Colorado Talent for an Innovation Economy

Powered by STEM

CHARTING A COURSE TO SUCCESS

STEM COLORADO

STEM

The Colorado STEM Education Roadmap

Contents

Why STEM? The Innovation Imperative

Through the leadership of Gov. John Hickenlooper's administration, Colorado is on the path to becoming the most innovative state in the country. Key to achieving this standard of excellence is the leadership of Colorado's private sector. With talent being a key driver of innovation, the public and private sectors in Colorado are focusing on growing local talent to ensure a strong, vibrant economic ecosystem. Strengthening science, technology, engineering, and math (STEM) education and experiences for all students is a critical component to supporting innovation. STEM competencies — often referred to as STEM literacy — prepare students to be critical thinkers, to persevere through failure to achieve success, to communicate and collaborate across real and perceived barriers, and to solve complex and ever-changing problems. (See Appendix A for a detailed description of learning in an innovation age and the importance of STEM education and STEM literacy.) Coloradans with these competencies will drive innovations and fuel our increasingly STEM-based economy.

Colorado's STEM Challenge

Colorado is expected to see above national average growth in STEM occupations over the next decade as well as a rapid increase in the demand for STEM talent across non-STEM professions. However, Colorado's students are not adequately prepared to compete for these jobs. Only 22 percent of 2009 high school graduates are on track to attain postsecondary credentials. And while Colorado does comparatively well in attaining postsecondary STEM degrees, national trends show that only about 50 percent of students who earn STEM credentials actually enter STEM fields. Further, while diversity of people and ideas drives innovation, the STEM pipeline in Colorado is notable for its lack of diversity. Females and Hispanics are vastly underrepresented in STEM occupations, yet females make up nearly half of the overall workforce, and Colorado's Hispanic population is the fastest-growing population in the state. Coupled with an aging STEM workforce (over 16 percent of Colorado STEM workers are nearing retirement) and declining in-migration of talent, it will be increasingly difficult for Colorado to meet current and future skill demand.[i] (See Appendix B for detailed information on national and local STEM trends and needs.)

Even as the economic imperative to improve the STEM competitiveness of our workforce is clear, there is a compelling social imperative as well. STEM education provides the building blocks to prepare students for success in an increasingly technological and complex global community. Financial, medical, environmental, and civic decisions all require higher levels of STEM literacy than ever before. STEM-literate citizens are foundational to a vibrant democracy. And because STEM occupations pay significantly more than non-STEM occupations, they are viewed as a vehicle to upward social mobility.

Colorado has a rich history of vibrant STEM programs and numerous stakeholders interested in STEM education, including economic development, K-12 education, postsecondary education, community-based partners, and workforce development organizations, each investing in different components of the ecosystem. However, the absence of a statewide vision and strategy to coordinate, align, and amplify STEM education and experiences for all students is impeding Colorado's ability to develop a strong local talent pipeline needed for an innovation economy.

Colorado has a unique opportunity to better leverage disparate but complementary assets to collectively mobilize change on behalf of the greater economic ecosystem. In response to this situation, The Colorado Education Initiative (CEI), a Colorado nonprofit focused on advancing K-12 public education through capacity building, innovation, and increased collaboration, facilitated the development of The Colorado STEM Education Roadmap (Roadmap). This plan will advance STEM education in ways that increase opportunities for all students, meet business needs, and attract new companies to the state.

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The vision, theory of change, goals, and strategies that make up the Roadmap were developed through collaboration with hundreds of key stakeholders. (See Appendix C for an overview of some of the stakeholder engagement efforts.)

Vision for STEM Education in Colorado

Colorado will be the most innovative state in the country in growing a local talent pipeline by ensuring all learners have the STEM education and experiences needed to succeed in an innovation economy.

Theory of Change for STEM Education in Colorado

If Colorado ...

- Builds community awareness and support for STEM, and fully coordinates and aligns STEM policies, practices, and partners to increase student interest, participation, and achievement in STEM
- Focuses on ensuring all students achieve STEM literacy
- Reduces its STEM talent and skills gap

... then it will lead the nation in STEM talent development.

GOAL 1:
Develop a state strategy to sustain and advance STEM education

- 1.1: Build a coalition of support
- 1.2: Define STEM
- 1.3: Identify and map existing and effective STEM efforts
- 1.4: Measure progress
- 1.5: Embed a system of continuous improvement

GOAL 2:
Support all students P-12 in achieving STEM literacy

- 2.1: Make STEM in the early grades a Colorado priority
- 2.2: Align STEM efforts to the development of competencies important in an innovation economy
- 2.3: Support STEM-ready educators and learning environments
- 2.4: Make access to STEM resources in rural Colorado a priority

GOAL 3:
Build a local STEM-ready talent pipeline

- 3.1: Focus on dramatically reducing the number of students needing to take remedial math courses
- 3.2: Increase the number and diversity of students entering postsecondary STEM pathways
- 3.3: Align workforce training resources with in-demand STEM skills
- 3.4: Excite and support females to enter STEM fields

These goals and actions are not final — they are not intended to be. They represent current best thinking. A more detailed draft of these goals and strategies as well as the initial work to articulate partner roles and actions is included in Appendix D of this report.

The Power of Public-Private Collaboration in Advancing STEM

Colorado has numerous assets which can and should be leveraged to advance a statewide STEM agenda. In addition to the Gov. John Hickenlooper administration, key public partners include the Colorado Department of Education (CDE), the Colorado Department of Higher Education (CDHE), the Colorado Department of Labor and Employment (CDLE), the Governor's Office of Economic Development (OEDIT), and the Colorado Workforce Development Council (CWDC). Each of these partners is making contributions to support a strong educational and economic ecosystem in Colorado. (See Appendix E for a description of the numerous state efforts supporting a strong educational and economic ecosystem.)

In addition to strong state partners, Colorado has key components of a vibrant STEM ecosystem already in place. The work of developing a comprehensive list of STEM assets is currently underway as a part of implementing the Roadmap. The following resources are examples of important components of the state's STEM ecosystem.

- Colorado has one of the highest per capita concentrations of science, research, and engineering facilities in the nation, with 24 federally funded research labs.
- Colorado is a national leader in sector partnerships and career pathway legislation.
- Colorado is a charter member (one of 20 states) of STEMx, the newly developed multistate STEM network aimed at connecting state STEM networks to generate and share new knowledge, promote clear indicators of quality, develop high-quality tools, and connect innovative policies and practices across the country.
- The Hickenlooper administration is a member of 100Kin10, President Obama's initiative to prepare 100,000 more STEM educators in 10 years.

The problem we face in Colorado in terms of STEM education is not one of inactivity. Colorado has a rich history of vibrant STEM programs and numerous stakeholders interested in STEM education, including economic development, K-12 education, postsecondary education, and workforce development organizations, each investing in different components of the ecosystem. While CEI is committed to working with key partners to increase coordination, alignment, quality, equity, and impact of STEM education efforts in Colorado, it is important to celebrate the important contributions of so many stakeholders currently underway. Numerous examples of these contributions are highlighted in this report.

Get Engaged!

We can't do this without you. Join us to ensure all learners have the STEM education and experiences needed to succeed in an innovation economy. Lend your unique talents, abilities, and resources to this important work.

Learn more at
www.coloradoedinitiative.org/stem

Click on the "Get Engaged" link to become a part of the evolving public-private efforts to advance STEM education in Colorado.

GOAL 1: Develop a state strategy to sustain and advance STEM education in Colorado

Colorado faces many and varied challenges to sustain and advance STEM education. For example, there is no common way to define STEM occupations, which makes it difficult to accurately determine STEM skill demand. Further, quality in STEM education has not been defined, which results in uneven returns on the investment of scarce resources. At the same time, there is no way to measure and demonstrate the impact of various efforts on key indicators in Colorado STEM education, leading to an inability to measure progress over time. Finally, there is a lack of focus on ensuring STEM education efforts are actually relevant to Colorado's economy, which translates into ineffective, out-of-date, and ill-fitting approaches to education and workforce development efforts.

A state strategy to sustain and advance STEM education through coordination, alignment, equity, transparency, and evaluation of impact is crucial to ensuring Colorado develops a local talent pipeline representative of the diversity of Colorado's communities able to meet the needs of an innovation economy. The private sector is advancing key efforts that, if aligned and strategically leveraged, will support the development and implementation of such a strategy.

JPMorgan Chase: Defining Middle-Skill STEM Occupations

There are many definitions of STEM occupations at the federal and state level — with no apparent coherence or rationale. Traditional definitions of STEM occupations are based on titles of occupations rather than the skills required within occupations, and leave out numerous high- and middle-skills occupations that require STEM skills such as medical doctors and advanced manufacturing jobs. Yet, middle-skill STEM jobs are crucial to Colorado's economy and to social upward mobility for low- to moderate-income Coloradans. These jobs make up 50 percent of the nation's STEM jobs and require less than a four-year degree. And these jobs are growing and offer a 10 percent wage premium over occupations requiring similar educational requirements without some STEM knowledge.

With support from JPMorgan Chase, CEI initiated a process to identify STEM occupational definitions that are relevant to and representative of Colorado's economy. CEI collaborated with the Brookings Institute, which developed an occupational definition for STEM. The Brookings methodology and the focus on defining STEM occupations based on STEM skill requirements make the Brookings definition relevant and allow for the development of strategies to close skill gaps that are based on transparently defined skills. As a result of this work, the Colorado Department of Higher Education is producing a report with STEM skill supply and demand projections that use both the traditional and more representative Brookings STEM occupational definitions to better inform strategies that will strengthen Colorado's local talent pipeline.

McKinstry: Building Cross-State STEM Partnerships

McKinstry, a Seattle-based firm offering consulting, construction, and facilities services with offices in Golden, partnered with CEI to convene state and company leaders from Colorado and Washington to share key strategies and tactics for improving STEM education in Colorado. McKinstry CEO Dean Allen was integral to the STEM movement in the state of Washington, helping to found and currently serving as the Board Chair of Washington STEM. Seventeen Colorado leaders, including representatives from the Governor's Office, ULA, Gay & Lesbian Fund for Colorado, and Colorado Technology Association (CTA), traveled to Washington for two days in April to learn about Washington STEM's successes and best practices. Specifically, stakeholders worked collaboratively to develop a cross-state partnership, strategize successful creation and implementation of a state STEM plan, and discuss the role of industry partners in supporting STEM. The meeting greatly increased visibility of Colorado's STEM effort and led to the development of the State STEM Advisory Committee.

Colorado Technology Association: Supporting STEM Education

Continual learning and skill development are essential in a vibrant STEM economy. To meet this challenge, CTA is working to engage employers in meaningful partnerships with education to fill the talent pipeline for Colorado's technology economy. CTA is a statewide organization representing more than 10,000 companies employing over 140,000 workers, as well as 95,000 information technology (IT) professionals across all industries. The association recently formed the Colorado Technology Foundation to catalyze a service-friendly marketplace between employers and educators to amplify and sustain connections that ultimately attract, train, and place more Colorado students into a growing number of technology professions. Focus areas include helping small- to medium-sized businesses open project-based internship opportunities; supporting teachers in their lifelong learning of technology; and engaging companies to host on-site exploration events for students. Concurrently, CTA leads the IT Sector Partnership aligned with the Colorado Workforce Development Center and the Office of Economic Development and International Trade to capture employer needs that will shape educational curriculum and programs to best align with industry needs.

United Launch Alliance: Preparing Students in STEM

United Launch Alliance (ULA) is sparking excitement in STEM education through the Intern Rocket Program. ULA, in partnership with Ball Aerospace, provides valuable hands-on learning experiences for K-12 and college students. In just eight to 10 weeks, participating college interns construct rockets and payloads — onboard instruments and experiments — and quickly gain experience with new design concepts, manufacturing techniques, and launch procedures. Elementary, middle, and high school students work with these college interns, learning basic rocket concepts, payload designs, and payload integration with the rockets.

ULA believes in contributing time, talent, and resources at all levels to support Colorado communities. A key thought partner and funder in advancing the statewide strategy to improve STEM education, ULA is a critical champion in engaging business and industry, with a special emphasis on the aerospace sector, to excite and prepare the workforce of the future. While ULA's contributions are impressive, many more companies will need to commit to this effort to ensure all students are excited and prepared to participate in and lead Colorado's innovation economy.

Learn more at www.coloradoedinitiative.org/stem.

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Mile High United Way: Targeting the Skills Gap

Mile High United Way partners with hundreds of local nonprofits, government agencies, policymakers, and businesses to collectively solve communitywide problems. In a recent effort to organize community efforts and inspire action, Mile High United Way launched Mobilize Mile High, an initiative that identifies shared goals and measures to improve education, economic, and health well-being throughout the community. Mobilize Mile High has hosted two meetings with representatives from the education, nonprofit, and business communities to examine the skills gap that exists between the education system and the local workforce. During these sessions, community leaders identified common language, pinpointed root problems, and developed collective solutions. Additional sessions are planned, culminating in a GradNation Summit in the spring of 2015.

The Colorado Education Initiative: Defining Quality

Colorado employers invest substantial amounts of time, talent, and financial resources to support STEM education. However, their ability to measure the impact of these investments is limited. CEI is convening a work group of company and school leaders to define quality in employer engagement in STEM education. Several companies, including Accenture, Ball Aerospace, Noble Energy, and United Launch Alliance, are joining with educators from Denver Public Schools, Englewood Schools, St. Vrain Valley Schools, and other districts to collaboratively define components of quality public-private partnerships between schools and companies. The work group will produce recommendations for schools and companies to increase the value and impact of partnerships.

Comcast and Comcast Spotlight: Understanding the Importance of STEM

To raise awareness about the need for STEM skills, Comcast and Comcast Spotlight are providing $1 million in financial and in-kind support over three years to develop critical STEM resources and opportunities for Colorado's students. This effort will include developing public service announcements about the importance of STEM to students, companies, and Colorado's innovation economy.

Future Forward Colorado: Raising Awareness of Skill Demand

Colorado companies know quite well that the global economy is constantly evolving and requires vastly different skills from its employees. They also know that to remain competitive, Colorado's schools must prepare high school graduates with the knowledge and problem-solving skills necessary to meet the rising demands of postsecondary education and the 21st century workplace. As a coalition of company leaders, Future Forward Colorado educates the broader, statewide community about this demanding new reality and the critical role that higher expectations, quality, aligned assessments, and STEM education play in ensuring that Colorado's kids are prepared for Colorado's jobs.

Future Forward's goal is to raise awareness and understanding of the real-world skills needed to succeed in today's highly skilled workforce. The coalition, which includes 10 business organizations with thousands of members, was created to show the business community's support of high expectations, transparency, and accountability for students, educators, and schools. To help businesses learn about this issue and what they can do to get involved, the coalition has developed educational materials and resources, including a website, videos, and infographics at www.futureforwardcolorado.org.

GOAL 2: Support all P-12 students in achieving STEM literacy

Increasingly, STEM literacy is a requirement for success in life. Making informed life choices, including health decisions, civic participation, and financial investments, all require consumers to analyze and synthesize vast and various amounts of information. All require a base-level competence in STEM literacy. A 2014 report of the National Network of Business and Industry Associations concludes that included within the skills all employees need, no matter where they work, is the ability to apply knowledge in mathematics, science, technology, and critical thinking.[ii]

Focusing on STEM education in the early grades is critical to achieving STEM literacy. Students begin to identify as being "bad at science" as early as second grade.[iii] Compelling and growing evidence shows that mastering early math concepts is the strongest predictor of future academic success.[iv] Quality science education and STEM experiences allow students to develop numeracy skills by engaging in the world around them while developing science concepts. Yet, in Colorado, the time spent on science in elementary school has decreased from 2.9 hours per week in 1993-1994 to 1.6 hours per week in 2011-2012, landing Colorado in the bottom five states in terms of time spent on science in the early grades.[v]

Students learn science by actively engaging in the practices of science.[vi] While 97 percent of Colorado schools have 8th-grade science labs, only 73 percent of schools with high percentages of minority populations have 8th-grade science labs — one of the starkest disparities in this regard in the country.[vii]

Effective educators are important to student success. And while it is difficult to track the number and availability of STEM-ready educators in Colorado, numerous interviews with district and BOCES (Boards of Cooperative Educational Services) administrators indicate that rural communities often simply do not have access to qualified STEM-ready educators.

STEM education and opportunities are simply not available to far too many Colorado students. Hispanic, female, and rural populations are often underserved or unrepresented in STEM educational opportunities.

Undoubtedly considerable work needs to be done to ensure all students achieve STEM literacy. But the news is not all bad. New and exciting partners are leading the effort to advance STEM education.

LASER: Advancing STEM in the Early Grades

The LASER program, an elementary inquiry-based science program, has decades of evidence demonstrating its effectiveness in increasing student achievement in multiple disciplines for all learners, including English Language Learners. The Blair and Kristin Richardson Foundation is providing seed money and coordinating investments from both nonprofit and for-profit stakeholders that recognize the value and need for a strong, inquiry-based science program. This support will allow 12 schools to participate in the LASER program in Colorado beginning in 2014-2015.

The participating schools in the four-year pilot represent public, private, and charter schools, and a diverse population of students. In the first year, this opportunity will reach about 5,600 students. While this is an ambitious effort, it will reach less than 1 percent of Colorado's nearly 600,000 public K-8 students. That's not enough. Every elementary school student in Colorado deserves a quality STEM education. To reach more students, CEI is working with partners to map existing efforts to embed science in elementary school, better understand the quality of these efforts, target gaps where no efforts exist, and expand support to ensure all students receive quality STEM instruction throughout their elementary years.

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Colorado Legacy Schools: Supporting AP Curriculum

The CEI-administered Legacy Schools program, the Colorado version of the National Math and Science Institute's Advanced Placement (AP) model, is generating high returns in terms of student participation, engagement, and success in rigorous AP course work in Colorado. For example, in their first year of program implementation, the 23 Colorado Legacy Schools demonstrated a:

- 70 percent increase in the number of qualifying scores earned on AP math, science, and English exams.
- 78 percent increase in the number of qualifying scores earned by female students on AP math and science exams.
- 106 percent increase in the number of qualifying scores earned by African American and Latino students on AP math, science, and English exams.
- 118 percent increase in the number of qualifying scores earned on AP science exams.
- 233 percent increase in the number of qualifying scores earned on AP Computer Science Exams in 2013-2014.

This is important because postsecondary remediation drops dramatically as a result of exposure to AP - only 28 percent of students who take just one AP class need remediation compared to over 68 percent remediation rates for students with no AP. Further, students who pass at least one AP exam (as opposed to those who do not) are 31 percent more likely to earn a postsecondary degree.

These statistics are impressive, particularly considering that the Colorado Legacy Schools program is engaging a diverse array of students – many of whom typically do not enter AP courses. Often, however, these students lack the cultural capital needed to navigate complex postsecondary and career options and professional life choices. To address this need, CEI is partnering with Ball Aerospace, Battelle, McKinstry, Thoughtbot, Quick Left, and Xcel Energy, to ensure students have STEM professionals as mentors. These mentor experiences are elevating students' ideas about their own potential.

There are 34 high schools participating in the Legacy Schools AP program impacting 500 teachers and 10,000 students. While this represents a significant increase in traditionally underserved students with access to AP, this number represents a mere 4 percent of Colorado public high school students. Much needs to be done to ensure every student has access to rigorous course work and meaningful mentorships, particularly students who face greater disadvantages and barriers to success.

Gay & Lesbian Fund for Colorado: Expanding STEM Opportunities for All

The opportunity gap created by underserving key segments of the student population, as well as the underrepresented Hispanic and female populations in high-wage, high-demand STEM occupations, is attracting the attention of the Gay & Lesbian Fund for Colorado. As the initial foundation supporting this work, the Gay & Lesbian Fund served as the catalyst for increasing equity and access to high-quality STEM education in ways that increase financial literacy and critical thinking, and prepare traditionally underserved populations for success in an innovation economy.

GOAL 3: Build a local STEM-ready talent pipeline

Improving STEM education is critical to ensuring Colorado is able to meet current and future talent demands. Nationally and locally we see growing gaps between labor market demands and knowledge and competencies that the education system was designed to produce. While there is sufficient evidence to understand this to be true, is it also important to consider why it is true.

Colorado has one of the highest skilled workforces in the country and is expected to experience above national demand for STEM-skilled workers. Yet Coloradans are not prepared to compete for these jobs – a trend commonly called the Colorado Paradox.

Specifically, Colorado is not preparing Coloradans to compete for high-demand, high-wage occupations. Further, there is a lack of diversity in the STEM workforce. While 48 percent of the workforce is female, STEM occupations only employ 23 to 31 percent of females (percentages vary depending on the STEM occupational definition). And while Hispanics make up 16 percent of the workforce, they only hold 6 percent of STEM occupations. Considering that women make up half the population and the Hispanic population is the fastest-growing population in Colorado, these trends do not bode well for meeting the state's future STEM skill demand.

Another fact: Colorado is emerging from the recent economic downturn with impressive resilience, yet key populations of Coloradans still lack the skills to fill in-demand jobs, and many suffer from long bouts of unemployment. Leaving these populations behind will inhibit the state's ability to meet the current and growing demand for skilled labor.

Many Colorado companies, districts, and state partners are pitching in to build a local STEM-ready talent pipeline.

Share your STEM!

Are you already doing great work in STEM? Let us know!

CEI is committed to working with partners to highlight successes, amplify impact, and support continuation of existing effective STEM efforts.

Tell us about your projects, the reach of your efforts, and the impact of your work: https://www.surveymonkey.com/s/P33SBML.

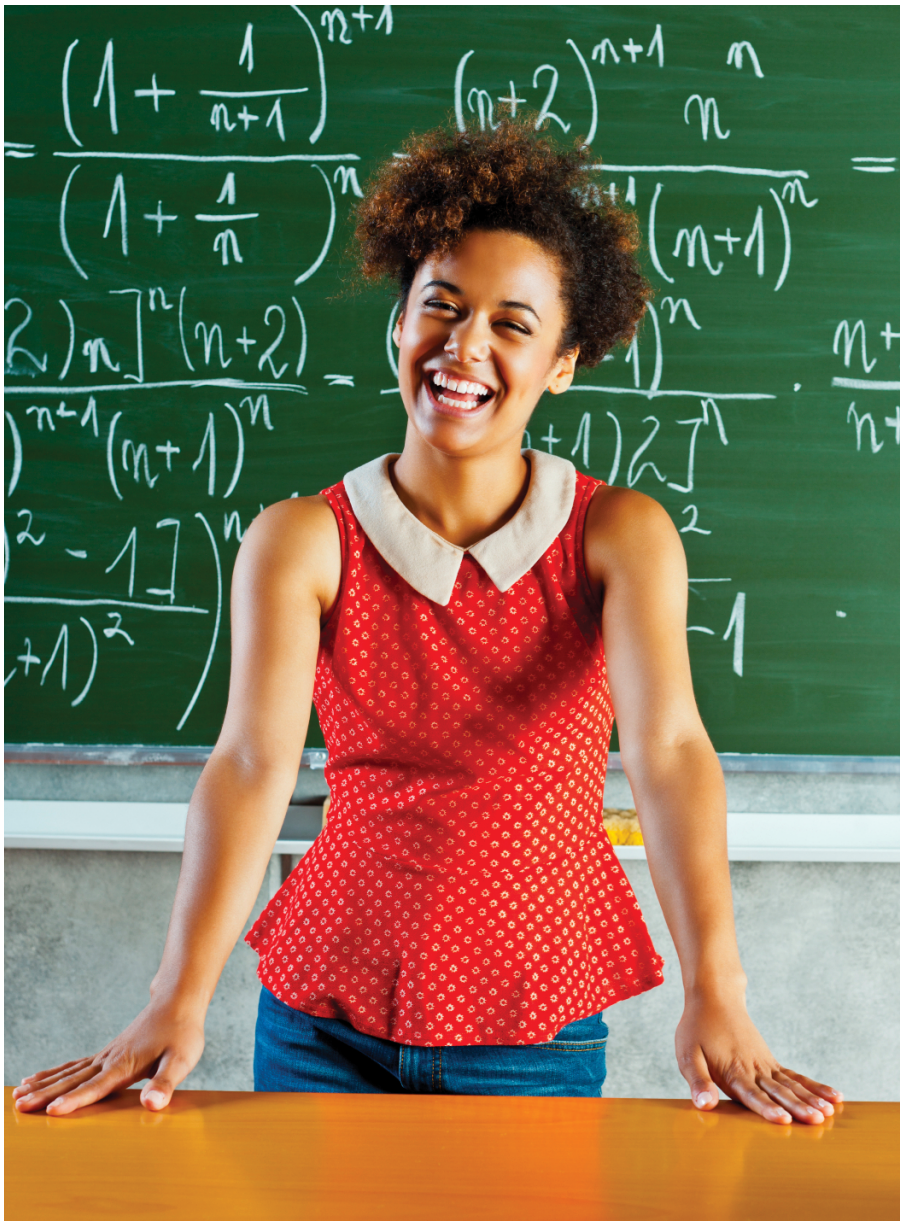
Together, we can achieve great results for Colorado students, our communities, and our economy.

IBM: Supporting District Innovation

IBM partners with St. Vrain Valley School District (SVVSD) to create innovative student programs aligned with industry needs. Among these programs is the Innovation Academy for a Smarter Planet, a two-week camp at IBM where students explore sustainable and innovative solutions to buildings, banking, water, food, and transportation systems. Students work directly with IBM engineers and scientists, University of Colorado professors, Skyline STEM Academy students and other agencies. To date approximately 500 students have participated in the program.

IBM was also instrumental in attracting additional funding for SVVSD by matching 20 percent of the Investing in Innovation and Race to the Top federal grants, resulting in over $20 million in federal dollars to advance STEM education in SVVSD. The grants are supporting efforts to engage students in real- world learning experiences that emphasize connections among school, business, and the global community. The grants also support a STEM elementary school summer program in which over 5,000 students have participated.

The next step in the IBM partnership is for SVVSD to adopt PTECH (Pathways to Technology Opportunities program), a career pathway providing an early college, associate in arts degree that is STEM-skills focused. After completing this two-year college curriculum while in high school, these workforce-ready students will receive mentoring from industry partners and an internship in a STEM-related field.



SeedPaths, DaVita, Ball Corporation, and SpireMedia: Employing Low-Income Youth

SeedPaths teaches young, low-income adults how to develop software during an intensive, eight-week boot camp and then helps them find employment in the IT industry. Of the graduates who sought employment in SeedPaths' first two programs, 89 percent found an opportunity within 90 days of graduating and enjoyed a 460 percent pay increase. SeedPaths also has an IT recruiting and staffing division that helps top-tier companies find top-tier talent and invests all of its profits into its academic division, creating a sustainable business model. The recruiting division also creates direct avenues to employment for its students, which increases the likelihood that graduates will find employment.

In 2014, 30 graduates completed the boot camp and are now employed at DaVita, Ball Corporation, SpireMedia, and a variety of consulting firms.

SeedPaths has a repeatable process for finding, training, certifying, and employing entry-level talent, many of whom have little to no job experience or no formal higher education. (Some even lack a high school diploma or equivalent.)

All low-income youth should have access to this type of opportunity, regardless of their educational track record.

Become a STEM Champion!

STEM Champions are companies, foundations, and private donors contributing financial resources, time, and talent to the implementation of the Roadmap.

Learn more: www.coloradoedinitiative.org/stem.

Colorado Workforce Development Council: Aligning Education and Training to Industry Skill Demand

The Colorado Workforce Development Council is instrumental in engaging cross-sector companies, educators, postsecondary, workforce development, economic development, and various other partners to develop sector partnerships and career pathways. These efforts support local stakeholders in developing the talent pipeline to meet local employer needs and to support economic growth across the state. For more information about this effort, see Appendix E.

Lockheed Martin: Engaging Girls in STEM

In spring 2014, Girls Inc. of Metro Denver launched the Rocket Girls program in partnership with Girls Inc. National and Lockheed Martin. This effort strengthens girls' interest and confidence in pursuing STEM education and careers. Fifty elementary-age girls completed the six-week program, and Lockheed Martin volunteers served as partners and mentors. Program components included a rocket science curriculum, hands-on activities, field trips, and guest speakers. At the end of the program, girls built and launched rockets hundreds of feet in the air at Sloan's Lake in Denver. In addition, two fifth-grade Rocket Girls attended the USA Science & Engineering Festival in Washington, D.C. The result of these efforts? Girls' enthusiasm for and skills in STEM were enhanced through activities that allowed them to explore, ask questions, persist, and solve problems — and view STEM careers as exciting and realistic options for their futures.

CH2M HILL: Supporting STEM Pathways

The Denver School of Science and Technology (DSST) Public Schools transform urban public education by eliminating educational inequity and preparing all students for success in college and the 21st century. Seventy-five percent of students at DSST's nine schools are minority while 65 percent come from low-income households. DSST has operated the highest-performing middle schools and the highest-performing high schools in Denver Public Schools (DPS) for the past three years:

- 100 percent of seniors have been accepted to college seven consecutive years.
- 45 percent of students are choosing STEM majors in college.

Recently, the CH2M HILL Foundation awarded a $100,000 grant to DSST to establish the Higher Education Partnerships for STEM Workforce Development. DSST will use the grant to build a comprehensive pathway for Denver secondary students pursuing STEM careers through open enrollment public charter schools in Denver. At full enrollment, DSST will serve over 6,500 students in 14 schools on seven campuses and will nearly double the number of four-year college-ready DPS graduates by 2023. This new program will bolster support for the 60 percent of DSST seniors who intend to major in STEM. The ultimate goal of this program is to infuse a diverse group of 250 new STEM professionals into the workforce by 2020, many of whom will remain in Colorado as a pipeline of talent for CH2M HILL and other employers reliant on STEM-capable employees.

An impressive goal, and impactful for the DPS students engaged in this program. But more needs to be done to ensure all of Colorado's students, particularly those in rural communities, can engage in these types of opportunities.

Learn more at www.coloradoedinitiative.org/stem.

Making It Happen — Partner Coordination and Alignment

Numerous companies, foundations, and individuals are investing in STEM education — the examples included in this Roadmap are certainly not an exhaustive list. And yet for all the effort and activity, the returns are uncertain and certainly uneven. The students who need STEM education the most — particularly in our rural communities — often don't have access to these resources. Further, trends show that traditionally underserved students are not achieving success in STEM and are vastly underrepresented in STEM degree attainment and STEM occupations in Colorado.

Despite the impressive efforts of the private sector and the numerous contributions of the public sector, Colorado is a long way from ensuring all students have access to the STEM instruction and experiences that will enable them to fully participate in an innovation economy. For this reason, CEI is committing to serve as the backbone organization that will facilitate the development and implementation of the Colorado STEM Education Roadmap. In this role, CEI will work with partners and stakeholders to ensure Colorado becomes the most innovative state in the country. The Roadmap will increase access to STEM opportunities for all and build a local talent pipeline for a thriving innovation economy by:

- *Defining quality* in STEM education in terms of learner, company, and economic outcomes.
- *Aligning scarce resources* to support efforts demonstrating results for Colorado's learners, companies, and economy.
- *Identifying and closing the gaps* in STEM programming and resources.
- *Expanding and amplifying the impact* of effective STEM efforts.

CEI will coordinate and interface with the state STEM Advisory Committee and STEM Champions to ensure the work is on track, meaningful, and sustained over time.

State STEM Advisory Committee — State Guidance and Industry Leadership

The state STEM Advisory Committee includes state and company leaders committed to advising and guiding CEI's efforts to implement the Roadmap. Learn more at www.coloradoedinitiative.org/stem.

STEM Champions

An absence of a common vision to advance a strategic approach to supporting STEM education in Colorado, as well as a lack of financial resources to sustain STEM efforts, have contributed to several false starts in STEM education in Colorado over the last 15 years. STEM Champions are companies, foundations, and individuals dedicated to ensuring all Colorado students have access to quality STEM education and experiences, which will directly support the development of a local talent pipeline. In addition to supporting Roadmap implementation through financial commitments, STEM Champions dedicate their time and talent by serving on the state STEM Advisory Committee and as STEM Mentors, working directly with Colorado students.

The Path Ahead

Colorado is poised to deliver on the promise to prepare all of our students for an innovation economy. Over the weeks, months, and years ahead, CEI will work with key partners across the state to advance implementation of the Roadmap. Join the numerous partners coming together to achieve success for all of Colorado's learners and to build a talent pipeline for Colorado's innovation economy. View www.coloradoedinitiative.org/stem to share your STEM, contribute financial resources, view the Roadmap appendices, or mentor students - get involved and start making a difference today.

View the Roadmap appendices at www.coloradoedinitiative.org/resources/stemroadmap

STEM Advisory Committee

Committee Members

- Lt. Governor Joe Garcia, Executive Director, Colorado Department of Higher Education
- Chris Chavez, Director, Government Affairs and Corporate Citizenship, United Launch Alliance
- Lesley Dahlkemper, Vice President of Strategic Engagement and Communications, The Colorado Education Initiative
- Ellen Golombek, Executive Director, Office of Labor and Employment
- Robert Hammond, Commissioner of Education, Colorado Department of Education
- Michelle Hadwiger, Executive Director, Colorado Innovation Network
- Ray Johnson, Corporate Citizenship and Corporate Affairs Manager, IBM
- Tim Jones, President and Founder, ISSAC Corp.
- Leslie Larocque, Director of Business Development, Rocky Mountain Region, McKinstry
- Ken Lund, Executive Director, Office of Economic Development and International Trade
- Katie Monahan, Field Marketing Manager, Comcast Spotlight Colorado
- Wendy Nkomo, COO, VP Industry Affairs, Colorado Technology Association
- Amber Ptak, Director of Education Programs, Gill Foundation's Gay and Lesbian Fund for Colorado
- Matt Smith, Vice-President of Engineering and IT, United Launch Alliance
- Stephanie Steffens, Director, Colorado Workforce Development Council

Staff

- Angela Baber, Director, Next Generation Learning – STEM, The Colorado Education Initiative
- Scott Wasserman, Chief of Staff, Lt. Governor Joe Garcia

Appendix A: Benefits of Colorado STEM Literacy and STEM Education

"We've arranged a global civilization in which most crucial elements — transportation, communications, and all other industries: agriculture, medicine, education, entertainment, and protecting the environment — profoundly depend on science and technology.

"We have also arranged things so that almost no one understands science and technology. This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces."

– Carl Sagan

Science, technology, engineering, and math **(STEM) literacy** is a foundational skill that matters for all careers, not just STEM-related fields or jobs. STEM education prepares students who are critical and creative thinkers, innovators, problem-solvers, collaborators, team workers, and strong communicators. Put simply, students who are prepared to tackle the challenges of a fiercely competitive and constantly changing 21st century economy.

STEM education is one of the most effective tools we have to prepare students as the next generation workforce and community. Why? At its foundation, STEM education is focused on building critical and creative thinking and analysis skills by addressing how students view and experience the world around them. Strong STEM teaching and learning opportunities rest on inquiry-, technology-, and project-based learning activities and lessons that are tied to the real world; a diverse, interdisciplinary curriculum where activities in one class complement those in other classes; robust partnerships that reach beyond the walls of the classroom to include higher education and business; and strong school leaders who understand the "STEM approach" and fully use it to transform the delivery of education.

Further, the K-12 sector has had competing education reforms that have prevented a focus on STEM education from being a clear priority. However, those reforms were necessary to ready the K-12 field for this work.

Learning in an Innovation Age

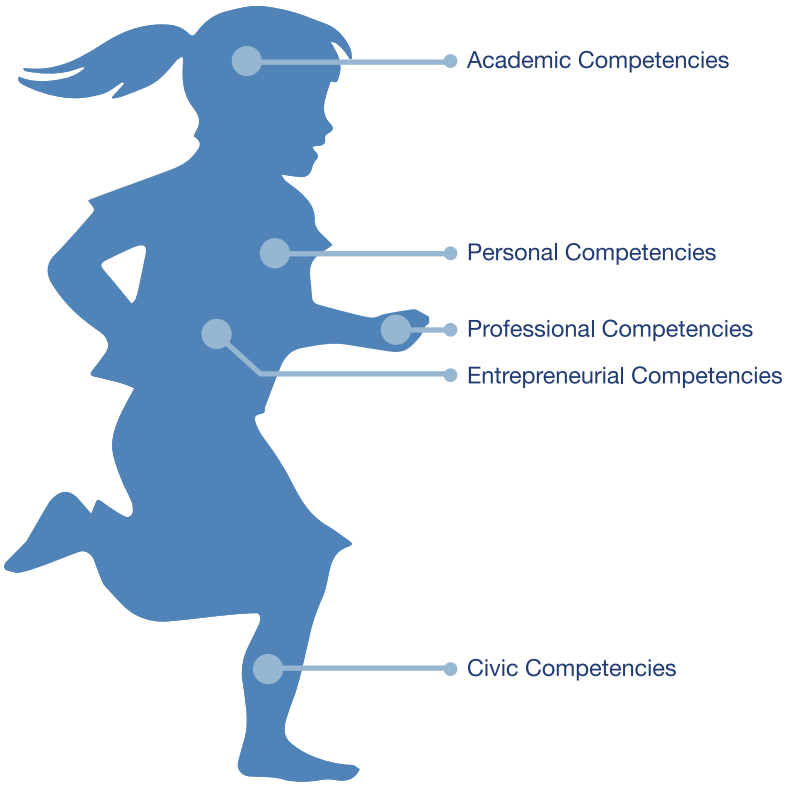
The current Colorado and American school systems were designed and built to align with the social and economic demands of the early 20th century. While demands have changed drastically, we know our systems and metrics have not followed suit.

	20th Century	*21st Century*
Job Market Characteristics	• Predictable roles • Established professional pathways seen in both blue and white collar career paths • College success gave a person nearly guaranteed access to a professional career and financial stability	• Rapidly evolving context and expanding number of roles • Career pathways need to be generated by the individual • Postsecondary training is universally needed; college is one part but not the only part of that equation; college is not a guarantee of professional work and financial stability

More specifically, schools were built in the 20th century to identify which role a student was headed for, and help build capacity for success in that role. Education reform has tried to ensure all students were given the instruction and support they needed to be on track for college, resulting in a significant emphasis on things known to be predictive of college success: graduating with strong literacy and math skills, taking algebra in eighth grade, and being "on grade level" in reading in third grade.

	Current View of How to Promote Uniform Readiness	*21st Century Competencies Required to Maximize Unique Potential of All Students*
Desired Student Outcomes	Linear and predictable progress toward readiness • Reading on grade level in 3rd grade • Taking algebra in 8th grade • Passing an adequate proportion of a prescribed sequence of courses in a prescribed amount of time • ACT scores that indicate an ability to go to college and persist	Annual attention to increased development of each of the following characteristics: • **Academic competencies** including: math skills, literacy skills, and critical thinking skills • **Professional competencies** including: ability to manage time, collaborate with others, and independently learn new things • **Entrepreneurial competencies** including: the ability to manage professional risk, make interesting connections, and learn from failure • **Deep knowledge of self (personal competencies)** that students can use to make good decisions that play on their strengths • **Drive to contribute (civic competencies)** as a member of the community and the workforce

Our system, driven by a moral imperative to ensure equity of postsecondary and career opportunity, has intentionally maintained a narrow focus on these indicators, sometimes at the expense of other skills. While still important, it is clear that these same indicators are no longer sufficient for young adults to enter an unpredictable and quickly evolving job market, which is increasingly driven by and dependent upon innovation and the intellectual capital of our people. Successful leaders in STEM-dependent industries identify that their ideal employee has strengths in all five competency areas. Successful STEM teachers, meanwhile, know that their best lessons develop their students in more of these ways than simply the narrow academic content. Informed by research, employers, parents, educators, and policymakers, we believe the competencies required for the next generation of learners to become self-sufficient and successful 21st century adults represent a significant change in direction from the current focus.



To meet the demands of Colorado's STEM industry — and help students achieve the benefits of a STEM career — we must build students' academic competencies without minimizing or crowding out learning experiences that develop a wide range of critical skills. This will require that classrooms and other learning environments be designed to look and feel very different from most classrooms in Colorado today: personalized; competency-based; co-created; safe and healthy; and time-, talent-, and technology-enabled.

This context is at the heart of better understanding how Colorado organizations can work together differently to leverage existing assets to change the current trajectory and build a strong pipeline of students who exit Colorado's education systems passionate and prepared to pursue leadership in STEM.

Simply stated, we will not meet workforce demand for STEM-skilled workers unless we do a better job of preparing and exciting the next generation of learners, particularly underrepresented populations, to enter STEM fields. This includes taking better advantage of quality STEM education and experiences that effectively foster student competencies to expand student access and inform educator practice in STEM. Additionally, we must cultivate stronger partnerships and more flexible systems that foster student competencies required for 21st century success, and that learn how to evolve as the labor market changes.

Appendix B: Current Economic and Social Context for STEM

This section highlights national and Colorado-specific STEM (science, technology, engineering, and math) trends that do not bode well for the health of Colorado's economy and the vitality of our communities.

National Trends

- **1 in 18 jobs are STEM** — In 2010, there were 7.6 million STEM workers in the nation, equating to about one in 18 workers.
- **STEM jobs are growing** — From 2000 to 2010, STEM job growth (7.9 percent) in the United States was three times as fast as employment growth in non-STEM jobs (2.6 percent),[viii] and STEM is second only to healthcare as the fastest-growing occupational category in the economy.[x] STEM occupations will grow by 17 percent compared with slightly less than 10 percent growth for non-STEM occupations.[xi]
- **STEM demand is growing in non-STEM jobs** — Demand for STEM talent is growing even faster outside of traditional STEM occupations (e.g., increased demand to understand science and technology in agriculture).[xii]

Colorado Trends

- **Advanced industries 30 percent of Colorado's economy** — Advanced industries comprise engineering and research and development intensive companies that share common workforce skills in STEM, accounting for 30 percent of the state's economy (520,300 high-paying jobs and hundreds of thousands of ancillary jobs).[xiii]
- **4th in job growth** — In 2014, Colorado ranked fourth in job growth out of all states.[xiv]
- **Growing demand for STEM skills** — The demand for STEM skills in Colorado is on the rise, with numerous projections showing that Colorado will see above national average growth in STEM occupations. The demand for STEM-literate workers is also increasing across non-STEM occupations.[xv]
- **Not growing our own** — Colorado ranks high (top 5) among states with adults with postsecondary degrees; it ranks low (bottom 20 percent) among states with high school students who go on to earn college degrees.
- **Leaving 75 percent of students behind** — Colorado has a leaking educational pipeline, producing 22 postsecondary degree holders for every 100 students who enter a Colorado high school.[xvi]
- **Talent in-migration down** — In-migration of talent is down and is projected to continue declining, making the need to grow our own talent increasingly urgent.[xvii]

Diversity Trends

- **Rural opportunity gap** — 68 percent of students are located in the 15 largest school districts in the state; the remaining 32 percent are spread over 110 small districts with vast and sprawling geographies, limited access to STEM companies and/or educational resources, though the demand for STEM skills in industries important to these communities is increasing (e.g., scientific and technological demand in agriculture).[xviii]
- **STEM jobs pay more** — STEM jobs requiring the most education have a 14 percent wage premium compared to non-STEM jobs with similar education requirements.[xix]
- **Lower unemployment in STEM** — According to the nonpartisan advocacy group Change the Equation, from 2009 to 2011 some 1.49 STEM jobs were posted online in Colorado for every one unemployed STEM worker in the state.
- **Nearly 50 percent underrepresentation of females in STEM** — Females make up 48 percent of Colorado's workforce, yet hold only 23 percent of the STEM occupations in the state.
- **Nearly 40 percent underrepresentation of Hispanics in STEM** — While Hispanics and Latinos make up 16 percent of Colorado's workforce, they hold only 6 percent of STEM occupations.
- **30 percent underrepresentation of Hispanics in STEM credential attainment** — In 2012 in Colorado, 24 percent of college degrees and certificates were earned by Hispanics and Latinos, but only 7 percent of STEM degrees were earned by them.
- **Hispanics comprise fastest-growing segment of population** — Hispanics and Latinos (1) were the fastest-growing population in Colorado, accounting for 41.2 percent of Colorado's growth since the 2000 Census; (2) are the largest minority group in Colorado; and (3) comprise 31 percent of the total population 18 and under in Colorado.
- **Persistent achievement gap** — While Colorado performs relatively well on key STEM indicators such as postsecondary degree attainment in STEM (above national average) and K-12 math and science achievement (top 25 percent of states), the achievement gap in Colorado is persistent and wide (bottom 25 percent of states).

Appendix C: Roadmap Development and Stakeholder Engagement Process

The development and implementation of The Colorado STEM Education Roadmap is a three-year-long process that began in March 2013. This effort is funded through the generous support of the Gill Foundation's Gay & Lesbian Fund for Colorado, the United Launch Alliance, and JPMorgan Chase. This effort builds on the work of Gov. John Hickenlooper's Education Leadership Council's STEM committee's work to develop a state plan to advance science, technology, engineering, and math (STEM) education.

Over the last year, The Colorado Education Initiative (CEI) has worked to engage Coloradans in developing a shared vision for advancing STEM education. During this period, a committee of stakeholders from the Colorado Department of Education (CDE); the Colorado Department of Higher Education (CDHE); the Colorado Community College System (CCCS); the Colorado Department of Labor and Employment (CDLE); the Colorado Workforce Development Council (CWDC); the Office of Economic Development and International Trade (OEDIT); and other industries, universities, and foundations met monthly to guide this work. This committee presented the Roadmap and gathered feedback through:

- Four in-person feedback sessions and three Web meetings that engaged 170 cross-sector, cross-region stakeholders.
- Three economic development regional partner meetings in La Junta, Limon, and Dillon.
- One Colorado Technology Association and two Colorado Space Coalition meetings.
- Meetings with CCCS presidents and vice presidents.
- Numerous education convenings, including the Colorado Association of School Boards (CASB) annual winter conference.
- Meetings with numerous community-based organizations, institutions of higher education, and educators to solicit input.
- Posting the plan online to collect additional feedback via an online survey.
- Presentations at CWDC meetings.
- Presentation to the Governor's Education Leadership Council and its STEM Committee.

This significant engagement effort was critical to ensure that the Roadmap is a plan for Colorado developed by Coloradans. Specific feedback is summarized in an addendum to this report.

Appendix D: Detailed Goals, Strategies, and Actions

The Colorado STEM Education Roadmap focuses on three goals, each with specific actions, and identifies short- and long-term outcomes of this work. These goals, developed in partnership with numerous stakeholders (a description of the stakeholder engagement process is included in Appendix C), are aligned to and in support of the vision and theory of change for STEM education.

Vision for STEM Education in Colorado

Colorado will be the most innovative state in the country in growing a local talent pipeline by ensuring all learners have the STEM education and experiences needed to succeed in an innovation economy.

Theory of Change for STEM Education in Colorado

If Colorado …

- Builds community awareness and support for STEM, and fully coordinates and aligns STEM policies, practices, and partners to increase student interest, participation, and achievement in STEM
- Focuses on ensuring all students achieve STEM literacy as a component of postsecondary and care readiness
- Reduces its STEM talent and skills gap

… then it will lead the nation in STEM talent development.

- Goal 1: Develop a state strategy to sustain and advance STEM education in Colorado.
- Goal 2: Support all P-12 students in achieving STEM literacy.
- Goal 3: Build a local STEM-ready talent pipeline.

GOAL 1:
Develop a state strategy to sustain and advance STEM education

There are many and varied challenges to sustaining and advancing STEM education in Colorado, including:

- No common vision to advance, or financial resources to support, a strategic approach to supporting STEM education in Colorado, which has contributed to several false starts in STEM education in Colorado over the last 15 years.
- No common definitions for STEM occupations and credentials, which has led to an inability to determine STEM credential production, STEM skill demand, and current and projected shortfalls accurately.
- No definition of quality in STEM education, which has led to variations in quality, confusion regarding the intent of STEM education efforts, and uneven returns on the investment of scarce resources.
- No tool to measure and demonstrate how STEM efforts in Colorado are impacting key indicators of STEM education, which has led to an inability to measure progress over time.
- A lack of focus on ensuring STEM education efforts are actually relevant to Colorado's economy, which has led to ineffective, out-of-date, and ill-fitting approaches to education workforce development efforts.

The following strategies and associated actions address these challenges.

Strategies	Action(s)	Lead(s)	Timeline
1.1: Build a coalition of support	**1.1.a:** Develop a plan for Colorado to coordinate, align, evaluate, and celebrate STEM efforts to ensure all Coloradans have access to the STEM experiences needed to succeed in an innovation economy	CEI-led in collaboration with CDE, CDHE, the Office of the Lt. Governor, CDLE, CWDC, foundations, companies, K-12 and postsecondary educators, students, community-based organizations	*Underway with a release date of August 27, 2014*
	1.1.b: Raise awareness about STEM's role in addressing the opportunity gap among students	CEI, CCCS, NAPE, CoCo STEM, Colorado MESA	*Underway 2013-2015*
	1.1.c: Establish a state STEM advisory committee to inform the development and implementation of STEM work	Lt. Governor Garcia	*Established May 2014*
	1.1.d: Leverage and connect existing networks at the national, state, regional, and local level to communicate STEM priorities and activities across key constituencies	STEM-X, 100Kin10 partners, Colorado STEM Network, CTA, Blueprint regional partners, sector partnerships, Mile High United Way, regional workforce centers, BOCES, community colleges	*Ongoing*
	1.1.e: Develop a mechanism for cross-agency alignment of STEM efforts across agencies and related efforts (e.g., career pathways, sector partnerships, Scholarship Pipeline Project)	CWDC	*Established Education and Training Committee in December 2013*
	1.1.f: Develop effective messages grounded in values for target audiences that explain what STEM is, why it matters for students and Colorado's workforce, and what stakeholders can do to help	CEI, STEM Champions, Future Forward, Colorado Technology Association	*Underway as of May 2014*

Strategies	Action(s)	Lead(s)	Timeline
1.1: Build a coalition of support	**1.1.g:** Create a recognizable brand identity for Colorado STEM work	CEI, Gill Foundation, Comcast, broad community of stakeholdersCEI, CCCS, NAPE, CoCo STEM, Colorado MESA	*Underway as of June 2014*
	1.1.h: Launch a public-private partnership of STEM Champions to support implementation of the Roadmap with the goal of raising $5 million over a three-year period	CEI in partnership with funding partners — STEM Champions — and state and local partners	*Underway with a launch date of August 27, 2014*
1.2: Define STEM	1.2.a: Identify a definition of STEM occupations based on skill requirements	CEI, CWDC, CCCS, OEDIT, CDHE	*Accomplished 2014*
	1.2.b: Define K-12 STEM competencies	CEI, CDE	*Underway 2014-2015*
	1.2.c: Use common, transparent STEM occupational definition(s), degree production, demand, and projected demand consistently	CDE, CDHE, CDLE, OEDIT, CWDC	*In Progress January 2015*
	1.2.d: Develop resources that show connections between STEM competencies and educator evaluation requirements, graduation guidelines, and content standards	Districts, education nonprofit associations and partners (coordinated by CEI in partnership with CDE)	*2014-2015*
	1.2.e: Incentivize IHEs to develop degree specifications for STEM based on revised STEM occupational definition(s)	CDHE and IHEs, STEM Champions	*2015-2016*

Strategies	Action(s)	Lead(s)	Timeline
1.3: Identify and map existing and effective STEM efforts	**1.3.a:** Define attributes of quality and effectiveness for STEM education efforts (e.g., STEM schools, teacher PD, internships, employer engagement, STEM in the early grades, etc.)	CEI (in collaboration with university research partners, existing STEM programs, practitioners, students, companies)	*Underway 2014-2015*
	1.3.b: Map existing STEM assets across the state	CEI, Civic Canopy, regional partners	*2014-2015*
	1.3.c: Build a STEM Works Colorado database to showcase effective programs in the state	Change the Equation, Colorado Succeeds, Mile High United Way	*2014-2015*
	1.3.d: Develop an online portal to showcase existing STEM programs and identify gaps across Colorado	TBD	*2015-2016*
1.4: Measure progress	**1.4.a:** Identify key STEM data indicators and build a STEM data dashboard to track indicators over time	CCCS, NAPE, STEM Data Consortium (CDE, CDHE, CEI, ACT, etc.)	*Underway and to be released in summer 2014*
	1.4.b: Use data dashboard to evaluate progress in meeting STEM targets on a biannual basis	TBD	*Biannually 2014-2024*
	1.4.c: Ensure supply and demand data are available publically	CDHE, CDLE, CWDC	*Established via 2014 Jobs Skills Report; STEM skills report under development*
1.5: Embed a system of continuous improvement	**1.5.a:** Update the Roadmap annually, including progress reports and monitoring of impact	CEI	*First quarter annually*

Strategies	Action(s)	Lead(s)	Timeline
1.5: Embed a system of continuous improvement	**1.5.b:** Track STEM data indicators and reported progress biannually to set policy priorities, make midcourse corrections, and decide future priorities	CSTEM Advisory Committee	*Second and fourth quarters annually*
	1.5.c: Report progress publically	COIN, CEI	*2013 COIN Index reported STEM skill shortage, highlighted Roadmap; 2014 COIN Summit release of Roadmap; 2015 COIN Summit report on progress*
	1.5.d: Ensure two-way communication between Colorado companies who employ STEM-skilled professionals and key education stakeholders to continue to align education with Colorado industry talent needs	CWDC, CEI, CTA, Colorado Succeeds	*Ongoing*

10-Year Outcome

State and local community stakeholders understand, support expansion of, and sustain effective STEM education efforts across Colorado, and all students have access to effective STEM education and experiences.

Year 1 and Year 3 Benchmarks

If we are successful in this work, these are the benchmarks we expect to reach in one and three years:

Year 1 (2015):

- Colorado STEM occupational definitions are transparent.
- Colorado companies and educators collaboratively define essential skills.
- CEI raises $600,000 to build the infrastructure to support and sustain the STEM work in Colorado.
- Nonprofit, state agency, practitioner, and other community partners engage in the implementation of the Roadmap.
- Colorado has a STEM identity aligned to the state's talent and innovation agenda.

Year 3 (2017):

- Colorado reports using data- and research-based strategies to advance STEM education and measure impact of efforts.
- Local public-private partnerships to support STEM education develop organically.
- A living asset map of effective STEM efforts is available online and is a tool for funders to make investment decisions.
- $2.5 million in public-private support is raised to support and expand effective STEM efforts across Colorado.

GOAL 2:
Support all students P-12 in achieving STEM literacy

The Need

Increasingly, STEM literacy is a requirement for success in life. Making informed life choices including health decisions, civic participation, and financial investments, all require the ability to analyze and synthesize vast and various amounts of information. All require a base-level competence in science, technology, engineering, and math — referred to within this work as STEM literacy, or competencies for an innovation economy. Further, a 2014 report of the National Network of Business and Industry Associations concludes that included within the skills all employees need, no matter where they work, are the ability to apply knowledge in mathematics, science, technology, and critical thinking.[xx]

Colorado face several challenges in ensuring all students achieve STEM literacy, including the following:

- A focus on STEM in the early grades is critically important to achieving STEM literacy. Students begin to identify as being "bad at science" as early as second grade.[xxi] Further, compelling and growing evidence show that mastery of early math concepts is the strongest predictor of future academic success.[xxii] Quality science education and STEM experiences allow for students to develop numeracy skills through engaging in the world around them while developing science concepts. Yet, in Colorado, the time spent on science in elementary school has decreased from 2.9 hours per week in 1993-1994 to 1.6 hours per week in 2011-2012, landing Colorado in the bottom five states in terms of time spent on science in the early grades.[xxiii]
- Currently, academic competencies are the only measures of student achievement that matter in education. This is out of sync with the competencies needed in an innovation economy and falls short of the types of competencies employers agree all employees need.[xxiv]
- Students learn science by actively engaging in the practices of science.[xxv] While 97 percent of Colorado schools have eighth-grade science labs, only 73 percent of schools with high percentages of minority populations have eighth-grade science labs — one of the starkest disparities in this regard in the country.[xxvi] Further, effective educators are important to student success. Yet, though it is difficult to track the number and availability of STEM-ready educators in Colorado, numerous interviews with district and BOCES administrators indicate that rural communities often simply do not have access to qualified STEM-ready educators.

The following strategies and associated actions address these challenges.

Strategies	Action(s)	Lead(s)	Timeline
2.1: Make STEM in the early grades a Colorado priority	**2.1.a:** Increase the time spent on science in the early grades	TBD	*TBD*
	2.1.b: Embed a focus on early numeracy in state, district, and local literacy efforts	State, districts, schools, education nonprofits, early childhood advocates, STEM Champions	*Align with graduation guideline requirements*
	2.1.c: Support the expansion of effective STEM efforts in elementary schools across Colorado with a particular focus on traditionally underserved populations	State, districts, schools, STEM Champions *Example:* LASER There are 12 schools participating in the Colorado LASER Initiative. The participating schools represent public, private, and charter schools and a diverse population of students.	*In 2014-2015, LASER is in 15 schools, impacting 154 teachers and 5,611 students*
2.2: Align STEM efforts to the development of competencies important in an innovation economy	**2.2.a:** Develop measures to assess development of professional, entrepreneurial, personal, and civic competencies	PAIREN, CDE, CEI, additional project partners	*Underway*
	2.2.b: Dramatically expand access to rigorous, relevant college preparatory courses	CEI, NMSI, state, districts, schools, STEM Champions *Example:* Colorado Legacy Schools thirty high schools are participating in the Legacy Schools AP Program, impacting 500 teachers and 10,000 students.	*Colorado Legacy Schools ongoing since 2011-2012*
	2.2.c: Expand students access to excellent STEM experiences	University, company, museum, community-based organizations, schools	*Ongoing*

Strategies	Action(s)	Lead(s)	Timeline
	2.2.d: Develop graduation guideline requirements that support the development of STEM literacy and competencies for an innovation economy	CDE, CEI, CEA, CASE, CASB, school boards, business leaders, postsecondary institutions, administrators, educators	*2015-2016*
2.3: Support STEM-ready educators and learning environments	**2.3.a:** Identify the essential competencies Colorado educators need to prepare P-12 students for an innovation economy	UNC, CDHE, CDE, IHEs, CEA	*UNC STEM Teacher Symposium in 2014; work needs to continue in 2014-2015*
	2.3.b: Invest resources to ensure all students have access to necessary STEM materials	State	*2014-2015*
	2.3.c: Expand public-private partnerships in ways that increase student exposure to real-world problems and learning environments	CEI, companies, schools, Colorado Succeeds, Mile High United Way	*2014-2017*
2.4: Make access to STEM resources in rural Colorado a priority	**2.4.1:** Map rural community assets and needs in developing STEM competencies	BOCES, community colleges, local chambers, employers, schools	*Initiate in 2014*
	2.4.2: Expand STEM grants and resources to rural communities	Funders, CEI, state	*Initiate in 2014*
	2.4.3: Provide targeted STEM professional development and STEM externships to teachers in rural communities	CEI, funders, technical assistance providers, BOCES, companies	*Initiate in 2015*

10-Year Outcome

All Colorado students graduate high school with the competencies to succeed in an innovation economy.

Year 1 and Year 3 Benchmarks

If we are successful in this work, these are the benchmarks we expect to reach in one and three years:

Year 1 (2015):

- Colorado commits financial resources to expand effective STEM efforts P-12 across Colorado.
- STEM efforts begin to demonstrate student development of academic, professional, entrepreneurial, civic, and professional competencies.
- Competencies that educators need to prepare students for an innovation economy are well-defined and are embedded within a number of IHE performance plans.
- The availability of STEM-ready educators is understood.

Year 3 (2017):

- Colorado districts develop graduation guidelines aligned to competencies important to an innovation economy.
- There are no disparities in access to STEM learning environments (e.g., science labs).
- Progress is being made on tracking and ensuring every P-12 student has access to STEM-ready educators.

GOAL 3:
Build a local STEM-ready talent pipeline

Colorado has one of the highest skilled workforces in the country. Further, Colorado is expected to experience above national average demand for STEM-skilled workers. Yet, Coloradans are not prepared to compete for these jobs — a trend commonly referred to as the Colorado Paradox.

Key trends that reinforce the Colorado Paradox include the following:

- Colorado is not preparing Coloradans to compete for high-demand, high-wage occupations. Further, there is a lack of diversity in the STEM workforce. While 48 percent of the workforce is made up of females, STEM occupations only employ 23 to 31 percent of females (percentages vary depending on the STEM occupational definition), and while Hispanics make up 16 percent of the workforce, they only hold 6 percent of STEM occupations. Considering that women make up half the population, and the Hispanic population is the fastest growing population in Colorado, these trends do not bode well for Colorado in terms of meeting future STEM skill demand.
- While Colorado is emerging from the recent economic downturn with impressive resilience, key populations of Coloradans still lack the skills to fill in-demand jobs, and many suffer from long bouts of unemployment. Leaving these populations behind will inhibit the state's ability to meet the current and growing demand for skilled labor.

The following strategies and associated actions address these challenges.

Strategies	Action(s)	Lead(s)	Timeline
3.1: Focus on dramatically reducing the number of students needing to take remedial math courses	**3.1.a:** Provide P-12 educators targeted professional development aligned to new math content standards	Funders, CDE, districts, schools, teachers, administrators	*Ongoing*
	3.1.b: Use data to target students needing remediation early and offer wraparound supports	Schools, districts	*Ongoing*
	3.1.c: Expand access to bridge programs to offer students needing remediation rapid and flexible remediation courses the summer in advance of postsecondary entrance	Postsecondary institutions, high schools, state partners	*Begin tracking in 2015*

Strategies	Action(s)	Lead(s)	Timeline
3.2: Increase the number and diversity of students entering postsecondary STEM pathways	**3.2.a:** Build data portfolios to map academic performance to labor and economic demand to set local priorities to address skill gaps	CEI, OEDIT, regional partners	*Underway— regional site visits to discuss local STEM assets and needs initiated in 2013; data portfolios and priorities for the 14 regions to be complete in 2015*
	3.2.b: Expand career pathways for low- to moderate-income youth to develop skills in middle-skill STEM growth sectors	Community colleges, CTE programs, employers, districts *Examples:* St. Vrain interest in adopting PTECH, the Aurora Lights Career Pathway model, DPS Youth Career Connect STEM Pathway model	*Underway – need to set targets for 1, 3, and 10 years*
	3.2.c: Expand internship and mentorship opportunities for underrepresented populations with a focus on female, Hispanic, and socioeconomically disadvantaged youth	CEI, STEM Champions, CTA, members of the Effective Employer Engagement work group, Colorado Succeeds, Mile High United Way	*Underway – need to set targets for 1, 3, and 10 years*
	3.2.d: Provide scholarships and wraparound supports to incentivize low-income, underrepresented students to enter the highest growth STEM occupations in Colorado	Scholarship Pipeline Project Fund	*Initiate in 2015*
	3.2.e: Seek ways of incentivizing IHEs to improve their performance in meeting industry demand	CDHE, IHEs	*Initiate in 2014*
3.3: Align workforce training resources with in-demand STEM skills	**3.3.a:** Develop a strategy to engage long-term unemployed workers in STEM within the Governor's long-term unemployed initiative	CDLE	*Underway*

Strategies	Action(s)	Lead(s)	Timeline
	3.3.b: Develop a strategy to re-engage disengaged and at-risk youth in STEM skill development programs	CEI, Donnell-Kay Foundation, Accenture, JPMorgan Chase, SeedPaths, CCCS, additional partners	*2014-2015*
	3.3.c: Launch an employer-led pledge to employ target populations	Governor, companies across key and advanced industries, CTA, CWDC, Accenture, additional partners	*2014-2015*
3.4: Excite and support females to enter STEM fields	**3.4.a:** Expand mentorship opportunities to girls in STEM P-12	STEM mentor programs, STEM Champions, Colorado employers, schools	*Initiate tracking of existing efforts in 2014*
	3.4.b: Develop STEM learning environments that engage females and STEM in inquiry	Postsecondary institutions, schools, funders	*Underway*
	3.4.c: Work with postsecondary institutions to focus on increasing female participation in STEM	Postsecondary institutions, NAPE, CCCS	*Underway*

10-Year Outcome

Colorado adults and students have the technical skills to compete for Colorado jobs.

Year 1 and Year 3 Benchmarks

If we are successful in this work, these are the benchmarks we expect to reach in one and three years:

Year 1 (2015):

- Colorado economic development regions make decisions to invest in talent development activities based on regional supply and demand data portfolios.
- More students have access to career pathways that lead to employment in in-demand occupations.
- IHEs include STEM performance indicators aligned to talent demand in performance plans.
- Scholarship Pipeline Project Fund invests in STEM occupations in alignment with Colorado labor market demand.

Year 3 (2017):

- Regions of the state begin to attract new companies and employers as an outcome of increased talent supply.
- Increasing percentages of students, particularly under-represented populations, attain in-demand education and training and are employed in growth occupations with upward salary mobility.
- Colorado reports a marked decrease in the underrepresentation of females and Hispanics in STEM degree paths and in STEM occupations.

Appendix E: Building on a Strong Foundation of Public-Sector Efforts

A focus on advancing science, technology, engineering, and math (STEM) education is not new to Colorado. The Colorado STEM Education Roadmap builds on a series of strategic and bold moves over the past few years in P-12 education, postsecondary education, workforce development, economic development, and local efforts.

P-12 Education Goals and Assets

The Colorado Department of Education (CDE) is a key partner in advancing education in Colorado. The mission of CDE is to ensure that all students are prepared for success in society, work, and life by providing excellent leadership, service, and support to schools, districts, and communities across the state. The department has four overarching goals that are focused on supporting students through every step of their schooling.

- **Start strong:** Every student starts strong with a solid foundation in grades preschool-3.
- **Read by third grade:** Every student reads by the end of third grade.
- **Meet or exceed standards**: Every student meets or exceeds standards.
- **Graduate ready:** Every student graduates ready for college and careers.

These goals, supported by over five years of systemic reforms, have readied classrooms across Colorado for a pivot toward robust STEM experiences. Specifically, three categories of specific initiatives allow for STEM to be deeply supported across the state: new academic standards, a focus on teacher effectiveness, and a set of postsecondary readiness initiatives aimed at modernizing learning and increasing outcomes at the middle and high school levels.

Colorado Academic Standards

In 2008, the Colorado Legislature passed Senate Bill 08-212, Colorado's Achievement Plan for Kids (CAP4K), calling for the development of postsecondary- and workforce-ready standards for students, also known as college- and career-ready standards. CDE engaged in a yearlong process to update academic standards in 10 content areas (science; mathematics; visual arts; music; dance; drama and theater arts; reading, writing, and communicating; social studies; world languages; and health and physical education) and English language proficiency standards. In addition to requiring Colorado to revise the content of its standards, CAP4K called for inclusion of 21st century skills and standards that would result in postsecondary and workforce readiness for all Colorado students.

Teacher Effectiveness

CDE is responsible for implementing Senate Bill 10-191 — the law requiring districts to evaluate teachers based on six quality standards (content, classroom, instruction, leadership, practice, and measures of student learning). CDE is responsible for supporting districts in implementation through developing tools and resources for the state model system for evaluating teachers, principals, and other specialized service professionals. This new and more rigorous evaluation system requires multiple annual observations of a teacher's instructional practice. The state-developed evaluation rubric values the actions students take based on the type of instruction they receive. Teachers cannot receive the highest ratings without students demonstrating learning. Effective STEM instruction and learning environments, while often less structured, place students at the center of learning through project- and inquiry-based learning experiences. These learning environments make possible the observation of instruction and practice that lead to the highest ratings on the state model educator evaluation system because STEM learning puts students at the center of the learning experience and empowers them to take ownership of their learning.

Postsecondary Readiness

CDE has a strategic goal of raising the graduation rate from 78.5 percent to 90 percent by 2018. However, high school graduation is no longer enough for a competitive economy, and the deeper aspiration is that students graduate ready for both college and career and are therefore able to choose the path that most interests them without need for remediation. In 2013, the State Board of Education adopted new graduation guidelines that will go into effect in 2021. These guidelines outline options districts can choose in charting paths for students to demonstrate mastery in each core subject area and include options for concurrent enrollment at an institution of higher education and for the successful completion of an approved industry certificate. Currently, over 20 percent of Colorado's 11th- and 12th-graders take at least one concurrent enrollment course and over 50 percent of students in

grades 9-12 take a Career and Technical Education (CTE) course, which lay the groundwork for industry certificates. Through defining quality in STEM education and through helping districts and schools understand how to best partner with industry, the STEM work will inform the resources and guidance provided for school districts in implementing the new graduation guideline requirements. Additionally, by asking each student to chart a personalized path through secondary school and by valuing seat time over mastery, the new guidelines signal the value of professional, personal, and entrepreneurial competencies.

Across Colorado's 178 school districts, educators are creating robust, engaging, STEM-inspired learning experiences for students. The recent policy changes across the state are poised to make these learning experiences the norm for all teachers and students, but more still needs to be done. Deeper partnerships with industry, an enhanced understanding that all students need both college- and career-ready experiences, and a sustained, statewide focus on the importance of STEM literacy in all careers can create an environment that connects P-12 education to the workforce and talent needs of the state, effectively eliminating the Colorado Paradox.

Postsecondary Goals and Assets

The Colorado Department of Higher Education (CDHE) works with public institutions, private degree-granting institutions, and private occupational schools to ensure that all Coloradans have access to high quality and affordable postsecondary education.

CDHE's work is framed by the master plan for higher education, *Colorado Competes*, which lays out four overarching goals for the state:

- **Increasing credential attainment** — Increasing the attainment of high-quality postsecondary credentials across the academic disciplines and throughout Colorado.
- **Improving student success** — Improving student outcomes in basic skills education, enhancing student support services, and reducing average time to credential for all students.
- **Reducing gaps** — Ensuring that the system of postsecondary education reflects the changing demographics of the state while reducing attainment gaps among students from underserved communities.
- **Restoring fiscal balance** — Developing resources that will allow public institutions to meet projected enrollment demands.

These goals, while established in consultation with the state's public institutions and implemented through performance contracts with public institutions, reflect statewide workforce needs and challenges. The goals are thereby applicable to all postsecondary education. Prominent among the challenges identified by Colorado Competes is the urgency of educating and training students for STEM careers and with STEM competencies.

Colorado's postsecondary institutions are already preparing students with skills required in many STEM fields as well as preparing students with STEM skills that will help them be successful in non-STEM careers:

- Colorado's community colleges offer a wide array of educational programs that seek to meet the demands of business in fields ranging from information systems to energy operations maintenance and technology, environmental technology, and process engineering. Community colleges are expanding CTE programs into areas of emerging industries and in other ways ensuring programs are aligned with state and local community economic and workforce needs, particularly in STEM fields.
- Recognizing that traditional higher education isn't for everyone, private occupational schools offer condensed vocational training programs that more rapidly get students from the classroom into the workforce. These schools are preparing students for careers in such fields as renewable energy, avionics, industrial automation, and electrical engineering technology.
- Colorado School of Mines, with applied programs in science and mathematics, engineering, economics, and energy, is a world leader in STEM. The University of Colorado, Colorado State University, and other four-year and research institutions similarly continue to be leaders in preparing engineers, medical professionals, and virtually every other STEM-related professional.

But as recognized by *Colorado Competes,* our postsecondary institutions know they need to do more and have a significant role to play in attracting more students to STEM programs and courses, especially to those programs in high-demand fields so as to support the health and growth of our economy. Institutions must also ensure that once on the path of STEM education, students persist and graduate. And the continued development of more STEM-proficient teachers is crucial to sustaining a strong STEM educational pipeline.

At the state level, increased data sharing allows the state and our institutions to better understand specific labor market needs. CDHE has worked closely with the Colorado Department of Labor and Employment (CDLE) on tracking supply and demand in high-demand jobs. A planned report for 2015 will focus on STEM fields, but even more specific analysis is needed, for example, identifying specific information technology and healthcare jobs where supply is not meeting demand.

Workforce Development Goals and Assets

Supply and demand of Colorado's competitive workforce require the private and public sectors to work creatively, entrepreneurially, and strategically to ensure a flow of well-educated new entrants to employment, enable skill and competency upgrades of employed individuals, and facilitate options for unemployed citizens. CDLE works to enhance statewide partnerships to promote the importance of education and employment opportunities to the underserved, underemployed, unemployed, and at-risk student populations and incumbent workers.

CDLE's vision is to increase employment and re-employment through business engagement and talent development for Colorado competitiveness. Its goals and strategies that align to the Roadmap include:

- Quality delivery of client-centered services to jobseekers, youth, and employers.
- Education, employment, and training services developed in partnership with specific employers or industry sectors and reflective of current and future skill needs.
- Innovation- and technology-enabled services, program development, and implementation.

In alignment with the strategic direction of the Colorado Workforce Development Council (CWDC), Workforce Development Programs administer, oversee, and disseminate funding; create policies; and develop virtual technologies to support the statewide network of workforce centers that are primarily responsible for direct services to job seekers and employers.

Colorado workforce centers are central to regional sector partnerships that include STEM-based healthcare, advanced manufacturing, and information technology. These collaborative groups surface current and future business workforce needs and requirements that are communicated to training providers and individual job seekers in the region. Workforce centers, including those in the Rural Workforce Consortium, offer both one-on-one and self-service options to job seekers, including veterans, dislocated workers, career changers, and disconnected youth.

Services may be accessed online through Connecting Colorado, virtual job fairs, and the Virtual Workforce Center at libraries, or in person at a local workforce center. Available services include access to job listings, matching to appropriate openings and referrals to employers, vocational counseling, skills assessments, labor market information, work search workshops, job fairs, and, when appropriate, referrals to training programs that will increase their ability to compete for jobs. Increasingly, understanding of STEM skills for needed for employment and awareness of availability of STEM education and training programs, certificates, and credentials are part of workforce center communication.

For Colorado businesses, workforce centers offer a tiered approach to companies that wish to list their job openings with the workforce system. Online self-services include access to Connecting Colorado, where a business can self-list job openings, run job matches to find qualified applicants, and also participate in virtual job fairs. Additionally, workforce center business services representatives offer customized services such as assessing candidates for employment, writing job orders, recruiting qualified job seekers, hosting on-site job fairs, providing space for interviews, compiling labor market information, developing training and wage subsidies, or offering access to tax credits to incentivize hiring of targeted groups.

Economic Development Goals and Assets

Not only are Colorado employers currently demanding more STEM-skilled workers across a broad range of occupations, Colorado's economic development efforts are also blazing a path to increase the number of STEM jobs. Colorado's STEM job forecast projects that the state will continue to grow STEM-based occupations. The economic growth policies pursued by Gov. John Hickenlooper and the Office of Economic Development and International Trade (OEDIT) incentivize education and workforce training partnerships to align to regional economic development needs and focus on preparing students for high-demand STEM fields.

Colorado Blueprint: Industry-Led Business Plans Per Industry Sector

The Colorado Blueprint is an economic development plan focused on 14 key industries across the state's 14 regions. The plan is developed through a bottoms-up process that rolls up to reflect a statewide action plan to spur Colorado's economy, help businesses grow, and attract new jobs to the state. The Colorado Blueprint is organized around six core objectives that serve as a framework for discussion across state agencies, regional partnerships, and key industry stakeholders:

- Build a business-friendly environment.
- Retain, grow, and recruit companies.
- Increase access to capital.
- Create and market a stronger Colorado brand.
- Educate and train the workforce of the future.
- Cultivate innovation and technology.

Advanced Industries: Acceleration Programs for High-Return Industries

Within the 14 key industries, seven have been grouped together and are referred to as the Advanced Industries. Colorado's Advanced Industries employ the largest population of STEM workers and include advanced manufacturing, aerospace, bioscience, electronics, energy and natural resources (including Cleantech), infrastructure engineering, and technology and information.

There are many important initiatives and programs under the Advanced Industries umbrella that are creating the momentum behind STEM job creation:

- Advanced Industries Accelerator Grant program.
- Advanced Industries Export Accelerator Grant program.
- Digital Manufacturing, new SMART, program.

COIN: Innovation is Accelerated by STEM

The Colorado Blueprint is supported by the Colorado Innovation Network (COIN), which is solely focused on spreading innovation across the state. Launched in 2012, COIN produces an annual Innovation Report to track our state's progress in innovation and entrepreneurism.

Colorado Workforce Development Council Goals and Assets

CWDC, led by Colorado businesses and driven by a powerful collaboration of state agencies and regional and community organizations, plays a strategic role in coordinating, aligning, and supporting Colorado's education, workforce, and economic development efforts. Its vision is that every Colorado business has access to a skilled workforce and every Coloradan has access to meaningful employment, resulting in statewide economic vitality.

Through its subcommittees and task-groups, the CWDC is ensuring cross-system, public-private partnerships to create and sustain a business-led Colorado talent system to meet the needs of businesses, students, and job-seekers.

Sector Partnerships: Actioning the Blueprint Locally

Sector partnerships provide a framework for economic and workforce development collaboration by investing in regional, public-private partnerships targeting key industries that are vital to the regional economies. A sector partnership aligns to an industry sector within one or several of the 14 regions. Sector partnerships action the Blueprint at a local level on a sustainable basis and ensure that a large majority of the current active partnerships are aligned to STEM.

Career Pathways: Guided Education and Experiential Paths to Good Jobs

A career pathway is a series of connected education and training programs, work experiences, and student support services that enable individuals to secure a job or advance in a demand industry or occupation. Career pathways must emerge out of two ongoing conversations: one with employers in the target industry and one with the education and training institutions ultimately responsible for their development and implementation. Sector partnerships are a vehicle for integrating these conversations. STEM pathways within every industry are critical to ensure the STEM knowledge, skills, and abilities that drive innovation.

Talent Report: Method to Drive Focus and Alignment to the STEM Pipeline

In 2014 Colorado passed legislation to guarantee a Colorado talent report will be produced annually by CWDC in partnership with CDLE, CDHE, CDE, and OEDIT. This report will reveal the agencies' best collective efforts for creating the relevant qualified pipeline of workers, outline current improvement initiatives, and facilitate alignment across this complex ecosystem. This is possible through intentional coordination of data collection, analysis, and reporting.

End Notes

[i] See the Appendix section for detailed information on national and local STEM trends and needs.

[ii] National Network of Business and Industry Associations. (2014, July 22). *Common employability skills, a foundation for success in the workplace: The skills all employees need, no matter where they work.* Retrieved from http://businessroundtable.org/sites/default/files/Common%20Employability_asingle_fm.pdf.

[iv] Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology,* 43(6), 1428-46. Retrieved from http://www.apa.org/pubs/journals/releases/dev-4361428.pdf.

Duncan, G. J. (2011, January). *The importance of academic skills for preK-3rd* (report to the Foundation for Child Development). Retrieved from http://fcd-us.org/sites/default/files/Brief%20on%20Academic%20Skills%20and%20School%20Readiness%20011311.pdf.

[v] Change the Equation. (2012, September). *Vital signs Colorado.* Retrieved from http://vitalsigns.changetheequation.org/tcpdf/vitalsigns/newsletter.php?statename=Colorado.

[vi] Duschl, R., Schweingruber, H., & Shouse, A. (2007). *Taking science to school: Learning and teaching science in grades K-8.* Washington, D.C.: National Academies Press.

[vii] Change the Equation. (2012, September). *Vital signs Colorado.* Retrieved from http://vitalsigns.changetheequation.org/tcpdf/vitalsigns/newsletter.php?statename=Colorado.

[viii] Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011, July). STEM: *Good jobs now and for the future* (issue brief #03-11). Retrieved from U.S. Department of Commerce Economics and Statistics Administration website: http://www.esa.doc.gov/sites/default/files/reports/documents/stemfinalyjuly14_1.pdf.

[x] Carnevale, A. P., Smith, N., & Strohl, J. (2010, June). *Help wanted: Projections of jobs and education requirements through 2018.* Retrieved from Georgetown University Center on Education and the Workforce website: https://georgetown.app.box.com/s/ursjbxaym2np1v8mgrv7.

[xi] Butcher, D. (2013, January 22). Employment outlook for STEM professionals is robust — and moving beyond traditional occupations [web log comment]. Retrieved from http://news.thomasnet.com/IMT/2013/01/22/employment-outlook-for-stem-professionals-is-robust-and-moving-beyond-traditional-occupations/.

[xii] Carnevale, A. P., Smith, N., & Melton, M. (2011, October 20). *STEM: Science technology engineering mathematics.* Retrieved from Georgetown University Center on Education and the Workforce website https://georgetown.app.box.com/s/cyrrqbjyirjy64uw91f6.

[xii] Colorado Office of Economic Development and International Trade. (2014). Retrieved from http://www.advancecolorado.com/international-business/advanced-industries-export-accelerator-program. Office of Colorado State Governor John Hickenlooper. (2013, January 7). Gov. Hickenlooper announces advanced industries accelerator act [press release]. Retrieved from http://www.colorado.gov/cs/Satellite/GovHickenlooper/CBON/1251638036525.

[xiv] Prah, P. (2014, January 7). Which states will generate jobs in 2014? [web log comment]. Retrieved from The Pew Charitable Trusts website http://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2014/01/07/which-states-will-generate-jobs-in-2014.

[xv] Draft – Colorado Department of Higher Education; *STEM in Colorado: Aligning Education and Workforce Needs.* Rothwell, J. (2013, June 10). *The hidden STEM economy.* Retrieved from The Brookings Institute website: http://www.brookings.edu/~/media/research/files/reports/2013/06/10%20stem%20economy%20rothwell/thehiddenstemeconomy610.pdf.

[xvi] Colorado Department of Higher Education. (2014, January). 2014 legislative report on the Skills for Jobs Act. Retrieved from http://highered.colorado.gov/Publications/Reports/Legislative/Workforce/2014_SkillsforJob.pdf

[xvii] Colorado Innovation Network. (2013, August 26). Colorado innovation report: *Accelerating Colorado's entrepreneurial* momentum 2013. Retrieved from http://www.coloradoinnovationnetwork.com/wp-content/themes/coin/assets/pdf/coii_2013.pdf.

[xviii] http://www.cde.state.co.us/communications/20140114pupilcount#sthash.ImUQmp1v.dpuf.

[xix] Rothwell, J. (2013, June 10). *The hidden STEM economy.* Retrieved from The Brookings Institute website: http://www.brookings.edu/~/media/research/files/reports/2013/06/10%20stem%20economy%20rothwell/thehiddenstemeconomy610.pdf.

[xx] National Network of Business and Industry Associations. (2014, July 22). *Common employability skills, a foundation for success in the workplace: The skills all employees need, no matter where they work.* Retrieved from http://businessroundtable.org/sites/default/files/Common%20Employability_asingle_fm.pdf.

[xxii] Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology,* 43(6), 1428-46. Retrieved from http://www.apa.org/pubs/journals/releases/dev-4361428.pdf.
Duncan, G. J. (2011, January). *The importance of academic skills for preK-3rd* (report to the Foundation for Child Development). Retrieved from http://fcd-us.org/sites/default/files/Brief%20on%20Academic%20Skills%20and%20School%20Readiness%20011311.pdf

[xxiii] Change the Equation. (2012, September). *Vital signs Colorado*. Retrieved from http://vitalsigns.changetheequation.org/tcpdf/vitalsigns/newsletter.php?statename=Colorado

[xxiv] National Network of Business and Industry Associations. (2014, July 22). *Common employability skills, a foundation for success in the workplace: The skills all employees need, no matter where they work.* Retrieved from http://businessroundtable.org/sites/default/files/Common%20Employability_asingle_fm.pdf

[xxv] Duschl, R., Schweingruber, H., & Shouse, A. (2007). *Taking science to school: Learning and teaching science in grades K-8.* Washington, D.C.: National Academies Press.

[xxvi] Change the Equation. (2012, September). *Vital signs Colorado*. Retrieved from http://vitalsigns.changetheequation.org/tcpdf/vitalsigns/newsletter.php?statename=Colorado

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