Television, Video, and Motion Picture	267	265	-2	-0.8%	0	24	24	HS diploma or equivalent	Associate's degree
27-4099	Media and Communication Equipment Workers, All Other	332	335	3	0.9%	3	63	66	HS diploma or equivalent	HS diploma or equivalent
Health Care		**81,604**	**95,792**	**14,188**	**17.4%**	**14,188**	**18,394**	**32,582**		
Health Diagnosing and Treating Practitioners		**62,820**	**73,953**	**11,133**	**17.7%**	**11,133**	**14,976**	**26,109**		
29-1011	Chiropractors	1,017	1,279	262	25.8%	262	183	445	PhD or professional degree	PhD or professional degree
29-1021	Dentists, General	1,600	1,827	227	14.2%	227	326	553	PhD or professional degree	PhD or professional degree

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29-1022	Oral and Maxillofacial Surgeons	- c -	- c -	- c -	- c -	- c -	- c -	- c -	PhD or professional degree	PhD or professional degree
29-1023	Orthodontists	- c -	- c -	- c -	- c -	- c -	- c -	- c -	PhD or professional degree	PhD or professional degree
29-1029	Dentists, All Other Specialists	203	233	30	14.8%	30	41	71	PhD or professional degree	PhD or professional degree
29-1031	Dietitians and Nutritionists	657	743	86	13.1%	86	50	136	Bachelor's degree	Bachelor's degree
29-1041	Optometrists	601	830	229	38.1%	229	214	443	PhD or professional degree	PhD or professional degree
29-1051	Pharmacists	3,750	4,170	420	11.2%	420	875	1,295	PhD or professional degree	PhD or professional degree
29-1061	Anesthesiologists	549	690	141	25.7%	141	148	289	PhD or professional degree	PhD or professional degree
29-1062	Family and General Practitioners	1,628	1,840	212	13.0%	212	438	650	PhD or professional degree	PhD or professional degree
29-1063	Internists, General	713	811	98	13.7%	98	192	290	PhD or professional degree	PhD or professional degree
29-1064	Obstetricians and Gynecologists	507	620	113	22.3%	113	137	250	PhD or professional degree	PhD or professional degree
29-1065	Pediatricians, General	604	686	82	13.6%	82	163	245	PhD or professional degree	PhD or professional degree
29-1066	Psychiatrists	460	549	89	19.4%	89	124	213	PhD or professional degree	PhD or professional degree
29-1067	Surgeons	707	875	168	23.8%	168	190	358	PhD or professional degree	PhD or professional degree
29-1069	Physicians and Surgeons, All Other	6,415	7,464	1,049	16.4%	1,049	1,727	2,776	PhD or professional degree	PhD or professional degree
29-1071	Physician Assistants	1,139	1,535	396	34.8%	396	256	652	Master's degree	Master's degree
29-1081	Podiatrists	42	49	7	16.7%	7	8	15	PhD or professional degree	PhD or professional degree
29-1123	Physical Therapists	2,750	3,778	1,028	37.4%	1,028	737	1,765	PhD or professional degree	PhD or professional degree
29-1124	Radiation Therapists	177	193	16	9.0%	16	41	57	Associate's degree	Bachelor's degree
29-1126	Respiratory Therapists	1,290	1,401	111	8.6%	111	304	415	Associate's degree	Bachelor's degree
29-1128	Exercise Physiologists	154	184	30	19.5%	30	15	45	Bachelor's degree	Bachelor's degree
29-1131	Veterinarians	1,420	1,625	205	14.4%	205	218	423	PhD or professional degree	PhD or professional degree
29-1141	Registered Nurses	33,421	38,377	4,956	14.8%	4,956	7,885	12,841	Bachelor's degree	Bachelor's degree
29-1151	Nurse Anesthetists	227	324	97	42.7%	97	54	151	Master's degree	Master's degree
29-1161	Nurse Midwives	99	129	30	30.3%	30	23	53	Master's degree	Master's degree
29-1171	Nurse Practitioners	1,447	1,948	501	34.6%	501	341	842	Master's degree	Master's degree
29-1181	Audiologists	183	240	57	31.2%	57	43	100	Master's degree	PhD or professional degree
29-1199	Health Diagnosing and Treating Practitioners, All Other	914	1,386	472	51.6%	472	213	685	PhD or professional degree	PhD or professional degree
Health Technologists and Technicians		**15,616**	**18,278**	**2,662**	**17.0%**	**2,662**	**2,773**	**5,435**		

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29-2011	Medical and Clinical Laboratory Technologists	2,157	2,469	312	14.5%	312	515	827	Bachelor's degree	Bachelor's degree
29-2012	Medical and Clinical Laboratory Technicians	1,320	1,552	232	17.6%	232	315	547	Postsecondary (non-degree)	Associate's degree
29-2021	Dental Hygienists	4,028	4,661	633	15.7%	633	662	1,295	Associate's degree	Bachelor's degree
29-2031	Cardiovascular Technologists and Technicians	643	791	148	23.0%	148	121	269	Associate's degree	Associate's degree
29-2032	Diagnostic Medical Sonographers	583	733	150	25.7%	150	110	260	Associate's degree	Bachelor's degree
29-2033	Nuclear Medicine Technologists	152	155	3	2.0%	3	29	32	Associate's degree	Bachelor's degree
29-2034	Radiologic Technologists	2,095	2,336	241	11.5%	241	396	637	Associate's degree	Bachelor's degree
29-2035	Magnetic Resonance Imaging Technologists	359	401	42	11.7%	42	68	110	Associate's degree	Associate's degree
29-2041	Emergency Medical Technicians and Paramedics	2,064	2,448	384	18.6%	384	338	722	Postsecondary (non-degree)	Postsecondary (non-degree)
29-2091	Orthotists and Prosthetists	78	109	31	39.7%	31	8	39	Bachelor's degree	Bachelor's degree
29-2092	Hearing Aid Specialists	154	198	44	28.6%	44	15	59	HS diploma or equivalent	HS diploma or equivalent
29-2099	Health Technologists and Technicians, All Other	1,983	2,425	442	22.3%	442	196	638	Postsecondary (non-degree)	Postsecondary (non-degree)
Other Healthcare Practitioners and Technical Occupations		**1,824**	**2,046**	**222**	**12.2%**	**222**	**365**	**587**		
29-9011	Occupational Health and Safety Specialists	913	984	71	7.8%	71	183	254	Bachelor's degree	Bachelor's degree
29-9012	Occupational Health and Safety Technicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Bachelor's degree
29-9091	Athletic Trainers	246	302	56	22.8%	56	49	105	Bachelor's degree	Master's degree
29-9092	Genetic Counselors	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Master's degree	Master's degree
29-9099	Healthcare Practitioners and Technical Workers, All Other	546	622	76	13.9%	76	109	185	Associate's degree	Associate's degree
Other Healthcare Support Occupations		**1,344**	**1,515**	**171**	**12.7%**	**171**	**280**	**451**		
31-9093	Medical Equipment Preparers	1,344	1,515	171	12.7%	171	280	451	Postsecondary (non-degree)	Postsecondary (non-degree)
Service		**10,526**	**11,397**	**871**	**8.3%**	**871**	**2,799**	**3,670**		
33-1021	First-Line Supervisors of Fire Fighting and Prevention Workers	1,311	1,369	58	4.4%	58	622	680	HS diploma or equivalent	Bachelor's degree
33-2011	Firefighters	3,835	4,047	212	5.5%	212	1,113	1,325	Postsecondary (non-degree)	Associate's degree
33-2021	Fire Inspectors and Investigators	178	190	12	6.7%	12	52	64	Postsecondary (non-degree)	Postsecondary (non-degree)
33-2022	Forest Fire Inspectors and Prevention Specialists	54	62	8	0	8	16	24	HS diploma or equivalent	Associate's degree
33-3021	Detectives and Criminal Investigators	685	700	15	2.2%	15	166	181	Associate's degree	Bachelor's degree
33-3031	Fish and Game Wardens	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	1,090	1,246	156	14.3%	156	182	338	HS diploma or equivalent	Postsecondary (non-degree)
37-2021	Pest Control Workers	362	399	37	10.2%	37	91	128	HS diploma or equivalent	HS diploma or equivalent
37-3012	Pesticide Handlers, Sprayers, and Applicators, Vegetation	1,289	1,459	170	13.2%	170	232	402	HS diploma or equivalent	HS diploma or equivalent
37-3013	Tree Trimmers and Pruners	1,391	1,577	186	13.4%	186	251	437	HS diploma or equivalent	HS diploma or equivalent
39-4011	Embalmers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Associate's degree	Associate's degree
39-4031	Morticians, Undertakers, and Funeral Directors	316	332	16	0	16	70	86	Associate's degree	Associate's degree

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Sales and Related		**9,489**	**10,930**	**1,441**	**15.2%**	**1,441**	**1,874**	**3,315**		
41-3031	Securities, Commodities, and Financial Services Sales Agents	3,891	4,408	517	13.3%	517	671	1,188	Bachelor's degree	Bachelor's degree
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	4,628	5,407	779	16.8%	779	952	1,731	Bachelor's degree	Bachelor's degree
41-9031	Sales Engineers	970	1,115	145	15.0%	145	251	396	Bachelor's degree	Bachelor's degree
Office and Administrative Support		**667**	**619**	**-48**	**-7.2%**	**0**	**143**	**143**		
43-9011	Computer Operators	384	347	-37	-9.6%	0	29	29	HS diploma or equivalent	HS diploma or equivalent
43-9111	Statistical Assistants	283	272	-11	-3.9%	0	114	114	Bachelor's degree	Master's degree
Farming, Fishing, and Forestry		**7,708**	**8,692**	**984**	**12.8%**	**984**	**1,933**	**2,917**		
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	1,953	2,094	141	7.2%	141	475	616	HS diploma or equivalent	HS diploma or equivalent
45-2091	Agricultural Equipment Operators	3,211	3,656	445	13.9%	445	855	1,300	HS diploma or equivalent	HS diploma or equivalent
45-4011	Forest and Conservation Workers	2,544	2,942	398	15.6%	398	603	1,001	HS diploma or equivalent	HS diploma or equivalent
Construction and Extraction		**30,901**	**37,295**	**6,394**	**20.7%**	**6,394**	**4,115**	**10,509**		
47-2011	Boilermakers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	Postsecondary (non-degree)
47-2031	Carpenters	16,528	20,527	3,999	24.2%	3,999	1,900	5,899	HS diploma or equivalent	Postsecondary (non-degree)
47-2051	Cement Masons and Concrete Finishers	1,812	2,301	489	27.0%	489	221	710	Less than HS	HS diploma or equivalent
47-2081	Drywall and Ceiling Tile Installers	1,705	2,199	494	29.0%	494	104	598	Less than HS	HS diploma or equivalent
47-2152	Plumbers, Pipefitters, and Steamfitters	5,424	6,134	710	13.1%	710	716	1,426	HS diploma or equivalent	Postsecondary (non-degree)
47-2211	Sheet Metal Workers	2,878	3,226	348	12.1%	348	619	967	HS diploma or equivalent	Postsecondary (non-degree)
47-2221	Structural Iron and Steel Workers	556	622	66	11.9%	66	93	159	HS diploma or equivalent	Postsecondary (non-degree)
47-2231	Solar Photovoltaic Installers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
47-4011	Construction and Building Inspectors	1,237	1,378	141	11.4%	141	345	486	HS diploma or equivalent	Associate's degree
47-4021	Elevator Installers and Repairers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
47-5031	Explosives Workers, Ordnance Handling Experts, and Blasters	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
47-5041	Continuous Mining Machine Operators	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
Installation, Maintenance, and Repair Occupations		**40,120**	**46,093**	**5,973**	**14.9%**	**5,997**	**8,190**	**14,187**		
Supervisors of Installation, Maintenance, and Repair Workers		**4,414**	**4,894**	**480**	**10.9%**	**480**	**880**	**1,360**		
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	4,414	4,894	480	10.9%	480	880	1,360	HS diploma or equivalent	Postsecondary (non-degree)
Electrical and Electronic Equipment Mechanics, Installers, and R		**6,442**	**6,959**	**517**	**8.0%**	**534**	**905**	**1,439**		
49-2011	Computer, Automated Teller, and Office Machine Repairers	1,316	1,479	163	12.4%	163	254	417	HS diploma or equivalent	Postsecondary (non-degree)

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49-2021	Radio, Cellular, and Tower Equipment Installers and Repairers	231	257	26	11.3%	26	21	47	Postsecondary (non-degree)	Postsecondary (non-degree)
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	2,702	2,825	123	4.6%	123	244	367	Postsecondary (non-degree)	Postsecondary (non-degree)
49-2091	Avionics Technicians	196	221	25	12.8%	25	34	59	Postsecondary (non-degree)	Associate's degree
49-2092	Electric Motor, Power Tool, and Related Repairers	175	211	36	20.6%	36	48	84	Postsecondary (non-degree)	Postsecondary (non-degree)
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment	292	307	15	5.1%	15	50	65	Postsecondary (non-degree)	Associate's degree
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	954	1,046	92	9.6%	92	165	257	Postsecondary (non-degree)	Associate's degree
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	116	118	2	1.7%	2	20	22	Postsecondary (non-degree)	Postsecondary (non-degree)
49-2096	Electronic Equipment Installers and Repairers, Motor Vehicles	120	103	-17	-14.2%	0	21	21	Postsecondary (non-degree)	Postsecondary (non-degree)
49-2097	Electronic Home Entertainment Equipment Installers and Repairers	340	392	52	15.3%	52	48	100	Postsecondary (non-degree)	Postsecondary (non-degree)
Vehicle and Mobile Equipment Mechanics, Installers, and Repair		**15,897**	**17,953**	**2,056**	**12.9%**	**2,056**	**3,794**	**5,850**		
49-3011	Aircraft Mechanics and Service Technicians	1,330	1,465	135	10.2%	135	316	451	Postsecondary (non-degree)	Associate's degree
49-3023	Automotive Service Technicians and Mechanics	8,028	8,912	884	11.0%	884	2,149	3,033	Postsecondary (non-degree)	Associate's degree
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	3,455	4,133	678	19.6%	678	593	1,271	HS diploma or equivalent	Postsecondary (non-degree)
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	1,770	1,936	166	9.4%	166	418	584	HS diploma or equivalent	Postsecondary (non-degree)
49-3051	Motorboat Mechanics and Service Technicians	200	228	28	14.0%	28	40	68	HS diploma or equivalent	HS diploma or equivalent
49-3053	Outdoor Power Equipment and Other Small Engine Mechanics	729	815	86	11.8%	86	147	233	HS diploma or equivalent	Postsecondary (non-degree)
49-3091	Bicycle Repairers	385	464	79	20.5%	79	131	210	HS diploma or equivalent	HS diploma or equivalent
Other Installation, Maintenance, and Repair Occupations		**13,367**	**16,287**	**2,920**	**21.8%**	**2,927**	**2,611**	**5,538**		
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	2,988	3,475	487	16.3%	487	456	943	Postsecondary (non-degree)	Postsecondary (non-degree)
49-9041	Industrial Machinery Mechanics	4,587	6,139	1,552	33.8%	1,552	1,190	2,742	HS diploma or equivalent	Postsecondary (non-degree)
49-9043	Maintenance Workers, Machinery	811	975	164	20.2%	164	130	294	HS diploma or equivalent	HS diploma or equivalent
49-9044	Millwrights	895	1,103	208	23.2%	208	181	389	HS diploma or equivalent	Postsecondary (non-degree)
49-9062	Medical Equipment Repairers	501	581	80	16.0%	80	90	170	Postsecondary (non-degree)	Associate's degree
49-9064	Watch Repairers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	Postsecondary (non-degree)
49-9069	Precision Instrument and Equipment Repairers, All Other	558	644	86	15.4%	86	100	186	Associate's degree	Associate's degree
49-9081	Wind Turbine Service Technicians	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Associate's degree	Associate's degree

STEM Oregon Employment Projections by Detailed SOC, 2014-2024

Oregon Employment Department, Workforce and Economic Research

Standard Occupational Classification Code and Title		2014 Employment	2024 Employment	Employment Change	Percent Change	Growth Openings*	Replacement Openings	Total Openings	Typical Entry Level Education	Competitive Education
49-9092	Commercial Divers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Postsecondary (non-degree)	Postsecondary (non-degree)
49-9095	Manufactured Building and Mobile Home Installers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
49-9099	Installation, Maintenance, and Repair Workers, All Other	2,877	3,221	344	12.0%	344	439	783	HS diploma or equivalent	HS diploma or equivalent
Production Occupations		**20,980**	**23,862**	**2,882**	**13.7%**	**2,993**	**4,649**	**7,642**		
Supervisors of Production Workers		**6,466**	**7,264**	**798**	**12.3%**	**798**	**1,022**	**1,820**		
51-1011	First-Line Supervisors of Production and Operating Workers	6,466	7,264	798	12.3%	798	1,022	1,820	HS diploma or equivalent	Bachelor's degree
Assemblers and Fabricators		**1,615**	**1,789**	**174**	**10.8%**	**174**	**247**	**421**		
51-2023	Electromechanical Equipment Assemblers	444	480	36	8.1%	36	55	91	HS diploma or equivalent	HS diploma or equivalent
51-2041	Structural Metal Fabricators and Fitters	1,171	1,309	138	11.8%	138	192	330	HS diploma or equivalent	Postsecondary (non-degree)
Metal Workers, Plastic Workers and Woodworkers		**9,043**	**10,733**	**1,690**	**18.7%**	**1,693**	**2,306**	**3,999**		
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	2,214	2,891	677	30.6%	677	673	1,350	HS diploma or equivalent	Postsecondary (non-degree)
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	448	597	149	33.3%	149	136	285	Postsecondary (non-degree)	Postsecondary (non-degree)
51-4021	Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic	623	640	17	2.7%	17	153	170	HS diploma or equivalent	HS diploma or equivalent
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	264	263	-1	-0.4%	0	65	65	HS diploma or equivalent	HS diploma or equivalent
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	466	503	37	7.9%	37	81	118	HS diploma or equivalent	HS diploma or equivalent
51-4041	Machinists	3,272	3,933	661	20.2%	661	946	1,607	HS diploma or equivalent	Postsecondary (non-degree)
51-4062	Patternmakers, Metal and Plastic	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
51-4071	Foundry Mold and Coremakers	256	267	11	4.3%	11	38	49	HS diploma or equivalent	HS diploma or equivalent
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	1,036	1,167	131	12.6%	131	180	311	HS diploma or equivalent	HS diploma or equivalent
51-4111	Tool and Die Makers	376	386	10	2.7%	10	19	29	HS diploma or equivalent	Postsecondary (non-degree)
51-7032	Patternmakers, Wood	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
Printing Workers		**479**	**371**	**-108**	**-22.6%**	**0**	**75**	**75**		
51-5111	Prepress Technicians and Workers	479	371	-108	-22.6%	0	75	75	HS diploma or equivalent	Postsecondary (non-degree)
Plant and System Operators		**1,985**	**2,126**	**141**	**7.1%**	**141**	**594**	**735**		
51-8011	Nuclear Power Reactor Operators	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
51-8013	Power Plant Operators	301	308	7	2.3%	7	103	110	Postsecondary (non-degree)	Bachelor's degree
51-8031	Water and Wastewater Treatment Plant and System Operators	1,177	1,272	95	8.1%	95	299	394	Postsecondary (non-degree)	Postsecondary (non-degree)
51-8091	Chemical Plant and System Operators	208	220	12	5.8%	12	79	91	HS diploma or equivalent	Postsecondary (non-degree)

STEM Oregon Employment Projections by Detailed SOC, 2014-2024

Oregon Employment Department, Workforce and Economic Research

Standard Occupational Classification Code and Title		2014 Employment	2024 Employment	Employment Change	Percent Change	Growth Openings*	Replacement Openings	Total Openings	Typical Entry Level Education	Competitive Education
51-8092	Gas Plant Operators	- c -	- c -	- c -	- c -	- c -	- c -	- c -	Bachelor's degree	Master's degree
51-8099	Plant and System Operators, All Other	268	293	25	9.3%	25	101	126	HS diploma or equivalent	Postsecondary (non-degree)
Other Production Occupations		**1,305**	**1,478**	**173**	**13.3%**	**173**	**385**	**558**		
51-9051	Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders	355	382	27	7.6%	27	93	120	HS diploma or equivalent	HS diploma or equivalent
51-9082	Medical Appliance Technicians	144	172	28	19.4%	28	35	63	HS diploma or equivalent	Postsecondary (non-degree)
51-9193	Cooling and Freezing Equipment Operators and Tenders	142	174	32	22.5%	32	29	61	HS diploma or equivalent	HS diploma or equivalent
51-9195	Molders, Shapers, and Casters, Except Metal and Plastic	664	750	86	13.0%	86	228	314	HS diploma or equivalent	HS diploma or equivalent
Transportation and Material Moving Occupations		**2,043**	**2,281**	**238**	**11.6%**	**238**	**587**	**825**		
Air Transportation Workers		**685**	**819**	**134**	**19.6%**	**134**	**167**	**301**		
53-2011	Airline Pilots, Copilots, and Flight Engineers	685	819	134	19.6%	134	167	301	Associate's degree	Bachelor's degree
Water Transportation Workers		**490**	**522**	**32**	**6.5%**	**32**	**165**	**197**		
53-5011	Sailors and Marine Oilers	155	160	5	3.2%	5	40	45	Less than HS	HS diploma or equivalent
53-5021	Captains, Mates, and Pilots of Water Vessels	224	237	13	5.8%	13	87	100	Postsecondary (non-degree)	Postsecondary (non-degree)
53-5022	Motorboat Operators	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	HS diploma or equivalent
53-5031	Ship Engineers	- c -	- c -	- c -	- c -	- c -	- c -	- c -	HS diploma or equivalent	Bachelor's degree
Other Transportation Workers		**392**	**395**	**3**	**0.8%**	**3**	**117**	**120**		
53-6041	Traffic Technicians	66	69	3	4.6%	3	33	36	Postsecondary (non-degree)	Bachelor's degree
53-6051	Transportation Inspectors	326	326	0	0.0%	0	84	84	HS diploma or equivalent	Postsecondary (non-degree)
Material Moving Workers		**476**	**545**	**69**	**14.5%**	**69**	**138**	**207**		
53-7011	Conveyor Operators and Tenders	476	545	69	14.5%	69	138	207	Less than HS	HS diploma or equivalent

Notes:

Occupations are selected according to Brookings Institute's definition of STEM occupation. According to Brookings

All data includes self-employment.

- c - means confidential.

* Occupations with declining employment have zero growth openings.

STEM Employment 2014-2024

STEM Investment Council

June 17, 2016

State of Oregon
Employment Department

Defining a STEM Occupation:
Brookings Institute identified STEM occupations using O*Net Knowledge Scores

* Uses the Department of Labor's O*NET (Occupational Information Network Data Collection Program)
  * Detailed surveys of workers in every occupation to document their job characteristics and knowledge requirements.
* Brookings uses the O*Net Knowledge information to classify occupations based on what workers need to know to perform their jobs.

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Knowledge Categories

* O*NET reports a knowledge score for each occupation across 33 domains.
* Six domains were chosen as representing basic STEM knowledge:
  * three for science (biology, chemistry, and physics),
  * one for technology (computers and electronics),
  * one for engineering (engineering and technology), and
  * one for mathematics

* "What level of knowledge of ENGINEERING AND TECHNOLOGY is needed to perform your current job?"

State of Oregon
Employment Department

Employment estimates and projections

* Based on employer tax records and employer surveys
* Updated every two years
* 2014 employment and projections for 2024 released on June 13, 2016
* About 700 occupational titles in our data
* 286 occupations identified as STEM in new projections data
    - 246 with published employment data
    - 40 with suppressed data

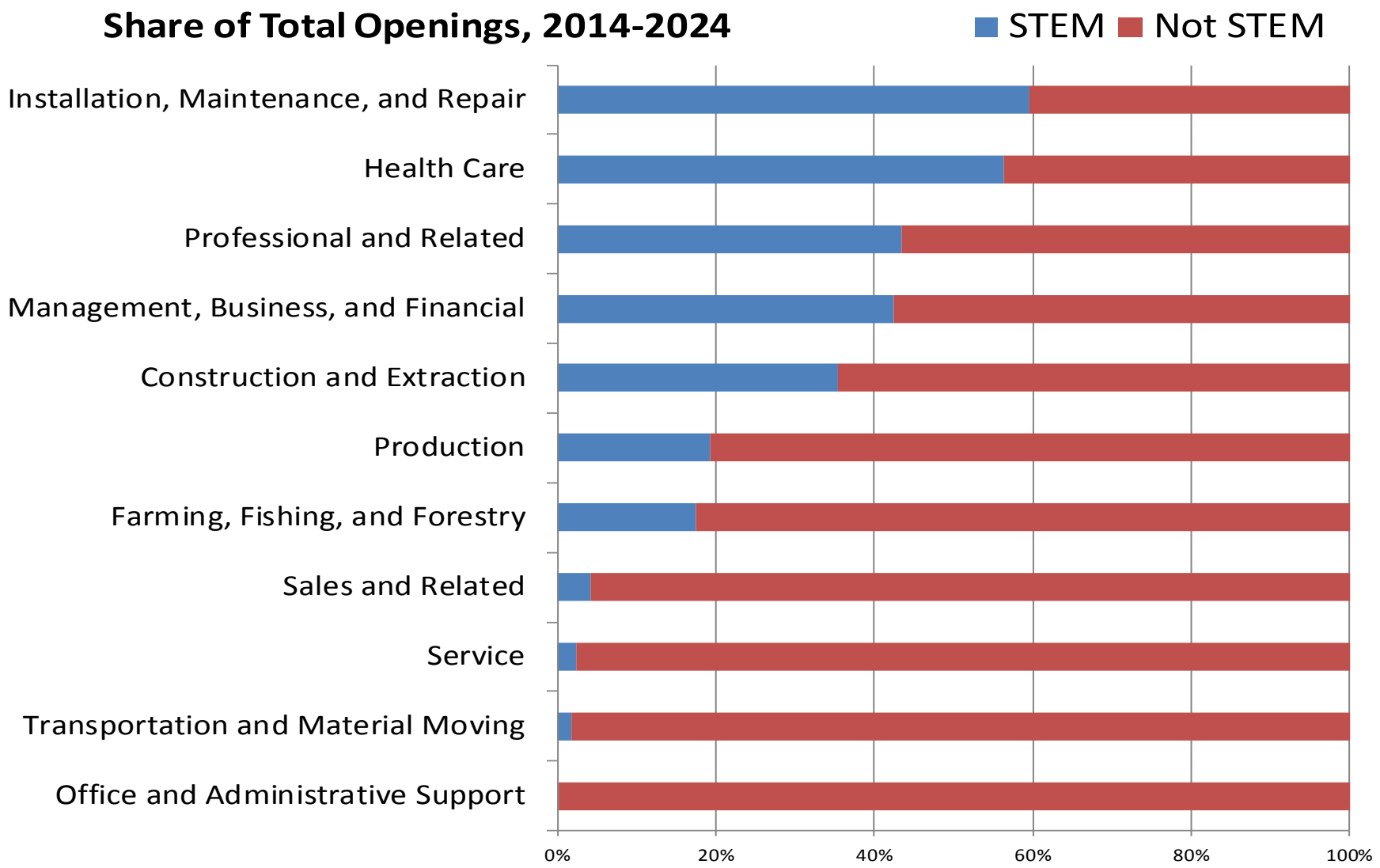
State of Oregon
Employment Department

Ratio of STEM jobs in Oregon projected to increase slightly

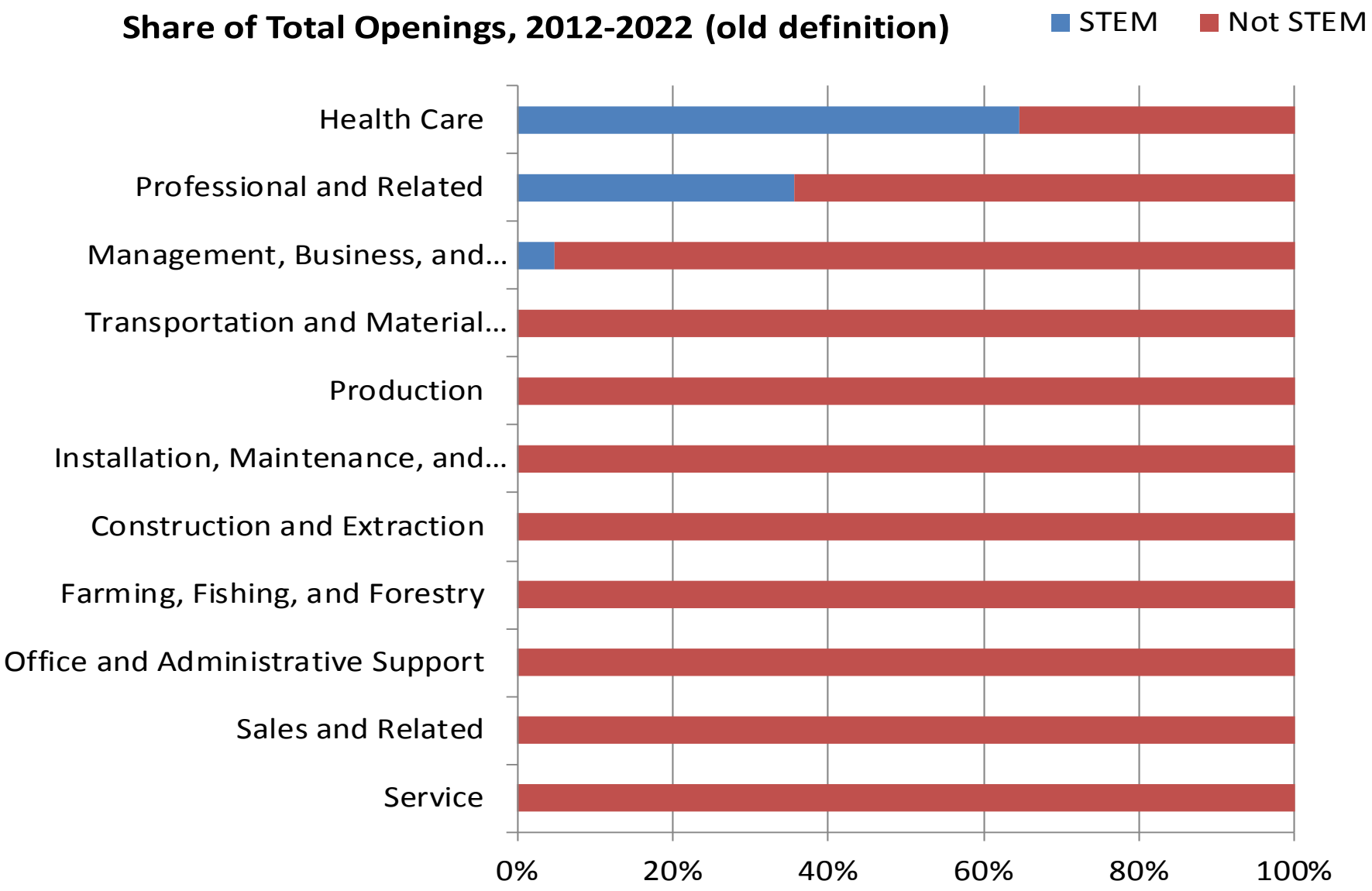
	2014 Employment	2024 Employment	Percent Change	Growth Openings	Replacement Openings	Total Openings
All Occupations	1,870,746	2,130,609	13.9%	263,208	440,074	703,282
STEM Occupations	410,096	475,552	16.0%	65,690	84,688	150,378
Percent STEM	21.9%	22.3%		25.0%	19.2%	21.4%

State of Oregon
Employment Department

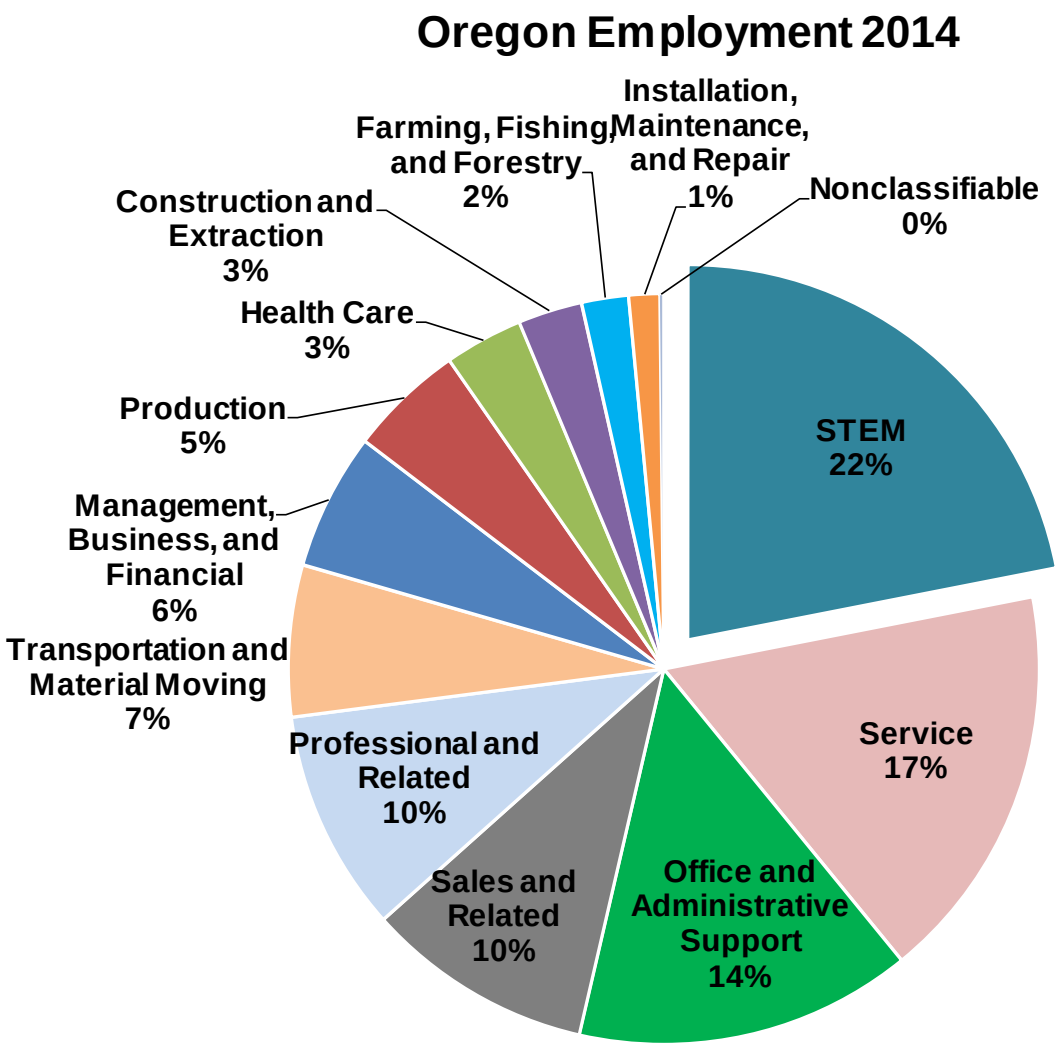
Where to STEM jobs fall?



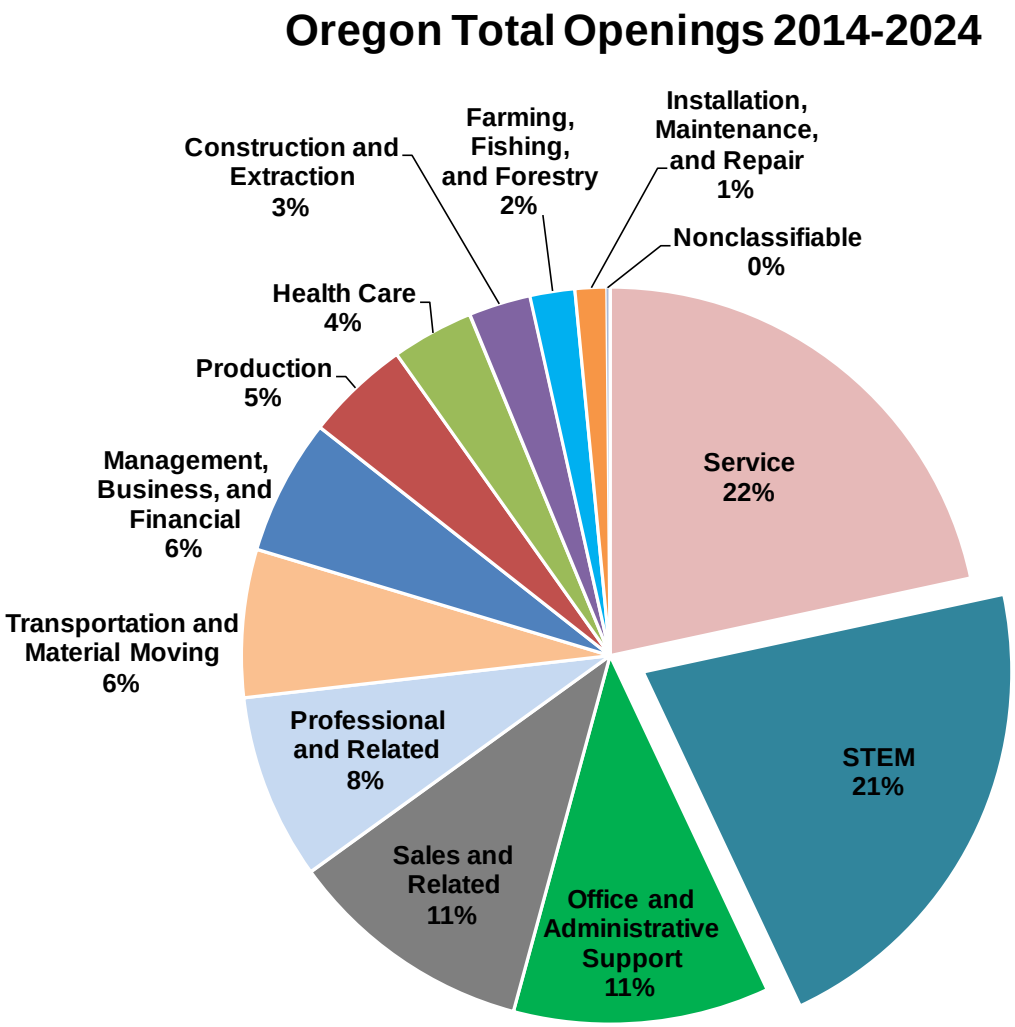
Where did STEM jobs fall – old definition



More than one in five jobs is a STEM job…



… and the same story holds for job openings



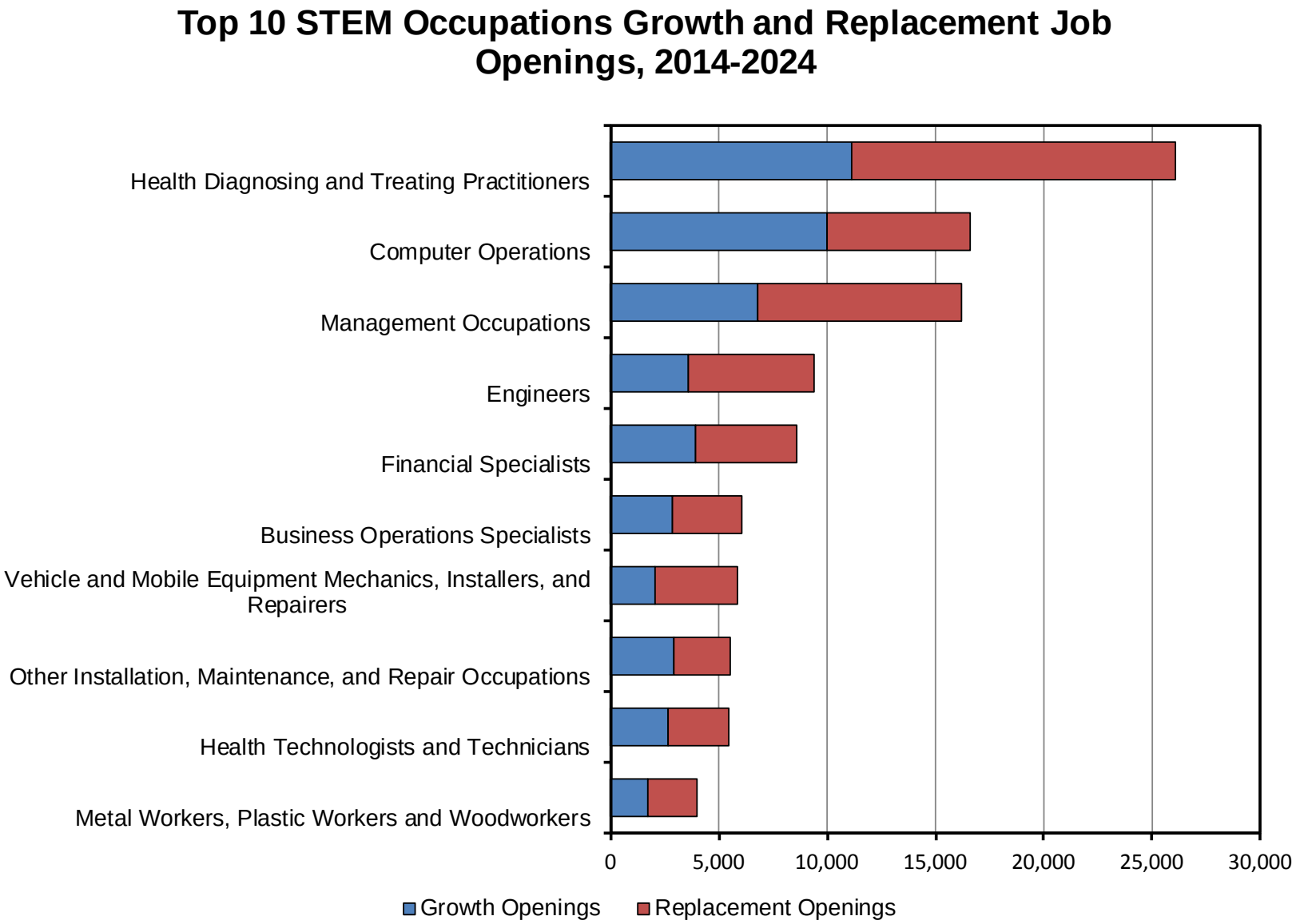
Growth projected in all STEM areas

	2014 Employment	2024 Employment	Employment Change	Percent Change
Health Diagnosing and Treating Practitioners	62,820	73,953	11,133	17.7%
Computer Operations	46,506	56,493	9,987	21.5%
Management Occupations	45,698	52,468	6,770	14.8%
Engineers	21,973	25,593	3,620	16.5%
Financial Specialists	19,491	23,386	3,895	20.0%
Business Operations Specialists	21,412	24,257	2,845	13.3%
Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	15,897	17,953	2,056	12.9%
Other Installation, Maintenance, and Repair Occupations	13,367	16,287	2,920	21.8%
Health Technologists and Technicians	15,616	18,278	2,662	17.0%
Metal Workers, Plastic Workers and Woodworkers	9,043	10,733	1,690	18.7%
Life, Physical, and Social Science Scientists and Related Workers	10,353	11,394	1,041	10.1%
Life, Physical, and Social Science Technicians	8,506	9,243	737	8.7%
Postsecondary Teachers	8,559	9,319	760	8.9%
Supervisors of Production Workers	6,466	7,264	798	12.3%
Electrical and Electronic Equipment Mechanics, Installers, and Repairers	6,442	6,959	517	8.0%
Supervisors of Installation, Maintenance, and Repair Workers	4,414	4,894	480	10.9%
Architects, Surveyors, and Cartographers	3,123	3,740	617	19.8%
Mathematical Science Occupations	1,651	2,250	599	36.3%
Entertainers and Performers, Sports and Related Workers	2,183	2,303	120	5.5%
Plant and System Operators	1,985	2,126	141	7.1%

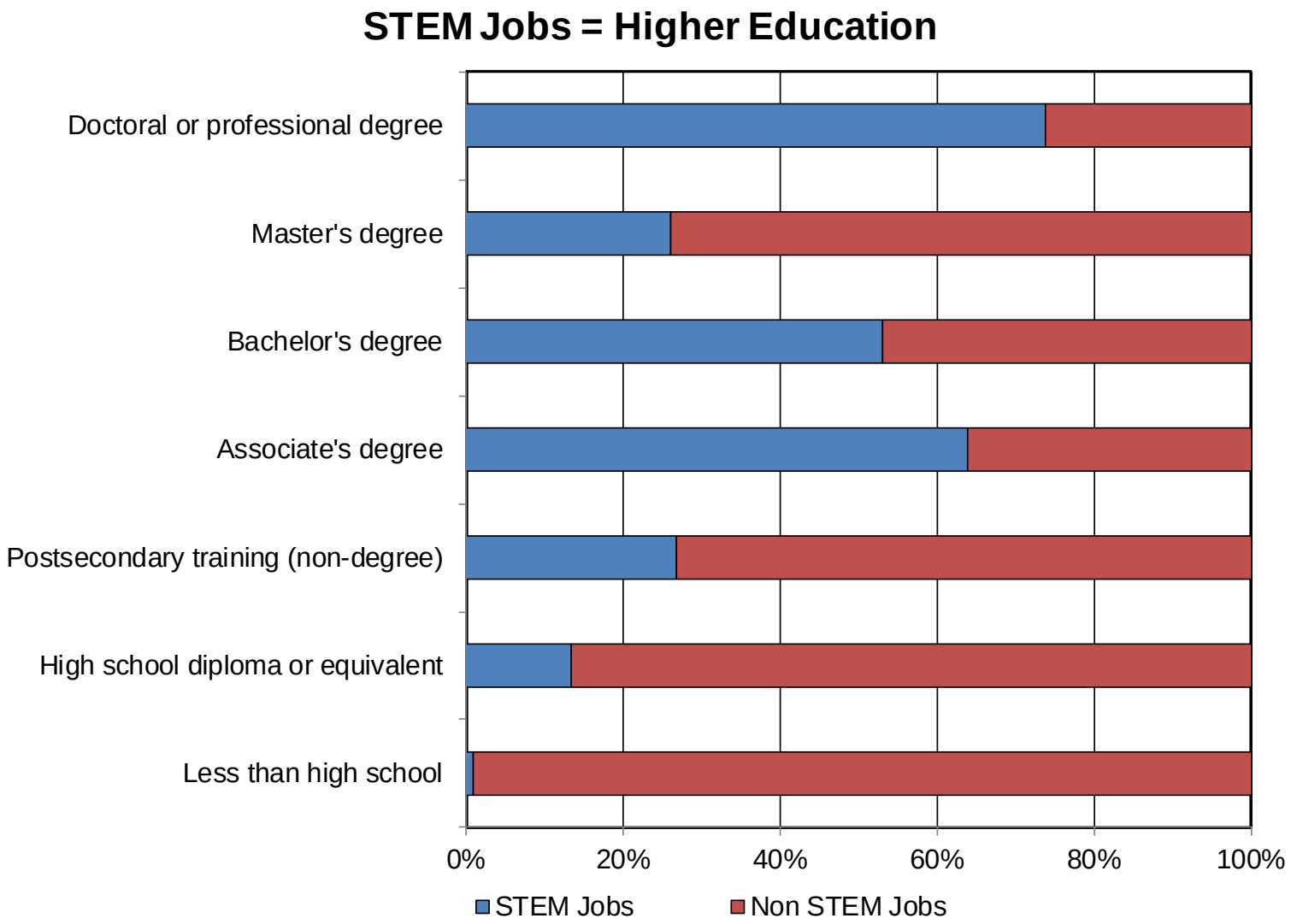
Top demand occupations are varied

	2014 Employment	2024 Employment	Percent Change	Total Openings
Registered Nurses	33,421	38,377	14.8%	12,841
Accountants and Auditors	12,623	15,328	21.4%	6,074
Carpenters	16,528	20,527	24.2%	5,899
Managers, All Other	11,135	12,532	12.6%	3,854
Business Operations Specialists, All Other	14,097	15,733	11.6%	3,316
Software Developers, Applications	7,662	9,844	28.5%	3,277
Automotive Service Technicians and Mechanics	8,028	8,912	11.0%	3,033
Physicians and Surgeons, All Other	6,415	7,464	16.4%	2,776
Industrial Machinery Mechanics	4,587	6,139	33.8%	2,742
Computer User Support Specialists	7,963	9,505	19.4%	2,567
Financial Managers	6,308	7,275	15.3%	2,461
Civil Engineers	4,552	5,414	18.9%	2,206
Computer Systems Analysts	5,112	6,552	28.2%	2,098
Farmers, Ranchers, and Other Agricultural Managers	5,427	6,552	20.7%	2,050
Web Developers	3,408	4,847	42.2%	1,878
Cost Estimators	3,731	4,543	21.8%	1,874
First-Line Supervisors of Production and Operating Workers	6,466	7,264	12.3%	1,820
Industrial Engineers	3,560	4,296	20.7%	1,780
Physical Therapists	2,750	3,778	37.4%	1,765
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	4,628	5,407	16.8%	1,731

Need to replace workers outweighs growth openings in most areas



STEM Jobs = Higher Education



Questions?

Brenda Turner, Occupational Economist
Workforce and Economic Research
Oregon Employment Department
Brenda.P.Turner@oregon.gov
503-947-1233

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State of Oregon
Employment Department

CHIEF EDUCATION OFFICE

Oregon STEM Measures – Baseline Report for STEM Council

June 17, 2016

CHIEF EDUCATION OFFICE

STEM Measures

- Double the percentage of students in 4th and 8th grades who are proficient or advanced in mathematics and science, as determined using a nationally representative assessment of student's knowledge in mathematics and science
- Double the number of students who earn a post-secondary degree requiring proficiency in science, technology, engineering or mathematics.

National Assessment of Educational Progress (NAEP)

Map Legend

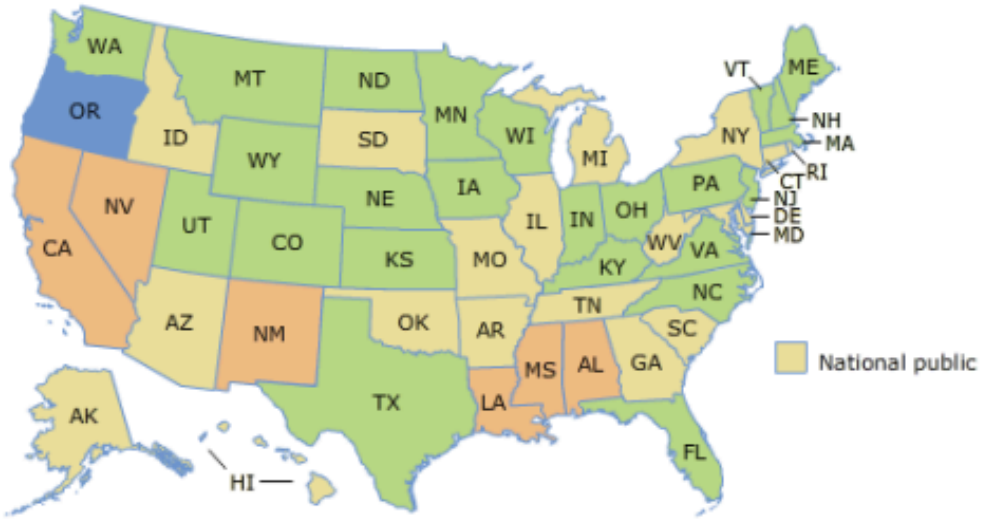
- Focal state/jurisdiction
- Has higher average scale score than focal state/jurisdiction
- Is not significantly different from the focal state/jurisdiction
- Has lower average scale score than focal state/jurisdiction

Data Source: www.nationsreportcard.gov

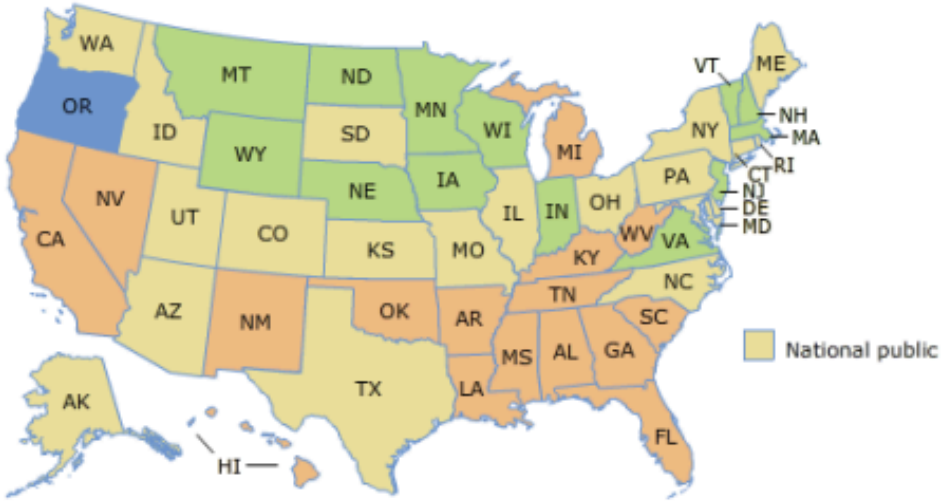
MATH FACTS

At grade 4, Oregon scored at the national average and higher than 6 states.

Math, Grade 4, Average Score Comparison



Math, Grade 8, Average Score Comparison



MATH FACTS

At grade 8, Oregon scored at the national average and higher than 16 states.

CHIEF EDUCATION OFFICE

2015 NAEP Grade 4 Math Results Achievement Levels & Participation Rates		Advanced %	Proficient %	Basic %	Below Basic %
All Students	Oregon	6	31	42	21
	United States	7	32	42	19

2015 NAEP Grade 8 Math Results Achievement Levels & Participation Rates		Advanced %	Proficient %	Basic %	Below Basic %
All Students	Oregon	7	27	39	27
	United States	8	24	38	30

2009 NAEP Grade 4 Science Results Achievement Levels & Participation Rates		Advanced %	Proficient %	Basic %	Below Basic %
All Students	Oregon	1	33	40	27
	United States	1	32	39	29

2011 NAEP Grade 8 Science Results Achievement Levels & Participation Rates		Advanced %	Proficient %	Basic %	Below Basic %
All Students	Oregon	2	34	35	30
	United States	2	29*	34	36*

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2015 NAEP Grade 8 Math Results Achievement Levels & Participation Rates		Advanced %	Proficient %	Basic %	Below Basic %
All Students	Oregon	7	27	39	27
	United States	8	24	38	30
American Indian/Alaska Native (not of Hispanic origin)	Oregon	~	~	~	~
	United States	3	16	38	43
Asian (not of Hispanic origin)	Oregon	29	27	32	13
	United States	26	34	27	12
Black (not of Hispanic origin)	Oregon	~	~	~	~
	United States	1	11	35	53
Hispanic origin	Oregon	2	14	39	45
	United States	3	16	41	40
Native Hawaiian or other Pacific Islander (not of Hispanic origin)	Oregon	~	~	~	~
	United States	6	24	35	35
Two or more races (not of Hispanic origin)	Oregon	8	24	38	30
	United States	9	26	38	28
White (not of Hispanic origin)	Oregon	8	32	39	21
	United States	10*	32	39	19

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2015 NAEP Grade 8 Math Results Achievement Levels & Participation Rates		Advanced %	Proficient %	Basic %	Below Basic %
All Students	Oregon	7	27	39	27
	United States	8	24	38	30
Economically Disadvantaged	Oregon	3	19	41	38
	United States	2	15*	40	42*
English Learners	Oregon	~	~	~	~
	United States	1	5	26	69
Students with Disabilities	Oregon	1	5	23	72
	United States	1	5	22	72
Female	Oregon	8	27	39	26
	United States	7	25	39	29
Male	Oregon	6	26	39	29
	United States	8	24	37	30

STEM Degrees and Certificates

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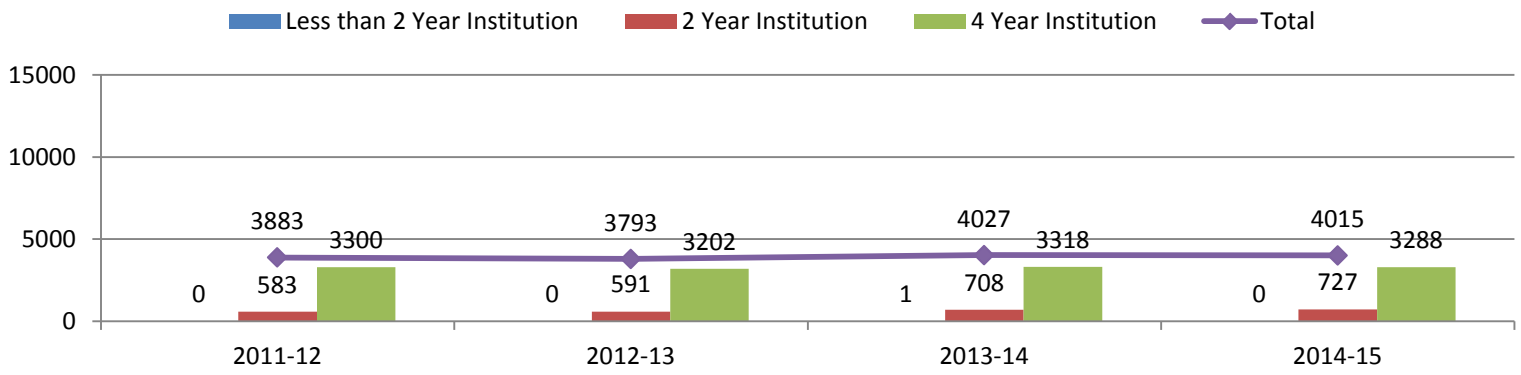
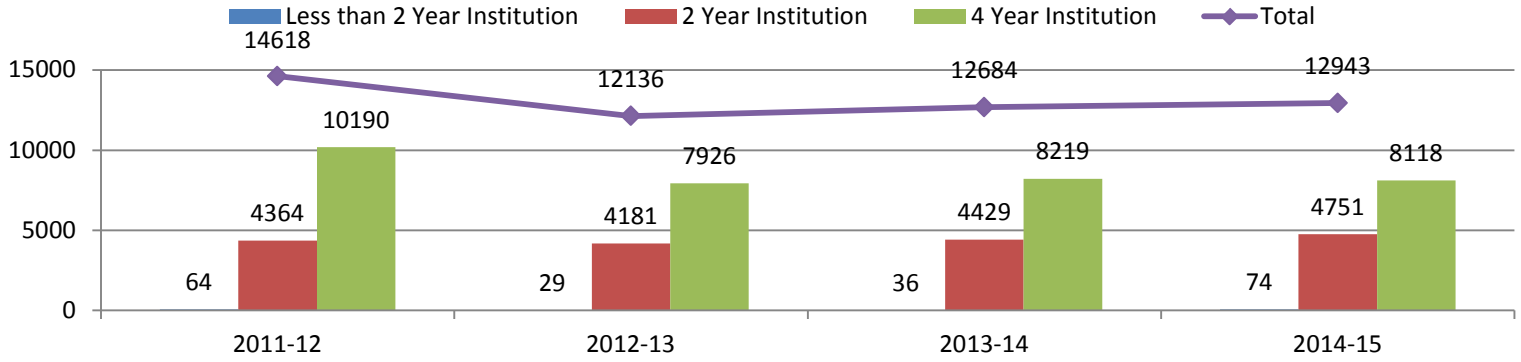
STEM



Non - STEM



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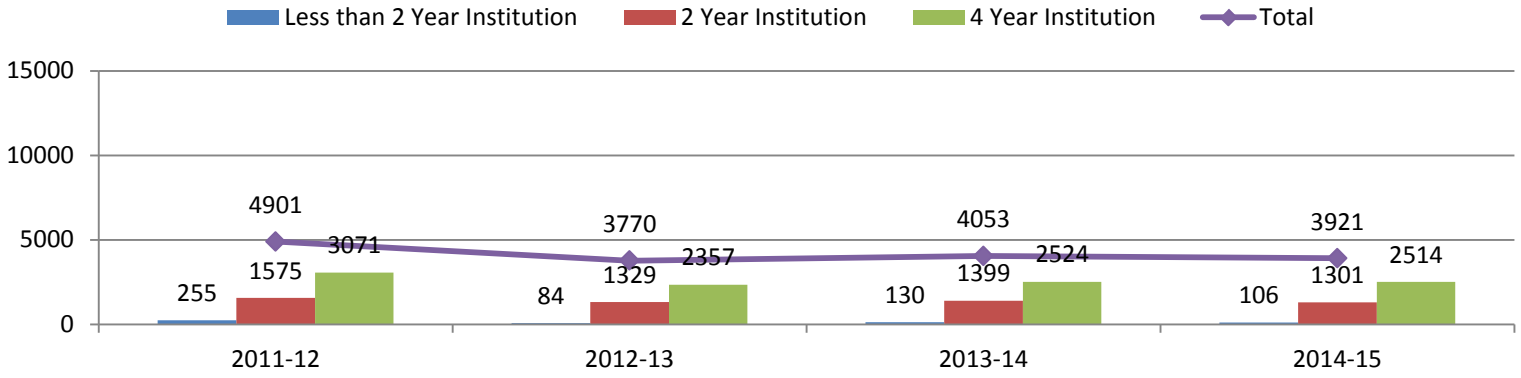

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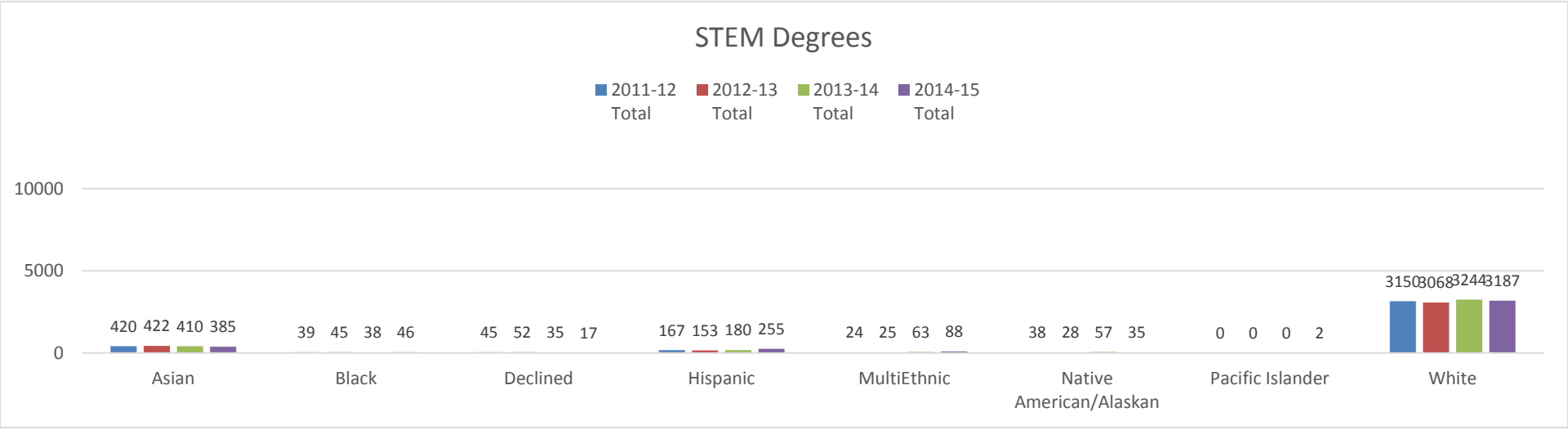

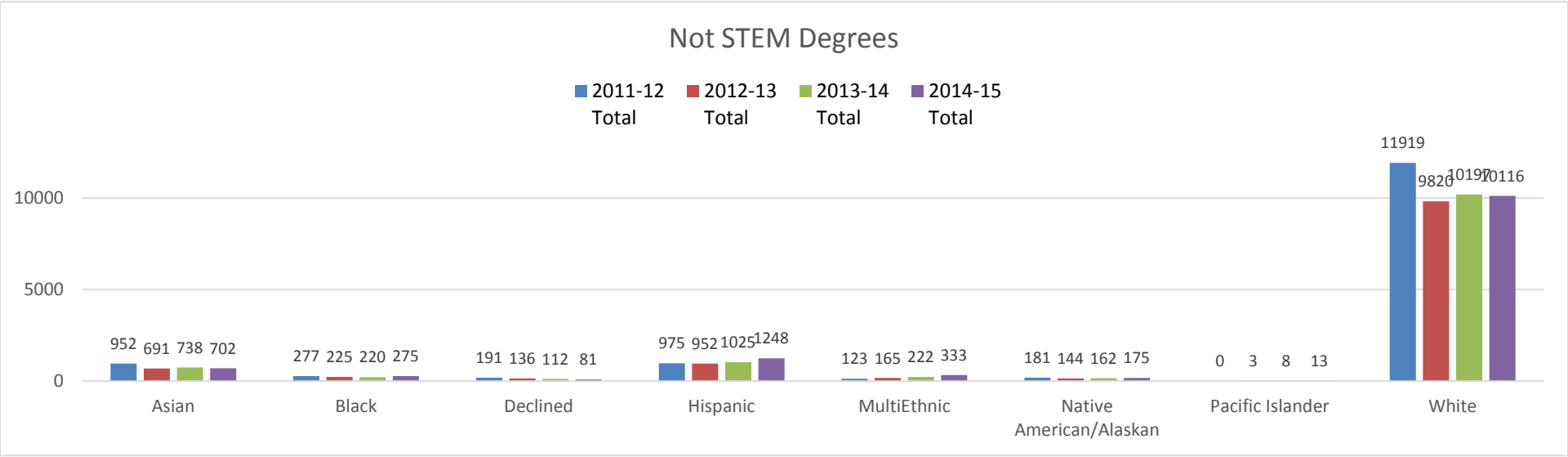

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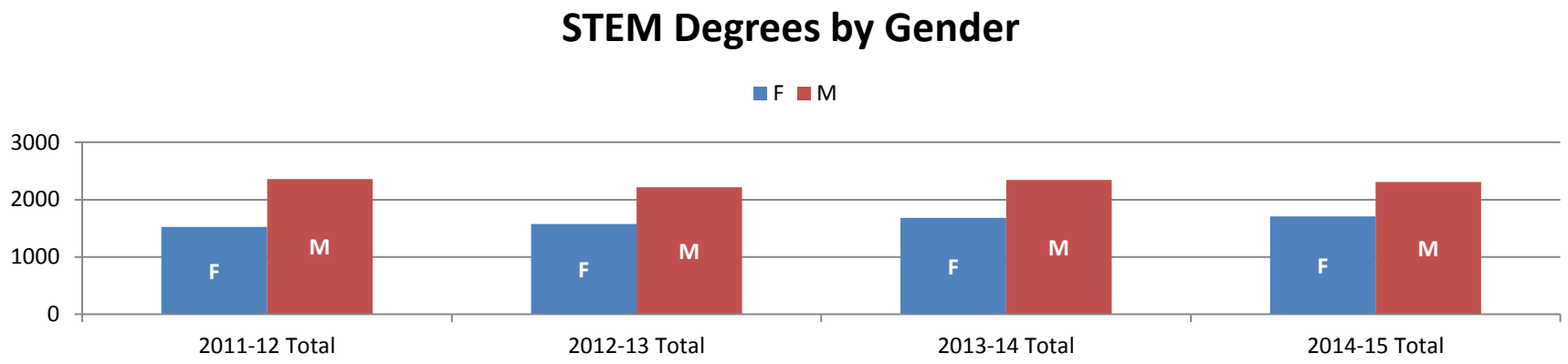

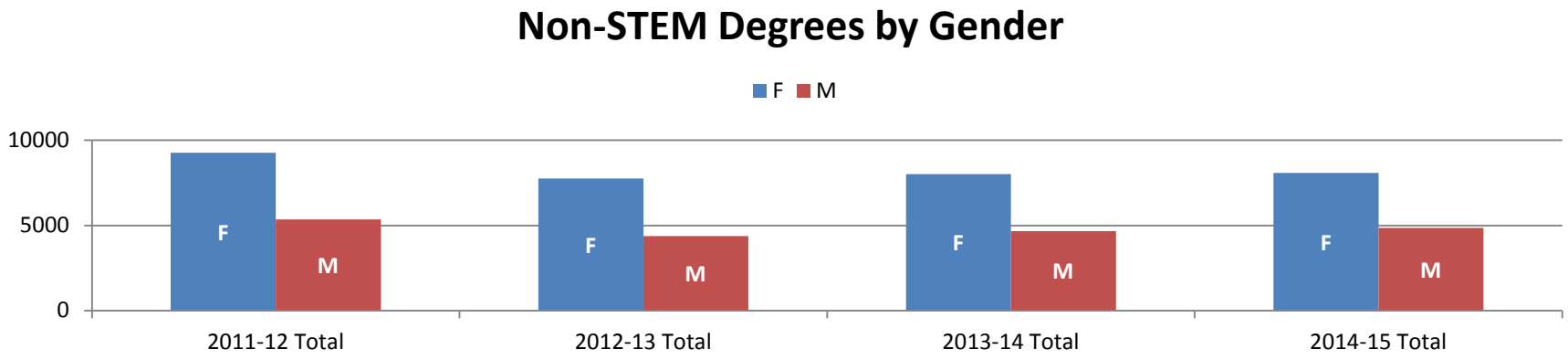

Discussion