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CTE should be an important aspect of a state's broader high school redesign strategy.

National Governors' Association, 2007



Engineering the Future:
Career and Technical Education Redesigned for Today's Students



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Colorado Succeeds is a non-profit, non-partisan coalition of business leaders committed to improving education for workforce development and economic growth. The organization was founded on the premise that the business community has the obligation, opportunity and capacity to improve the state's education system to prepare every student to succeed in a competitive international environment.

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CEPA's mission is to provide applied research and program evaluation, strategic planning, and facilitation that enhance the capacity of local and national education communities to make informed decisions and solve problems.

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CTE is the best kept secret in education.
Joe Shaw, principal, Warren Tech High School

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December 1, 2007

Dear Friend of Colorado Education:

Colorado Succeeds was founded by the Colorado business community on the belief that business has the obligation, opportunity, and capacity to ensure that Colorado's public education system prepares every student to succeed in a competitive international environment. It is in the business community's best interest to have a pool of well-educated individuals to recruit and hire, to ensure that our employees are satisfied with the quality of the schools their children attend, and to provide for the economic future of our state.

With this report, we turn the state's attention to a highly promising area of education of great importance to the business community: career and technical education, or CTE. Colorado Succeeds began hearing about this vision of CTE last year, through teachers and business colleagues who told anecdotes about students saved from dropping out of high school, companies benefiting from well-trained local workforces, students who were the first in their families to attend college, and high-paying technical jobs. We heard about programs that combined explicit and rigorous academic content with real-world technical knowledge and skills, infused throughout with the key habits of problem-solving, critical thinking, and teamwork.

We wanted to know the whole story. Did CTE really make a difference for kids? Should Colorado be investing in this approach? Here's what we found:

- Support for the new CTE from well-regarded national organizations such as the National Governors' Association, Jobs for the Future, and the American Youth Policy Forum
- Innovative local career and technical programs at the secondary and postsecondary levels that meet the needs of Colorado employers
- CTE programs whose students outperform general education students
- CTE programs that are so rigorous that some students are afraid to participate for fear of risking their grade point average
- High-paying, highly-skilled jobs that fit local and regional economies
- Research showing that CTE courses help at-risk students stay in school

We also found some challenges:

- State policies that squeeze out CTE at the high school level by prioritizing academic preparation for four-year liberal arts college programs
- Smaller and more isolated schools and institutions face problems in funding CTE, finding qualified staff, and developing industry partnerships
- A state governance structure that has allowed the Colorado Department of Education to abdicate its role in promoting and improving CTE
- Principals, counselors, families and students who are not aware of the career and educational opportunities available in CTE

Colorado Succeeds believes that high-quality CTE is critical to Colorado's economic success, and should serve as a key strategy for improving education in our state. In the year to come, we will be visible and vocal in supporting CTE at the state and local levels. Please join us as we work to implement the recommendations of this report.

Sincerely,
Tim Taylor
President

A New Day for Career and Technical Education

Those states that undertake this strategic approach to retooling CTE programs can expect more engaged and persistent graduates who have added earning potential and are better prepared to enter high-wage/high-skill occupations.

National Governors' Association¹

This is not your father's vocational education.

Career and technical education has its roots in the shop and home economics classes of yesterday – but it has transformed itself in many schools so as to be almost unrecognizable. Prior generations of vocational education focused almost entirely on narrow skill acquisition in a few programs, earning a reputation for vocational education as a dead-end track, “only” for students who couldn't cut it academically and would go straight into the workforce. Critics charged that vocational education lacked academic rigor and was a way for schools to ignore underachieving students.

This low point resulted in the transformation of vocational education, now known as career and technical education, or CTE. The change is more than name only. CTE offerings today are incredibly diverse, and the best of today's CTE classes work at the intersection between academic content and practical application, focusing on content knowledge as well as skill acquisition. Students who take CTE classes not only learn math, science, and language arts – but they also know why learning is important as they apply their learning in a real-world context and plan for their own careers.

Career Clusters, Career Pathways, and Plans of Study

The new federal Perkins Act mandates a whole new approach to CTE.² This new approach to the education pipeline will affect industry sectors as diverse as agriculture and natural resources, skilled trades and technical sciences, and business and public administration. Using this model, students can prepare for career paths

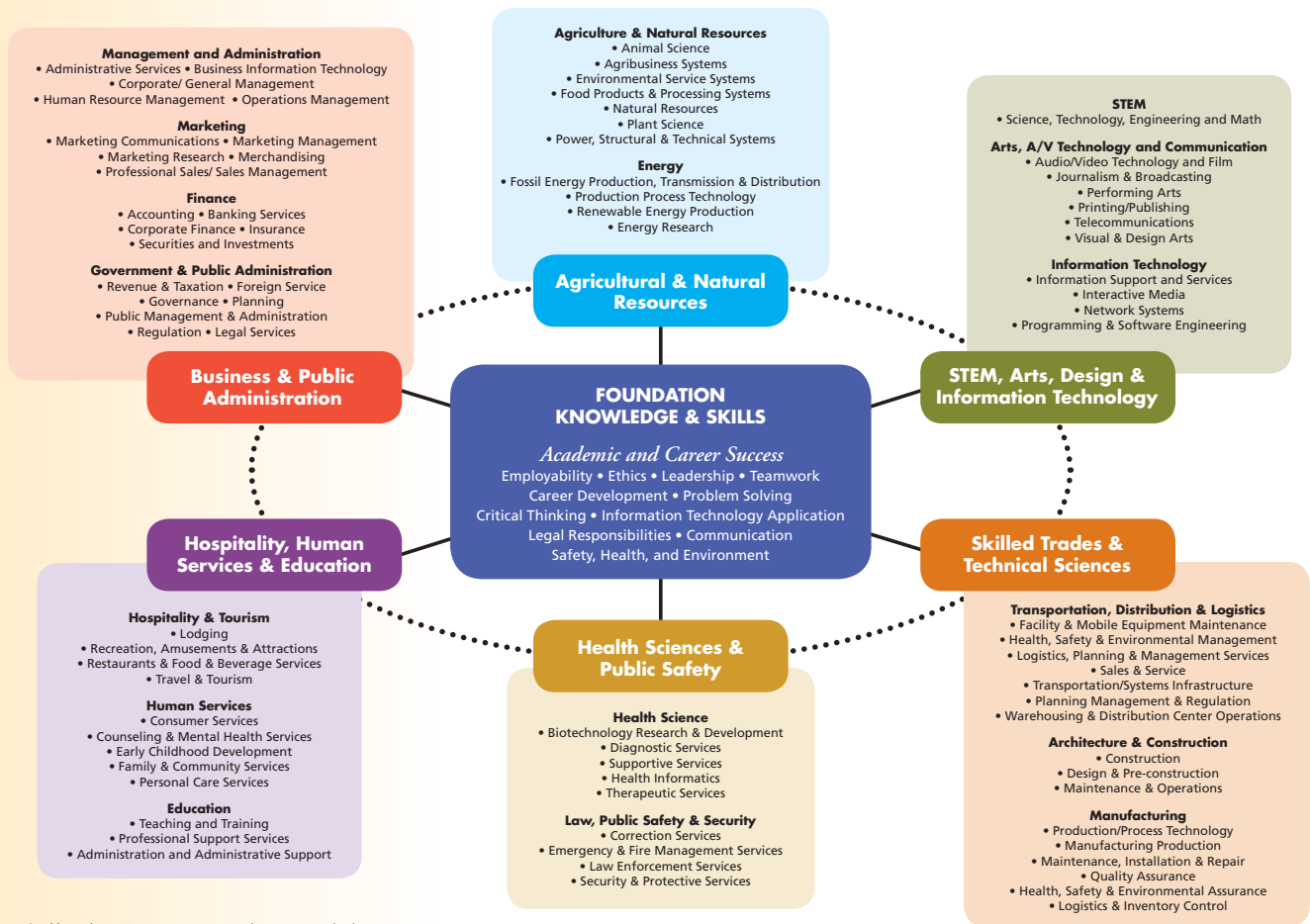
in cosmetology and engineering, construction and biotechnology, welding and teaching, transportation logistics and accounting.

CTE programs and courses are designed together with the business community, using the latest equipment and technology. In addition to the specialized knowledge and skills required by specific plan of study, every career cluster is linked to foundation knowledge and skills that lead to academic and career success, such as teamwork, problem solving, and critical thinking. Students learn not only relevant content and skills, but also understand the career pathways they can take and how to achieve education and career goals.

- Different types of careers are broadly grouped into “career clusters,” located in six different industry sectors. For example, in Colorado, careers in marketing and finance are contained in career clusters located in the Business and Public Administration industry sector.
- Each career cluster contains a number of “career pathways” that relate to specific sets of occupations. Examples of career pathways in the Finance cluster include accounting, corporate finance, and securities and investments.
- Each career pathway contains “plans of study” for the various occupations in it, listing necessary credentials and salary ranges for the related occupations. Plans of study create a seamless pathway from high school certificates and diplomas to postsecondary training, certificates, and associates/bachelors degrees, providing guidance and direction to students interested in particular fields.

In short, the new Perkins Act essentially forbids structuring career and technical education so that it operates as a dead-end path for students who couldn't otherwise succeed. Instead, the new approach envisions a seamless transition between secondary and postsecondary education, and a system of lifelong learning guided by career goals.

Colorado Career Cluster Model*



*Organized by Industry Sector www.cccs.edu Prepared July 2, 2007

PROGRAM PROFILE

PEER: The Partnership for Engineering Education in the Rockies

In 2004, the Poudre School District, Front Range Community College, Colorado State University, and Hewlett Packard started the Partnership for Engineering Education in the Rockies to address the great need along the Front Range for electrical and computer engineers. Industry partners such as HP and Intel have provided instructors for courses in circuit theory and VLSI design, digital devices, and Java programming. Students take a pre-engineering curriculum simultaneously with college preparatory math and science classes. PEER courses are offered at both high school and community college sites, and credits earned by high school students are transferable to Front Range Community College and Colorado State University. FRCC offers an associate's degree and certificate in microelectronic mask design, and CSU offers baccalaureate and graduate degrees in engineering. In addition, PEER offers summer camps at which high school students and teachers can work with CSU researchers. Intel reserves several internships for students who have completed introductory coursework, and graduates have been hired by Intel and Hewlett-Packard. For more information, visit the PEER website at:

<http://www.engr.colostate.edu/peer/index.html>.

² For a summary of the new Perkins Act requirements, see "The Carl D. Perkins Career and Technical Education Improvement Act of 2006" from the Association for Career and Technical Education. Available online at www.acte.org.

Career and technical education courses have become more academic, more technical, more challenging, providing valuable 21st century skills for all career choices.

Hon. Sue Windels, Colorado State Senate, Chair, Senate Education Committee

From a student's perspective, this new approach opens up a world of possibilities. Imagine you are a Colorado high school student interested in the health fields. You take core math and science classes at your high school, but you also want some experience to see if a health career is really right for you. Thanks to CTE, you can get started on a health career pathway by taking a MedPrep curriculum at your local high school, an area technical college, or a community college. You will learn about health careers, gain practical, hands-on experience, earn college credit, and graduate from high school eligible to take entry-level examinations to be a certified nursing assistant. After completing high school, you can go directly into the workplace, or continue on for an associates' degree in a variety of programs such as nursing, EMT/paramedic training, clinical laboratory technician, or health care administration. In many areas, local health employers have partnered with your school and are eager to hire students with your knowledge and training. Because you have explored a wide variety of health careers and the education necessary to achieve each of them, you know that you can re-enter the education pipeline at any time if you eventually decide to pursue a career such as a medical doctor or biologist that requires additional education and training. All along the way, you have the skills and knowledge you need to pursue a high-paying, highly-skilled career.

CTE imparts important academic, technical, and workplace behavior skills that are valued by employers and that highlight the relevance of school to students.

Scott Wylie, president and chief executive of First Western Bank and Trust

CTE Careers

The careers that CTE students are preparing for are built on good jobs. According to the Colorado Labor Market Information (LMI) Gateway,³ annual per capita income in Colorado for 2006 was \$39,186, making us one of the wealthiest states in the nation. Compare that income with the following sample of salaries for CTE occupations requiring specialized training and/or some college:

Occupation	Mean salary 2006
Licensed practical nurses	\$37,994
Rotary drill operators, oil and gas	\$42,367
Plumbers and pipefitters	\$43,602
Electricians	\$43,863
Paralegals and legal assistants	\$45,399
Paralegals and legal assistants	\$45,399
Interior designers	\$45,785
Mechanical drafters	\$46,733
Office managers	\$47,981
Computer support specialists	\$48,605
Multi-media artists and animators	\$48,695
Media and communications equipment workers	\$48,698
Firefighters	\$48,919
Surveyors	\$50,709
Forensic science technicians	\$51,505
Cardiovascular technologists and technicians	\$53,317
Interpreters and translators	\$55,114
Construction supervisors	\$56,133
Fashion designers	\$58,865
Aerospace engineering and operations technicians	\$59,807
Dental hygienists	\$72,919

According to the LMI Gateway, many of the occupations for which CTE students train are listed among the 50 fastest-growing occupations in Colorado over the next eight years. At a time when the average four-year college student graduates with \$17,520 in debt, and one in four students graduate owing more than \$22,000, "learn and earn" career pathways that alternate education with lucrative work experiences are good options for many students.⁴

The Importance of CTE to Colorado's Future

CTE not only meets student needs, but it also meets Colorado's economic needs. We are a highly educated state with a promising high-tech economy that needs employees with technical expertise. The U.S. Department of Labor recently awarded a \$15 million WIRED grant (Workforce Innovation in Regional Economic Development) to the nine-county Denver metro area. The Metro Denver WIRED Initiative focuses its work in four target high-growth industries: aerospace, energy,

bioscience, and IT/software. Surveys of employers in these areas revealed the following conclusions:⁵

- Experience and skill sets are the most highly valued characteristics of an applicant for WIRED businesses
- Finding applicants with solid, basic skills in math and science is a challenge for many WIRED businesses
- Employees with business and marketing skills, such as sales and customer service, combined with technical or practical understanding, are in increasing demand

The WIRED industries certainly need engineers and biologists with advanced degrees, but they also need engineering technicians, laboratory assistants, sales representatives, and business operations specialists. CTE plays a significant role in training employees for our high-tech future, benefiting industry and workers alike. Unfortunately, Colorado has many barriers to overcome in preparing our workforce for this promising future. Much of our college-educated workforce is imported. High school graduation rates in Colorado are about 75 percent, which is slightly better than the U.S. average but surprisingly low for a wealthy state

PROGRAM PROFILE

Applying the New Model – Process Technology

Production/Process Technology is a Career Pathway located within the Career Cluster of Manufacturing. In Colorado, Jefferson County Public Schools has been a leader in the development of plans of study for CTE, and the district has partnered with Red Rocks Community College and industry to offer an integrated plan of study for process technology.

The process technology pathway prepares students to be a key part of a team responsible for planning, analyzing, and controlling the production of products, from raw materials through production and distribution of products. Industries that need process technicians include oil and gas, pharmaceuticals, food and beverage, power generation, and wastewater treatment. This particular field is important to many local industries, including Suncor USA, Xcel Energy, and Molson-Coors. The Rockies Alliance for Process Technology, formed in 2004, recognized the need for cooperation between education and industry to prepare qualified employees for this field.

Jeffco high school students who have already taken biology and earth sciences can take Process Technology I and II, which are standards-based multimedia courses that include hands-on experiences in physics, chemistry, and biology, and also provide opportunities for students to work in teams. These classes are located in regular classrooms at four Jeffco high schools (Alameda, Golden, Jefferson, and Standley Lake) and the district offers 4th-year science credit to students. Students who perform well may earn college credit at Red Rocks or other area community colleges.

Upon graduation from high school, process technology students may move to a two-year associate's degree program at Red Rocks that provides further training and internship opportunities. Associates' degrees in process technology are also available at Colorado Mountain College. Estimates for starting salaries for process technicians are around \$40,000. Students wishing to continue their education beyond an associates' degree can transfer to four-year colleges to pursue related degrees in fields such as engineering.

For more information, visit the Rockies Alliance for Process Technology website at:
<http://www.rcc.edu/isod/rapt.html>.

⁴ American Association of State Colleges and Universities (2006). "Student Debt Burden." Policy Matters, v. 3 n. 8 (August 2006).

⁵ Development Research Partners (2007). "Metro Denver WIRED Initiative Workforce Study." (Denver, CO: Metro Denver Economic Development Corporation).

such as ours. Hispanic students, the fastest-growing sector of our school population, graduate from our high schools at a rate of just 54 percent, lower than the national average for Hispanic students of 58 percent.⁶ Because Hispanic students represent more than one-quarter of our student population, this has huge implications for our future economy.

A recent report by the National Center on Higher Education Management Systems estimated that if current trends in Colorado's population and educational attainment continue, Colorado will lose ground in the percentage of the population that is college-educated. The most substantial growth will occur in the percentage of the population that has not graduated from high school. This in turn translates into a projected decline in per capita personal income of \$662 between 2000 and 2020 – a decline that will have huge impacts on the quality of life in Colorado.⁷

We need education reform that addresses these issues, for the sake of our economy and our students. CTE can do this, if we do it right. CTE has the potential to engage our students by showing them the relevance of education, and encourages postsecondary attainment through career pathways that bridge high school and postsecondary education. In his Colorado Promise, Governor Bill Ritter set the ambitious goal of halving the number of high school dropouts and doubling the number of postsecondary degrees and certificates awarded over the next ten years. CTE may be our state's best hope for accomplishing the Colorado Promise.

The talent crunch is creating structural changes in the workplace, and employers who are not paying attention could find their businesses healthy one year and in trouble the next. Many enterprises today are so lean that, if just a few vital positions are unfilled, the entire organization could break down. This means there is a need to focus on not just the top 10 percent of talent categories, but rather on the entire talent spectrum.

Manpower, Inc. "Confronting the Talent Crunch 2007."

Business and industry involvement and support will be key to the successful rebirth of CTE in Colorado. By its very nature, CTE seeks to educate and train students for the demands of the workforce and the 21st century workplace. **Colorado's employers are essential to guiding and supporting this process.** Our state is showing great promise in CTE. However, we have a lot of work to do. The business community will need to support CTE as an essential part of the education system, supporting CTE policy initiatives at state and local levels. Business people will need to tell students and their families that CTE is a valuable educational pathway, and that there are good jobs to be had. Finally, business leaders need to ensure that local CTE programs are rigorous and relevant by sharing up-to-date expertise, equipment, and workplace experiences.

CTE Programs in Colorado

Multiple Delivery Models for Multiple Needs

Career technical education has the power to engage and motivate all students by giving them chances to learn in applied settings.

National Governors' Association, "Retooling Career Technical Education"

As CTE evolves and transforms, it is taking on many different shapes to meet the needs of different types of students, schools, and programs. CTE exists at both the high school and postsecondary level, and in venues that combine levels. Some high school students will take just one CTE course at their local high school. Others are "CTE concentrators," who take three or more courses in the same career pathway. High school students and community college students may take classes at the same location, or even take the same classes. This section will explore the many ways in which students can access CTE in Colorado, from the high school junior exploring multimedia design to the experienced health care technician returning to learn the latest equipment at a local community college.

⁶ Editorial Projects in Education Research Center (2007). "Colorado: Ready for What? Preparing Students for College, Careers, and Life after High School." State-focused supplement to Diplomas Count, the Graduation Project 2007. (Bethesda, MD: Editorial Projects in Education).

⁷ Kelly, P. (2005). "As America Becomes More Diverse: The Impact of State Higher Education Inequality – Colorado State Profile." (Boulder, CO: National Center for Higher Education Management Systems).

High school students generally access CTE courses through their home high schools, through a technical education school or college that serves an entire district or region, and/or through CTE courses offered at area community colleges. Most traditional high schools offer at least a few CTE courses. Students in some metro-

area districts can split their time between their home high school and the district technical education center. Career academies, which are either self-contained high schools or schools-within-schools that focus on career and technical education, are popular in many states and are just now beginning to emerge in Colorado. In many cases, students taking secondary-level CTE courses can also obtain college credit for these courses. A new trend is the establishment of middle colleges, which are intentionally set up to provide high school students both with the credits needed for high school graduation and credits needed to get a head start on a college experience. Postsecondary students generally take CTE courses at their institutions. Some K-12 school districts and community colleges share CTE facilities, so that college students take coursework alongside high school students. For example, students at Red Rocks Community College's welding courses use the welding facility at Warren Tech

CTE – Multiple Delivery Methods		
Students served	CTE Delivery Site	Some Examples
Secondary	Comprehensive high school offering CTE courses	East High School (Denver) Battle Mountain High School (Minturn) Del Norte High School (Del Norte) Rifle High School (Rifle) Thunder Ridge High School (Highlands Ranch) Centennial High School (Pueblo)
	CTE-focused high school	Adams County District 50 Construction Academy (scheduled to open in 2010)
	District technical center	Bollman Technical Center (Thornton) Warren Technical High School (Lakewood) Boulder Valley Technical Education Center (Boulder)
Secondary and Postsecondary	District middle college focusing on CTE	Pickens Tech Middle College and Community College of Aurora (Aurora) CEC Middle College and Community College of Denver (Denver)
	Regional technical college	San Juan Basin Technical College (Cortez) Pickens Technical College (Aurora) Emily Griffith Opportunity School (Denver) Delta-Montrose Area Vocational/Technical Center (Delta)
	Community college	Front Range Community College Morgan Community College Colorado Mountain College Community College of Aurora Colorado Northwestern Community College

PROGRAM PROFILE

Pickens Technical College

Pickens Technical College in Aurora is one-stop shopping for many students looking for career and technical education. For high school students in Aurora Public Schools, it is the district's technical education center. Many Aurora students split their days between their home high school and the CTE program at Pickens. As an "area vocational school," Pickens provides both secondary and postsecondary students the opportunity to earn certificates in nearly 50 programs ranging from dental assisting to landscaping to precision machining.

Pickens recently opened a Middle College program in partnership with the Community College of Aurora, which exemplifies the way in which CTE students are blurring lines between secondary and postsecondary education. Middle College students who complete the program graduate with three credentials: a high school diploma (including credits for pre-collegiate math and English), a Pickens technical program certificate, and an applied associate's degree from CCA.

High School next door. At San Juan Basin Technical College and the other area vocational schools around the state, high school students and postsecondary students earn technical program certificates at the same facility. Students can also take CTE courses at private institutions, such as Johnson & Wales University, DeVry University, and ITT Tech.

In Colorado, publicly-funded career and technical education is governed by the Colorado Community College System (CCCS). After a scathing report in 2005 by the State Auditor’s office, CCCS implemented new reporting and accountability systems to ensure that CTE in Colorado is compliant with both state and federal requirements. As a result, Colorado is well-positioned to take advantage of the mandated linkages between secondary and postsecondary CTE, as long as our secondary and postsecondary governing bodies communicate and cooperate fully with each other. The Colorado Department of Education and CCCS are exploring ways to improve communication and coordination, which has been a problem in the past.

The Face of the CTE Student

For a program that has received little to no attention from Colorado policy makers recently, CTE is very popular among both high school and community college students.

Secondary level: In FY 2005, nearly 82,000 high school students took CTE classes, with a total number of CTE enrollments of 103,105. This represents 37% of the total 9-12 student enrollment. By grade 12, participation in CTE is at 65 percent.⁸ According to the latest figures available on CCCS’ website, there are 1,393 approved secondary CTE programs in Colorado.⁹ Fifty-four percent of Colorado school districts responding to a recent survey performed for this report characterized student demand for CTE as “very high” or “high.”

Secondary CTE enrollment in Colorado is fairly evenly divided between genders, with 52.5 percent of enrollments by male students and 47.5 percent by female students. Interestingly, although part of the perception of vocational education is that of a dead-end track for low-income and minority students, this does not seem to be the case in

Colorado. For example, students eligible for free- and reduced-lunch subsidies make up 34.3 percent of the overall student population in Colorado, but just 14.7 percent of CTE enrollments. White students take a larger share of CTE courses than do their minority counterparts, as the table below shows.¹⁰

Minority Representation in CTE					
	White	Hispanic	Black	Asian	Amer. Indian
Percentage of overall K-12 population	61.9	27.6	6	3.3	1.2
Percentage of secondary CTE enrollments	68.7	22	5.1	2.7	1.1

Rather than being concerned about CTE being a “tracking” mechanism for less fortunate students, we may want to consider whether poor and minority students in Colorado have sufficient opportunities to take CTE. This discrepancy may also be a function of Colorado’s dropout rate. Secondary CTE is mainly an option for juniors and seniors in high school, and our state sees many poor and minority students drop out of high school before that time.

On the other hand, some Colorado teachers have anecdotes about high-achieving students choosing to avoid challenging CTE courses such as Project Lead the Way, for fear of harming their carefully cultivated GPA and damaging their chances of getting into the most exclusive colleges! At a time when CTE’s identity is transforming and bouncing back and forth between “too easy” and “too hard,” we may want to consider the words of an administrator from CTE-focused Lake Travis High School in Austin, Texas: “Career and technical programs are for the top 90 percent of our students.”

⁹ See http://ctep.ccs.edu/reports/report_list.jsp.

¹⁰ Authors’ analysis of data provided by CCCS.

Career and technical programs are for the top 90 percent of our students.

High school administrator in Austin, Texas

At the secondary level, business programs are the most popular CTE offerings. The largest CTE program in the state is Business Education at Douglas County High School, with over 900 enrollments. In fact, of the top 50 programs in the state in terms of enrollment, all but six are business or marketing programs. Other popular programs in terms of enrollment include the Engineering-Related Technologies program at Rocky Mountain High School in the Poudre School District, with 537 enrollments; the Family and Consumer Sciences core program at Sand Creek High School in the Falcon School District, with 648 enrollments; and the Catering program at Brighton High School, with 498 enrollments.¹¹

Of course, generally speaking the larger high schools located primarily along the Front Range will have larger CTE classes and a wider variety of programs than will smaller, more isolated schools. For example, Bear Creek High School in Jefferson County, with an enrollment of around 1,900 students, offers 14 different CTE programs ranging from Teacher Cadet to Engineering Technology. Rocky Ford High School, with 231 students, is typical of many smaller schools on the Eastern Plains, offering just Business Education and Vocational Agriculture. With

that said, many larger schools in metro areas choose not to offer a wide range of CTE classes, and many smaller schools choose to make CTE an important part of their curriculum. In some cases, CTE enrollments in small districts outnumber student enrollment, reflecting that much of the student body takes multiple CTE courses. For example, in Wray High School, CTE enrollments are approximately 120 percent of total student enrollment.¹²

Postsecondary level: In Colorado, fully one-third of the state's community college students are enrolled in career and technical programs. In 2005, nearly 10,000 students received certificates or degrees in CTE postsecondary programs.¹³ Like secondary programs, postsecondary program offerings and popularity vary by location. Health-related programs, such as nursing and emergency medical services, are popular around the state. The largest CTE programs in the state are the nurses' aide program at Front Range Community College, with 669 enrollments, and the emergency medical services at Pikes Peak Community College, with 433 enrollments. Criminal justice programs are also popular, with the largest programs in the state at Pikes Peak Community College and the Community College of Aurora, respectively.¹⁴ Not surprisingly, agriculture programs are popular on the Eastern Plains. Morgan Community College's top two CTE programs involve agribusiness. Lamar Community College's largest program is in horse training and management.

PROGRAM PROFILE

Cool CTE Programs

- Biotechnology (Warren Tech, Lakewood)
- Gunsmithing (Trinidad State Junior College)
- Sports Medicine (CEC Middle College, Denver)
- Teacher Cadet (Bollman Technical Center, Thornton)
- Ski and Snowboard Business (Colorado Mountain College)
- Geography Information Systems (Pueblo Community College)
- Computer Magnet (North High School, Denver)
- Fire Science Technology (Aims Community College)
- Commercial Photography (Cherry Creek High School)
- Forestry, Wildlife, and Natural Resources (Front Range Community College)
- Sport Vehicle Technologies (Career Center, Mesa 51, Grand Junction)
- Rural Entrepreneurship (San Juan Basin Technical College)
- E-Commerce (Morgan Community College)

¹¹ Ibid.

¹² Ibid.

¹³ Colorado Community College System (2007). "Follow Me to Opportunity: Annual Report." (Denver, CO: Author).

¹⁴ Authors' analysis of data provided by CCCS.

The Effect of CTE on Students

Academic Performance

Past research on the impact of traditional vocational education on high school academic performance was not encouraging. Until very recently, vocational courses were not designed to teach academic skills; in fact, they were designed to be an alternative to academic classes. As a result, when students took vocational classes, their academic skills generally did not improve. Results like these prompted the re-examination of vocational education described above.

Several factors are causing districts and schools to take a new look at academic content in CTE courses. First, the new Perkins Act will hold states accountable for the performance of CTE students on state assessments of reading, writing, and mathematics, and also for high school graduation rates for these students. Measurements of student technical achievement are to be aligned with industry-recognized standards whenever possible. Second, the recent policy debate in Colorado around the types of credits required for high school graduation have led many schools and districts to look at ways in which CTE courses can be taken for both elective and core academic content.

The new CTE is about using your head as well as your hands.

Tim Taylor, President, Colorado Succeeds

Data from a sample of Colorado school districts indicates that CTE students are doing well. When asked how well their CTE students were doing on standardized tests such as the CSAP when compared to the rest of their students, 26 percent reported that CTE students performed better, and 65 percent indicated that CTE students have similar scores. Just 9 percent reported that their CTE students tend to have lower scores. Thirty percent reported that CTE students received higher course grades, and 70 percent saw similar grades for CTE and regular students. For example, in 2007, students in Yuma County Schools' CTE programs scored 10 percent higher on reading and writing CSAPs than general education students, and 20 percent higher on math.¹⁵ Similarly, 11th-grade students at CEC Middle College, a technical magnet school in Denver with 67 percent of its students from low-income families, had 2006 composite ACT scores of 17.9. This compares to the district average of 15.6, and the district as a whole has the same percentage of low-income students. CEC Middle College subscores in areas such as reading, writing, math and science all exceeded district averages in these areas. In science, CEC Middle College students scored 18.2, compared to the district average science subscore of 16.1.¹⁶

When academic rigor is combined with CTE relevance, student learning improves significantly.

Nationally and locally, advocates of the new CTE believe that when academic rigor is combined with CTE relevance, student learning improves significantly. Early

PROGRAM PROFILE

The EPIC Program at Trinidad State Junior College

Trinidad State Junior College's Energy Production and Industrial Construction (EPIC) program is an example of local employers and the community college working together to meet workforce needs. The program, which offers certificates and associates' degrees in heavy equipment mechanics, heavy equipment operations, and welding, was developed to address shortages in workers for the booming local coal bed methane extraction industry. Industry partners include Pioneer Natural Resources (the largest employer in the area), Weatherford, and Purgatoire Valley Construction. Students reportedly are being hired from the program at salaries of over \$60,000.

For more information, visit the EPIC website at: <http://www.trinidadstate.edu/programs/epic.html>.

¹⁵ Personal correspondence with Brian Cunningham, CTE Coordinator, Yuma School District, October 19, 2007.

¹⁶ Colorado ACT results are available on the website of the Colorado Department of Education at http://www.cde.state.co.us/cdeasses/documents/COACT/coact_summary.html.

results from research on this new approach to CTE support this belief. For example, after Arizona redesigned its CTE curriculum to center around its academic content standards, students who took two or more CTE courses outperformed the general high school population in the reading, writing, and math portions of the state's high school graduation tests.¹⁷

Are you a visual learner? View a webcast of "State Efforts to Integrate CTE With Rigorous Standards," hosted by the American Youth Policy Forum on June 22, 2007, at <http://www.aypf.org/forumbriefs/2007/fb062207.htm>.

National research on "Math in CTE" involved 131 teachers and 3,000 students in 12 states, including Colorado. CTE and math teachers were asked to collaboratively develop lesson plans that identified the embedded math content in CTE courses and instructional strategies that would enhance the teaching of this mathematics. The results were impressive. Students who were taught using the new Math in CTE curriculum scored significantly higher on TerraNova and Accuplacer tests of mathematics ability than did students in traditional CTE courses. The Math in CTE curriculum did not detract from CTE content knowledge – students in both groups scored equally well on measures of occupational and technical knowledge. Key to these results, researchers noted, were the deliberate and

continuing professional partnerships between teachers of CTE and math teachers.¹⁸

Across the state, districts and schools are looking at ways to make the academic content embedded in the CTE content more explicit. Schools in Jefferson County and Colorado Springs have adopted the Math-in-CTE approach, teaching geometry in construction classes and algebra in business classes. CTE teachers and district content specialists work together to cross-walk CTE courses with district content standards in areas such as math, language arts, and science. Districts are finding that the amount of academic content in CTE courses, once made explicit, can qualify these courses for academic as well as elective credit. In a sample of Colorado districts, 65 percent of responding districts reported that they were in the process of implementing or had implemented the granting of academic credit for certain CTE classes. Another 22 percent were considering this approach.

Warren Technical High School in Jefferson County has been a leader in integrating academic content into CTE courses. The school has two instructional coaches who work with traditional CTE teachers to identify the ways in which academic content such as science, math, or language arts is already part of the course, and to build strategies for making these concepts more explicit in the curriculum. Working with district content specialists, the school can submit coursework to be approved for credit in academic

PROGRAM PROFILE

Project Lead the Way

Project Lead the Way is a national organization that provides a rigorous pre-engineering curriculum. Originally developed for high school students, PLTW has expanded to middle schools as well. The high school curriculum consists of three foundational courses (Introduction to Engineering Design, Principles of Engineering, and Digital Electronics), four specialization courses (Computer Integrated Manufacturing, Civil Engineering and Architecture, Biotechnical Engineering, and Aerospace Engineering), and a capstone project completed in the senior year. The program requires students to be simultaneously enrolled in college preparatory math courses.

PLTW programs are in place in all but four states. In Colorado, 14 high schools have certified PLTW programs. All certified PLTW high schools are located either in the Denver or Colorado Springs metro areas. Another six Colorado high schools, including high schools in Montrose and Loveland, use the PLTW curriculum.

For more information, visit the PLTW website at www.pltw.org.

¹⁷ Arizona Department of Education (2005). "Career and Technical Education 2004 Data Snapshot."

¹⁸ Stone, J., Alfeld, C., Pearson, D., Lewis, M., and Jensen, S. (2006). "Building academic skills in context: Testing the value of enhanced math learning in CTE." (St. Paul, MN: National Research Center for Career and Technical Education).

as well as elective CTE content. For example, students in the dental assisting program can earn anatomy/physiology credits, students in the computer-assisted drafting program earn geometry and mathematical modeling credits, and students in the multimedia program can earn language arts credits. The new biotechnology program is exclusively for academic credit.¹⁹

Some schools are beginning to approach the benefits of CTE in a different way – by incorporating CTE concepts into traditional academic classes, rather than the other way around. In the Geometry in Construction class at Loveland High School in the Thompson School District, CTE teacher Scott Burke and math teacher Tom Moore partner to teach a class in which students learn geometry concepts and then apply those concepts to building a house (including framing, plumbing, and electrical work). Students of all abilities take this class, from struggling learners to students in the rigorous International Baccalaureate program, and student interests include architecture, engineering, construction, and simply wanting to know how to maintain a house.

Burke and Moore had heard CSU faculty in engineering and construction management complain that incoming freshmen had no practical experience, and in fact had never seen the processes they were studying. Inspired by the Math in CTE project in Jeffco, Burke and Moore approached the district about starting the Geometry in Construction class, which they built from the ground up. The district, wary of a class that would cost \$50,000 to start up, told the teachers that the class needed to meet the same standards as any traditional geometry class, and that students needed to perform well on CSAP tests in order to justify continuing the class.

The class fulfilled its promise. According to the district, 9th-grade students taking the class had math scores just below those of the district's IB students. For 10th-graders, students who had previously scored unsatisfactory or partially proficient made higher gains than students in all other geometry classes across the district. In all, students in the Construction Geometry class scored higher on items testing geometry than other district students. Based on these results, the Geometry in Construction course proved its worth to the district. This year, students

are partnering with Genesis Homes and the Interfaith Hospitality Network to build housing for the homeless. (For more information, visit www.geometryinconstruction.org.) Burke and Moore have been commissioned to design a class that teaches Algebra II using transportation applications.²⁰

If you don't have academic skills, you won't be successful in CTE. If you can't read a technical manual, you won't be successful.

Dan Lucero, Executive Director, Colorado Association for Career and Technical Education

Several national high school reform models explicitly integrate academics, practical skills, and career preparation. As the transformation of CTE moves ahead, we may see more high schools in Colorado structured around these types of reforms. Research shows that students attending schools where these reforms are well-implemented tend to have higher levels of achievement.

Career academies, for example, generally operate as small schools-within-schools focused around career themes such as health care, computer technology, or business. MDRC (formerly Manpower Demonstration Research Corporation), which has been studying career academies since 1993, estimates that there are more than 2,500 career academies in the country. Students at career academies follow a curriculum that includes both academic and career-oriented courses, and participate in work-related experiences outside the classroom. MDRC's Career Academies Evaluation has followed 1,700 mostly minority students from nine career academies across the country, comparing them with students who were not in career academies. While both categories of students were equally likely to graduate from high school and continue to postsecondary education, male career academy students who entered the workforce earned about 18 percent more than their counterparts. MRDC researchers concluded that “[c]areer academies are one of the few youth-based interventions that have been found to improve the labor market prospects of young men.”²¹

High Schools That Work (HSTW) is a whole-school reform model from the Southern Regional Education Board, used by more than 1,200 schools in 32 states.

¹⁹ See the Warren Tech website at www.warrentech.org.

²⁰ Personal interviews and site visit, September 14, 2007.

²¹ Kemple, J., and Scott-Clayton, J. (2004). “Career Academies: Impacts on Labor Market Outcomes and Educational Attainment.” (Oakland, CA: MDRC).

Who teaches CTE?

Traditionally, vocational education teachers were hired to pass skills on to students, not to teach academic content. As a result, K-12 CTE teachers do not need to meet the same requirements as teachers of other subjects. However, both secondary and postsecondary CTE teachers do need to be credentialed in order to teach in an approved CTE program. The new Perkins Plan also requires states to revisit the credentialing process. The new CTE credentialing process is intended to ensure that CTE teachers possess both formal academic preparation and “real world” occupational experience.

Under Colorado’s new credentialing process, persons interested in applying for a CTE credential must meet certain criteria that vary depending upon the pathway for which they are seeking the credential.²³ For example, a candidate for an initial three-year secondary credential in the Animal Sciences pathway, located in the Agriculture and Natural Resources career cluster, must have a bachelors or masters degree in agriculture or some other pathway-related field, including 50 semester hours of technical preparation content in career

cluster fields. The candidate must also have 2,000 hours of paid work experience in agriculture or 1,000 hours of an internship in agriculture within the last five years. To be eligible for a five-year professional credential, the candidate must meet all of the above requirements and complete postsecondary career and technical education coursework.

Some pathway credentials require the completion of an associate’s degree, rather than a bachelor’s or master’s degree. For example, the credential for the Maintenance and Operations pathway, located in the Architecture and Construction career cluster, allows candidates to have either an associate’s, bachelor’s, or master’s degree. In career pathways leading to a professional certificate or license, such as nursing or plumbing, teachers must possess the applicable license or certification. Some credentialing pathways do not allow internships to count for experience, and may require more extensive professional experience.

The postsecondary credentialing process is somewhat similar, but there are different requirements and a wider variety of options to qualify for a credential. For example, an applicant for an initial postsecondary Animal Sciences pathway credential need not

have a postsecondary degree, but must have greater amounts of professional experience. If the candidate does have a postsecondary degree, the experience requirements are not as high. Moving from an initial to a professional credential requires the applicant to take specified education courses in teaching, and to obtain a postsecondary degree in the field if that was not part of the initial credential.

Given that the new model of CTE expects students to be able to move seamlessly between secondary and postsecondary programs and institutions, one would expect that a credentialed CTE teacher may teach CTE content no matter where the class is located. In fact, teachers with a secondary credential are also considered qualified to teach at a postsecondary institution, but the reverse is not always true. The federal No Child Left Behind law states that for a secondary CTE course to be eligible for academic credit, the class must be co-taught by a licensed secondary academic content teacher. These are barriers for programs looking to make CTE more rigorous and to create a seamless transition back and forth between CTE at secondary and postsecondary levels.

PROGRAM PROFILE

New Metro-Area High Schools Using CTE to Build on Future

New high schools in the Adams 50 and Douglas County school districts will be using the model of the career academy to help students create pathways to the future. The new Adams 50 high school, set to open in 2010, will feature several career academies, including programs focused on construction and health care. Douglas County’s new high school in Parker will offer career pathways in automotive repair/maintenance, criminal justice, landscape design/management, health sciences and information technology. Douglas County is also building a new CTE wing at its Rock Canyon High School that will feature programs in business technologies, digital media, construction technologies, and science, technology, engineering and math (pre-engineering). In both districts, school administrators are working closely with members of the business community to design the programs and ensure top-quality facilities, equipment, instructors, and workplace experiences.

²³ Schools to Implement Comprehensive Reform? SREB Research Brief. (Atlanta, GA: Southern Regional Education Board).²³ New Colorado credentialing requirements are available online at http://www.coloradostateplan.com/default_cred.htm.

There are no HSTW schools in Colorado. This model combines rigorous academics with a career focus. HSTW students take an academic core that includes four years of English, four years of mathematics (including Algebra I and higher), and three years of science (with two years in laboratory courses). This academic core is combined with high quality CTE courses and work experiences with seasoned mentors. Students learn hands-on skills through working on “real-world” projects based in the community and running school-based businesses. Students at schools with high levels of implementation of HSTW key concepts are much more likely to complete the academic core than are students at schools with low implementation levels.²²

Student Engagement

Advocates for CTE and its predecessor, vocational education, have always argued that students are more engaged and motivated when they are able to do hands-on work that is relevant to the real world and has meaning to them. In general, research has proven this to be true. CTE provides a way for students to place their learning in context, to understand why they are learning what they are learning. This contextualization of learning can be very important for many students, particularly those who do not learn abstract concepts well or who need additional motivation to stay in school. For these reasons, the National Center for Dropout Prevention has identified CTE as one of 15 proven methods for decreasing the high school dropout rate.²⁴

I love being professional. I really feel we get more from learning in an applied setting.

Samantha, student in welding program at Warren Tech and RRCC

In a 2005 study, the National Research Center for Career and Technical Education used longitudinal data to examine the courses taken by over 1,600 students and correlate CTE courses with the likelihood of dropping out of school. Researchers found that there was a highly significant curvilinear relationship between CTE coursetaking and high school graduation. In other words, students who took few CTE courses and those who took

extreme amounts of CTE courses were at greater risk of dropping out. The most beneficial CTE ratio, according to researchers, is a 1:2 CTE to academic course ratio.²⁵ This makes sense, in that students need a certain number of academic credits to graduate, and those students who focus too much on CTE may not be accumulating enough academic credits. On the other hand, those students who do not take CTE lose out on the engagement benefits offered by these courses. As more and more CTE courses offer academic as well as elective credit, we may see more students benefiting from even higher ratios of CTE courses to purely academic courses.

When asked to agree or disagree with the statement: “I will need to know most of the things my teacher is teaching when I get out into the real world”:

All Jeffco students: 45 percent agree

Warren Tech students: 83 percent agree

Districts in Colorado believe that CTE plays a large role in reducing the dropout rate for their students. When asked whether, in their district, CTE helped at-risk students stay in school, 100 percent of responding districts said yes, and 50 percent of these responded, “Yes, absolutely.”

We lose so many kids because Algebra I doesn't connect to anything real.

Linda Bowman, Vice-President, Colorado Community College System, President, Community College of Aurora

Much research has documented the role of relationships in keeping students in school.²⁶ For many students, CTE courses offer ways to learn in teams and produce tangible results that are not readily available in other classes. This learning process often leads to close friendships, both with other students and with teachers. Teachers Burke and Moore, of Loveland High School’s Construction Geometry class, recounted a student panel discussion that presented their experiences to a group of teachers. One student said of the course, “This is kind of like being on a sports team rather than a class.” Another student said, “No, it’s more like being in a family.”

²² Bottoms, G., Presson, A., and Han, L. (2004). “Linking Career/Technical Studies to Broader High School Reform: What Can School Districts, States, and the Nation Do to Get More High Schools to Implement Comprehensive Reform?” SREB Research Brief. (Atlanta, GA: Southern Regional Education Board).

²⁴ National Dropout Prevention Center/Network. “Effective Strategies for Dropout Prevention.” Online at <http://www.dropoutprevention.org/effstrat/default.htm>.

²⁵ Plank, S., DeLuca, S., & Estacion, A. (2005). “Dropping out of high school and the place of career and technical education: A survival analysis of surviving high school.” (St. Paul, MN: National Research Center for Career and Technical Education).

21st Century Skills

As technology and economic changes lead to more uncertainty about the specific knowledge and skills needed for tomorrow's jobs, many analysts have focused on the need for students to learn more broadly applicable skills such as problem-solving and critical thinking. Many elements of CTE lend themselves well to this approach.

In particular, CTE courses tend to employ a problem-solving approach to learning, often using teams of students to analyze a particular situation and develop solutions. Project Lead the Way, for example, requires high school seniors to complete a capstone project in which they work as a member of a team to solve an open-ended engineering problem. Team members must present progress reports, submit a written report, and defend their solution to a panel of outside reviewers.

CTE addresses all those lost arts that business is seeking – problem solving, teamwork, refining techniques.

Sandy Steiner, executive director, Adams County Education Consortium.

Many CTE classes utilize technology, and place a great deal of emphasis on using the most recent technology available. At Warren Tech High School in Jeffco, for example, principal Joe Shaw estimates that there are approximately 400 computers in the building. The Jeffco school district shows its support for this approach by committing to keep computer technology up-to-date (no computers older than three years). In a district survey, 83 percent of Warren Tech students agreed with the statement “My teachers use technology to help me

Partnership for 21st Century Skills Framework
<http://www.21stcenturyskills.org/>.

Learning and innovation skills

- Creativity and innovation skills
- Critical thinking and problem solving skills
- Communication and collaboration skills

Information, media, and technology skills

- Information literacy
- Media literacy
- ICT literacy

Life and career skills

- Flexibility and adaptability
- Initiative and self-direction
- Social and cross-cultural skills
- Productivity and accountability
- Leadership and responsibility

learn,” while just 56 percent of other Jeffco students did. Technology also makes global teamwork possible. Students in Littleton High School's International Business and Computer Applications 2 classes paired with students in Canada and Malaysia to win the grand prize in the international 2006–07 Global Virtual Classroom Contest. (To see their winning website, visit www.virtualclassroom.org.)

PROGRAM PROFILE

Teacher Cadet – Growing the Next Generation of Teachers Through CTE

In Colorado, 29 high schools in 15 school districts offer Teacher Cadet, a popular curriculum for students considering teaching. Entrance requirements are generally rigorous. In the Adams 12 Five-Star School District, for example, applicants must have at least a 3.0 GPA and submit three recommendations from teachers. The one-year course is divided into three sections: experiencing learning, experiencing the profession, and experiencing the classroom. Students participate in 50 hours of field experience and can begin building the portfolio necessary for a teaching license. They receive 1 elective credit, and .5 credits each of composition and literature. Of the 500 Colorado students who took Teacher Cadet in 2005, two-thirds reported having decided on teaching as a career choice. For more information, visit the Colorado Teacher Cadet website at <http://coloradoteachercadet.com/>.

²⁶ For a review of the research, see Lehr, C., Johnson, D., Bremer, C., Cosio, A., and Thompson, M. (2004). “Increasing Rates of School Completion: Moving from Policy and Research to Practice.” (Minneapolis, MN: National Center on Secondary Education and Transition).

Career and technical student organizations (CTSO's) play a large role in secondary CTE programs. Many programs have affiliated student organizations, such as SkillsUSA (trade and industrial occupations), Health Occupations Students of America (health occupations), Future Farmers of America (agriculture education), and Distributive Education Clubs of America (marketing). These organizations are facilitated by a teacher-advisor and focus on developing leadership and employability skills through competitive events, leadership and professional development opportunities, and community service. SkillsUSA contests, for example, allow individual

Student Leader Profile

Loveland High School student Kelly VanWoerkom was elected as the 2007-08 international president of DECA (formerly Distributive Education Clubs of America), a CTSO for students interested in marketing, management, and entrepreneurship. Her responsibilities will include speaking and presenting workshops at DECA conferences, representing the organization to the bipartisan DECA Congressional Advisory Board, and communicating with state affiliates. Upon successful completion of her duties, Kelly will receive a full scholarship to Johnson & Wales University, valued at approximately \$140,000. Visit DECA's High School Division at <http://www.deca.org/hsd.html>.

students and teams to compete in areas as diverse as extemporaneous speaking, architectural drafting, 3D animation, and crime scene investigation. Not surprisingly, CTSO students are in high demand in the workplace.

To understand the effects of participating in CTSOs, researchers at the University of Minnesota compared students in three groups: CTE students who participated in CTSOs; CTE students who did not participate in CTSOs; and students in general education classes (who are not eligible for participation in CTSOs). They found that CTE students who participated in CTSOs tended to score higher in measures such as academic engagement and career self-efficacy, and that more CTSO participation, particularly in competitive events, was associated with higher scores.²⁷

Transitions to Postsecondary Education and Other Long-Term Outcomes

As mentioned previously, one pillar of Governor Ritter's Colorado Promise is the plan to double the number of postsecondary certificates and degrees earned by Colorado residents. Colorado has a number of policies in place that encourage students to continue on to postsecondary education, and several of them involve granting high school students college credit for courses taken in high school. CTE has recently adopted its own version of this – Advanced Credit Pathways (ACP). Through ACP, high

PROGRAM PROFILE

Good News for Fine Dining in Colorado

CTE students from Battle Mountain High School in Minturn won first place in the 2007 National Restaurant Association Educational Foundation's ProStart Culinary Competition, beating out teams from across the country. The students were required to prepare a starter, entrée and dessert within 60 minutes, and were judged on taste, presentation, sanitation, safety, and teamwork. The winning menu featured a wild mushroom, fennel, and pancetta salad, sautéed Colorado striped bass, and a rustic buttermilk pancake with caramelized apples. The winning teams were presented with \$1.3 million in scholarships to institutions such as The Culinary Institute of America and Johnson & Wales University. For more information, visit the National Restaurant Association Educational Foundation's website at <http://www.nraef.org/prostart/npsi/>.

The Key Role of Business in CTE

Now is the time to enhance communications between industries and educational institutions. Businesses must clearly make their workforce needs understood and educational institutions must be willing to adapt programs to their needs.

Metro Denver WIRED Initiative Workforce Survey, 2007

school students earn college credit for CTE classes that are equivalent to college-level learning. As CTE advances and partnerships between high schools and postsecondary institutions expand and become more seamless, we should see greater numbers of postsecondary credentials earned by CTE students. A recent research report looking at CTE dual enrollment programs in Florida and New York confirmed that these programs increased postsecondary enrollment for these students.²⁸

Research shows that even the “old” form of vocational education did not discourage students from moving on to postsecondary education. A study that looked at students who were CTE concentrators in 1992 found that the majority of students had enrolled in postsecondary education by 2000, and about 30 percent of these earned postsecondary certificates or degrees in fields related to their CTE area of study.²⁹

CTE courses tend to have a positive labor market payoff. In one study looking at national data, high school CTE concentrators earned 12 percent more one year after graduating, and 8 percent more seven years after graduating. Those who took at least one computer course earned even more. These results held whether or not students ultimately entered or completed postsecondary education.³⁰ Researchers looking at California’s career academies found that CTE concentrators earn 18 percent more per month than comparable high school graduates.³¹

Business support is essential to public and legislative awareness of CTE as a viable and valuable education strategy. The business community is perhaps the most influential voice in advocating for the importance of CTE to national, regional, and local economies, because in essence it is the primary customer for CTE. If business does not advocate for CTE, policy makers will question its usefulness. Recognizing this, the Colorado Community College System is creating a new state-level executive advisory council of business leaders to advise the state on economic trends and employer needs. As Secretary of Education Margaret Spellings recently told Colorado business leaders, CTE “is a great place for business to get involved.” Specific recommendations for business leadership in support of CTE at the state level are found at the end of this report.

At the local level, the federal Perkins Act has long required vocational programs to have community advisory groups with a majority of membership from businesspeople engaged in the field. These groups are responsible for

PROGRAM PROFILE

Center for New Media

The Center for New Media is a partnership between Colorado State University–Pueblo, Pueblo Community College, and Pueblo District 60. CNM focuses on the digitization of electronic media technologies and the convergence of traditional media with the computer. Pueblo District 60, PCC, and CSU share equipment and resources, including access to digital production and post-production facilities and a television station. The school district offers New Media CTE courses, and the 2-year New Media CTE program at PCC transitions seamlessly into the 4-year major in Mass Communications with an emphasis in New Media.

For more information, visit <http://chass.colostate-pueblo.edu/mccnm/cnm3.html>.

²⁸ Karp, M., Calcagno, J., Hughes, K., Jeong, D., and Bailey, T. (2007). “The Postsecondary Achievement of Participants in Dual Enrollment: An Analysis of Student Outcomes in Two States.” (St. Paul, MN: National Research Center for Career and Technical Education).

²⁹ Laird, J., Chen, X., and Levesque, K. (2006). “The Postsecondary Experiences of High School Career and Technical Education Concentrators: Selected Results from the NELS:88/2000 Postsecondary Education Transcript Study.” (Washington, DC: United States Department of Education, Institute for Education Sciences).

³⁰ Bishop, J. and Mane, F. (2004). “The impacts of career-technical education on high school labor market success.” *Economics of Education Review*, 23, 381-402.

³¹ Kemple (2004).

ensuring that the program meets local workforce needs and is up-to-date on the latest technologies, processes, and equipment. If local programs are not high-quality, the promise of CTE will not be realized.

Business, tell us what you want kids to learn.

CTE educator

CCCS has published a nationally-recognized guide to effective CTE advisory committees.³² This guide provides a list of suggested advisory committee activities, including strategies for leadership in the following areas:

- Curriculum development, including
 - Identifying competency levels and performance standards
 - Identifying employability skills
 - Reviewing textbooks and instructional materials
- Public relations, including
 - Obtaining effective media coverage
 - Presenting to civic and community groups
 - Securing additional funding for equipment and resources
- Job placement, including:
 - Providing students with cooperative training and internships
 - Provide job offers for qualified students and coordinate job openings with other employers
 - Conduct occupational surveys and economic forecasts
- Recruitment
 - Of new teachers
 - Of new students
 - Of new advisory committee members
- Teacher training, including:
 - Provide summer and part-time workplace opportunities for teachers to upgrade their skills
 - Provide inservice training for teachers on new developments and methods
 - Encouraging personal innovation

- Student organizations, including
 - Designing and judging skill competitions
 - Sponsoring and recognizing student organization events
- Legislative, including:
 - Giving legislators tours of local CTE programs
 - Communicating with legislators about the benefits of CTE and the needs of particular programs
- Program evaluation, including:
 - Reviewing program outcomes such as completion, graduation, placement
 - Assuring the programs are up-to-date and technologically current

Without solid and reliable business participation in these areas, CTE programs risk being irrelevant to business and students. Reports from the Colorado field indicate that local CTE advisory committees vary widely in their usefulness to programs. Some advisory committees are fully engaged and proactive in meeting their responsibilities. Others have had the same membership for years and act more as rubber stamps for outdated programs.

How Is CTE Funded in Colorado?

In general, CTE is more expensive to provide than general education. Many CTE offerings require specialized equipment, larger facilities, and smaller student-teacher ratios to meet safety regulations. According to reports from Colorado's school districts, providing CTE to Colorado's K-12 students costs about \$95 million annually. About 75 percent of this cost is borne by the districts, using operating revenue they receive under the School Finance Act. The School Finance Act provides per-pupil operating revenue to districts, and does not give districts extra for more expensive CTE students, so districts must fund most of CTE by juggling funds meant for all students. Some states and districts address this issue by "weighting" CTE students so that districts will receive additional per-pupil funding for them. For example, Texas provides 1.35 times the base funding for CTE students.³³ Colorado school districts receive about \$21 million in

assistance from the state under the Colorado Vocational Act (CVA), specifically meant to reimburse districts for part of their CTE costs above and beyond district per-pupil funding.³⁴ Because of the nature of the formula, some districts receive a majority of their funding from the CVA, while others receive very little. Districts also receive \$6.3 million from the federal Perkins Act. In order to receive funds from the Perkins Act and the CVA, CTE programs in districts must agree to abide by the substantive requirements of the laws.

The cost of CTE per district varies widely depending upon the types of programs provided and cost-efficiencies. For example, providing a business administration class generally does not require specialized equipment, while providing automotive repair classes requires not just specialized equipment but also larger facility sizes. Agricultural programs are generally the most expensive programs for districts to run. Districts who can partner with community colleges, technical colleges, and/or local industry to share equipment, facilities, and expertise will be better positioned. Many district CTE programs depend upon such partnerships.

Colorado's four technical colleges, which partner with school districts to provide CTE certificates, are funded by school districts (which may include funds from the Colorado Vocational Act). The state also allocates approximately \$8.5 million to the technical colleges, administered by the State Board of Community Colleges and Occupational Education.

Community colleges also receive funding for CTE from the federal Perkins Act, approximately \$8.5 million. This covers approximately 10 percent of their costs of providing CTE. The remaining amount comes from outside grants and donations, tuition and fees, and per-student funding through the state's College Opportunity Fund (COF). Because COF provides a set amount of money per student without regard to the cost of the program attended by the student, the community college system must spread costs represented by COF throughout the system. This means that urban community colleges generally subsidize rural institutions, and general education programs subsidize CTE programs.

Fulfilling the Promise of CTE

CTE Initiatives in Colorado

To meet the requirements of the new CTE, the Colorado Community College System has formed a Colorado State Planning Team to develop a state plan. Participants in the planning process include the Colorado Department of Education, the Colorado Department of Higher Education, the Colorado Association of Career and Technical Educators, local and postsecondary CTE directors, and the Colorado workforce system. Topic teams, on issues ranging from Assessment of Student Learning to Workforce Needs and Technology, have been meeting to develop drafts for Colorado's Five-Year Perkins Plan. Under the state's one-year transition plan, career clusters will become effective in Colorado in the 2008-09 school year. Information about the Colorado State Plan is available at www.coloradostateplan.com.

PROGRAM PROFILE

Wray Wind Turbine Project

The Wray School District, in eastern Colorado, was in trouble. Declining enrollment and increasing costs caused the district to cut 15% of its overall budget. Energy costs, in particular, were soaring. The superintendent challenged district staff to come up with savings ideas that would also enhance student educational experience. The result? Under a plan created by CTE instructor Jay Clapper and his agriculture class, the district is purchasing a wind turbine to offset

energy costs and to generate revenue through the sale of renewable energy credits. Community business leaders such as the Yuma County Economic Development Corporation, Highline Utility, Y-W Electric, and the Rocky Mountain Farmers Union have been involved in planning, donations, and technical and professional support. As a result of this project, the district saves money, Wray residents benefit, and Wray students learn about renewable energy through the operation of the only district-owned wind turbine in the state.

For more information, visit <http://www.wrayschools.org/>.

³³ Texas Education Code sec. 42.154.

³⁴ Colorado Community College System (2005). "Colorado Vocational Act: 35th Annual Report." (Denver, CO: Author).

The State Planning Team will finalize its proposed plan in December 2007. The next few months will be devoted to gathering public input and comments on the plan from business and industry leaders, educators, community members, and other stakeholders. The plan will be formally presented to the U.S. Department of Education in May 2008.

In the meantime, CCCS is developing technical resources for districts and postsecondary institutions to use in revamping their CTE programs and curricula. CCCS is holding multiple training sessions for CTE administrators. Foundation standards for CTE programs are expected soon, and a plan of study template has been completed. While CCCS is taking an active and visible role in leading the transformation of CTE, the community college system was seriously affected by budget cuts in the past few years, and staff is spread thin. Without assistance from other parts and levels of the education system, it will be difficult to CCCS staff to singlehandedly transform CTE.

CTE Initiatives in Other States

Many states have already embraced the promise of the new CTE and are ahead of Colorado in its implementation. National CTE expert Hans Meeder, former Deputy Assistant Secretary for Education in the U.S. Department of Education's Office of Vocational and Adult Education, characterizes Colorado as "middle of the pack" in terms of implementing the new CTE. Meeder points to the greater ability and willingness of other states to coordinate CTE efforts as key to their success.³⁵

The most important reform that CTE programs must commit to and pursue aggressively – with help from state and federal governments – is to steadily ratchet up academic standards so that CTE is an alternative pathway to postsecondary success, not a lesser track. Academic rigor must come first. Without it, CTE cannot succeed – and should not be allowed to divert resources and students from more profitable options.

Jobs for the Future, 2005³⁶

The following states are taking the lead in doing what must be done to bring CTE into today's world: they are mandating academic rigor in CTE classes and providing the resources and support to ensure that it happens.

Arizona: Arizona has developed CTE curricular frameworks for a variety of career pathways. The website of the Arizona Department of Education's CTE department provides a curricular scope and sequence, academic crosswalks, competencies and indicators, assessment options, teaching resources, and teacher certification requirements for pathways ranging from fashion design to sports medicine. (See http://www.aztechprep.org/CTE_Programs/cte_programs.html) As discussed above, Arizona CTE students are now outscoring general education students.

California: In March 2007, Governor Arnold Schwarzenegger hosted the state's first CTE summit, gathering education, business, labor, foundation, and political leaders to form strategies for CTE to help fill the need for qualified workers in fast-growing, high-demand fields.

I love career tech, love it.

Gov. Arnold Schwarzenegger, 2007 State of the State address

California has invested heavily in career academies, which it calls Partnership Academies after its model of creating academies that are partnerships between the school, the district, and industry. Partnership Academies are small schools-within-schools focusing on career themes and targeted to at-risk students. Students at Partnership Academies learn academics and CTE skills, and benefit from business mentoring and internships. Partner employers commit to serving on a school steering committee, assist in the development of the curriculum, provide speakers and host field trips, supply mentors, and provide summer jobs and part-time school year jobs for students. Partnership academies are funded jointly by the state, the district, and the employer partners.³⁷ Partnership Academy students have higher graduation rates and higher completion of a college entrance curriculum than other students in the state, with the largest outcomes for minority students.³⁸

³⁵ Telephone interview, September 27, 2007.

³⁶ Kazin, R. (ed.) (2005). "Remaking Career and Technical Education for the 21st Century: What Role for High School Programs?" (Boston, MA: Jobs for the Future).

In May 2005, California adopted Career Technical Education Model Curriculum Standards for grades 7-12. There are two types of standards: foundation standards such as academics, communication, and technology, needed by all students for success in the workplace; and pathway standards, representing knowledge and skills necessary for each specific career pathway. For more information, visit <http://www.cde.ca.gov/ci/ct/sf/>.

Maryland: In building its CTE career clusters and pathways, Maryland has focused on emphasizing problem-solving and critical thinking skills throughout CTE programs. The state also bundles CTE courses with college preparatory coursework. For example, Maryland's finance and accounting students must also take four years of college preparatory math, including end-of-course examinations. Maryland supports quality CTE by provides funding for statewide curriculum development and assessment toolkits. Teacher professional development is funded by the state in partnership with business and industry. Project Lead the Way, a pre-engineering curriculum, is provided in 19 of Maryland's 24 school districts, and many schools use the High Schools That Work model. As a result of this integration of rigor and CTE, more than half of Maryland's CTE concentrators meet state college entrance requirements, up from 14 percent a decade ago.³⁷

Texas: Achieve Texas is a new state initiative that uses the career cluster model to prepare all students for success by combining "rigorous academics with relevant career programs." (www.achievetexas.org). The initiative encourages districts to embrace career clusters as a priority educational improvement strategy. The following are the goals of Achieve Texas:

- Career clusters and programs of study are an integral part of the Texas education system
- Every student prepares a personalized graduation plan in middle school to plan for grades 9-16 and beyond. The student chooses a career cluster and program of study to guide his or her learning in the context of personal career interests. Plans are evaluated and updated annually.

- Clusters span all grades (P-16+). Career awareness begins in elementary school and transitions into career exploration in middle school. Career concentrations in high school help students transition into career preparation in postsecondary. All participants experience career advancement in employment.
- The system is seamless between high school and postsecondary institutions. Students have opportunities in a program of study to earn dual credit and articulated credit that flows seamlessly into postsecondary education or training.
- Partnerships are in place throughout the system. Partnerships are established statewide and locally between business and education. Educational institutions form meaningful partnerships.
- Academics are woven throughout the P-16+ curriculum. There is an integration of academic and technical knowledge and skills within the curriculum. Interdisciplinary teaching takes place and academics are taught in context. Curriculum alignment occurs between secondary and postsecondary education.
- Career guidance is dramatically enhanced. All students have access to quality assessment and career information resources. Career counseling is provided with a strong emphasis on career and college readiness.
- All students take part in extended learning opportunities. Every student chooses extended learning opportunities such as service learning, internships, apprenticeships, and work-based learning.
- Professional development supports the cluster system. Professional development is a critical part of the teacher's career. Schools of education train teachers for the cluster system.

Approved CTE courses count towards fulfillment of the Texas Recommended High School Program and/or the Texas Distinguished Achievement High School Program, including technology application requirements and math and science requirements.

³⁷ For more information about California Partnership Academies, visit <http://www.cde.ca.gov/ci/gs/hs/cpaoverview.asp>

³⁸ Bradby, D., Malloy, A., Hanna, T., and Dayton, C. (2007). "A Profile of the California Partnership Academies 2004-05." (Berkeley, CA: ConnectEd and Career Academy Support Network).

³⁹ Maryland State Department of Education. (n/d). "Career and Technology Education: Frequently Asked Questions." Available at www.marylandpublicschools.org.

Recommendations for Colorado

In order to reap the full promise of CTE as a rigorous and relevant approach that prepares students both for the workplace and for postsecondary education, Colorado will need to be intentional and vigilant as the transformation of CTE moves ahead. State and local policies must support CTE. Policy change, however, is necessary but not sufficient. Ultimately, high-quality CTE will be forged by communities, schools, and businesses working together, and the ultimate test of quality will be revealed daily in CTE classrooms around the state. This requires keen and sustained focus on the quality of individual programs. Consequently, recommendations will be discussed for both policy and programmatic levels.

State-level recommendations:

1. State legislation and rules should reflect the role of CTE as a key strategy for education reform. Colorado should consider the following strategies:

- a. Any proposed state-level legislation or rules that may affect high school course-taking should provide incentives for students to take rigorous CTE courses if they so choose. The state should define minimum procedures that must be followed to approve CTE courses as rigorous for state-level purposes. Policies affected may include:
 - i. CCHE rules relating to public college admission requirements, which should allow approved CTE courses to count for credit in academic areas such as mathematics, science, and/or language arts
 - ii. Any proposed state-level high school diploma requirements
 - iii. Any proposed state-level high school diploma endorsements
 - iv. Any proposed coursetaking requirements for eligibility for postsecondary financial aid or scholarships
- b. Create a state-level high school diploma endorsement for students who complete applicable

high school graduation requirements and also complete a CTE program

- c. Create a statewide work-readiness certificate for students who successfully complete a CTE program and wish to enter the workforce directly

2. The structure, processes, and actions of state-level institutions responsible for education should reflect the importance of CTE as a pathway to success. Recently, there has been very little focus on CTE from those responsible for K-12 education in Colorado, and this has hampered our state's ability to move ahead as quickly as other states in this area. Colorado should consider the following strategies:

- a. Appoint a position or department at the Colorado Department of Education that is responsible for communicating and coordinating with the CTE governance structure located at the Colorado Community College System. This position or department should be prepared to provide technical assistance to CTE secondary programs, to assist with transitions between secondary and postsecondary education, and to represent secondary CTE in K-12 policy decisionmaking
- b. Conduct public awareness campaigns, in partnership with local institutions and schools and with business and community leaders:
 - i. to ensure that students and their families are aware of the opportunities presented by CTE
 - ii. to ensure that superintendents, principals, and counselors are aware of the opportunities presented by CTE
- c. Show that CTE outcomes are important to Colorado by adopting indicators for CTE processes and outcomes that are incorporated into the accreditation process
- d. Ensure that educational data systems have the ability to track all students from secondary into postsecondary education, including those who are pursuing a CTE career pathway

3. State-level financial support for CTE should reflect that rigorous and relevant CTE is a key strategy for education reform in the state. Colorado should consider the following strategies:

- a. Amending the Colorado School Finance Act to provide a “weight” for full-time equivalent CTE students in K-12
- b. Amend the Colorado Vocational Act to provide grants for districts and schools needing to purchase equipment or supplies for CTE programs, in addition to the formula funding currently provided in the act
- c. Provide financial incentives for districts to open schools and programs that are research-based, such as career academies, models such as High Schools That Work, Project Lead the Way, and others.
- d. Amending the terms of the College Opportunity Fund to provide a “weight” for full-time equivalent CTE students attending postsecondary institutions
- e. Funding additional secondary and postsecondary academic and career counselors for students, and ensuring that counselor training includes information about CTE opportunities
- f. Provide financial incentives for businesses to create internship/externship opportunities and to donate equipment, expertise, and/or space to CTE programs

4. The Colorado Community College System and the Colorado Department of Education should provide high-quality resources and assistance for districts and postsecondary institutions as they adopt career pathways, plans of study, and rigorous assessments for CTE programs. Colorado should consider the following strategies:

- a. Adopt model foundation and content standards for CTE programs, building from work done in other states and in some Colorado districts
- b. Provide a model curriculum and assessment bank for CTE programs, completing the work begun at www.coloradocte.com.
- c. Develop a bank of rigorous on-line and/or

distance CTE education courses, particularly for technology-based CTE, to allow students to have access to a wide range of CTE regardless of geographic location

- d. Provide opportunities for CTE program providers to share best practices, challenges, and opportunities

5. State-level institutions should support the efforts of districts and institutions to find and retain high-quality CTE instructors. Colorado should consider the following strategies:

- a. Require university-based teacher preparation programs to instruct secondary education candidates in incorporating CTE projects and concepts into traditional academic courses, and in working with CTE teachers to make academic concepts explicit in CTE courses
- b. Provide incentives for candidates for traditional teacher licenses to also become credentialed in CTE
- c. Ensure that state-level policies permit qualified community college instructors to teach secondary CTE courses even if they do not possess a professional teacher’s license
- d. Provide grant-based funding for districts to provide time for secondary academic content and CTE teachers to work together for the purpose of cross-walking CTE courses and academic content standards, so that academic credit may be granted for CTE coursework

6. State-level institutions and processes should ensure that business and industry leaders are brought into the CTE planning and implementation process as full and essential partners. Colorado should consider the following strategies:

- a. Implement current plans to form a business-focused state-level executive advisory committee to advise CCCS on economic and workforce trends
- b. Provide professional development opportunities for CTE and academic content teachers in partnership with business and industry, following national benchmarks such as Maryland

K-12 School District Recommendations:

1. K-12 districts should provide clear guidance to schools about the levels of quality expected in CTE programs. Districts should consider the following strategies:

- a. Adopt foundation and technical content standards for CTE courses and provide curricular frameworks and assessments
- b. Establish a process for the awarding of academic credit for CTE courses that contain rigorous academic content.
- c. Provide time for secondary academic content and CTE teachers to work together to cross-walk CTE courses and academic content standards
- d. Provide instructional coaches to work with CTE teachers
- e. For NCLB purposes, set up processes that allow academic content teachers to be the teacher of record for CTE courses that grant academic content in the event that the CTE teacher does not meet NCLB qualifications
- f. Disaggregate student performance data for CTE programs and compare with regular programs; use data to hold programs accountable

2. K-12 districts should ensure that district policies and procedures provide the greatest range of CTE learning possible for district students. Districts should consider the following strategies:

- a. Providing a wider range of CTE coursework through rigorous online and/or distance learning

CTE, particularly for technology-based CTE courses

- b. Partnering with other districts to share “circuit-riding” CTE teachers

3. K-12 districts should ensure that students are engaged in planning their own futures and understanding the variety of pathways open to them, including CTE. Districts should consider the following strategies:

- a. Require students to begin a career planning process in 8th-grade that continues through high school, using resources such as College in Colorado (www.collegeincolorado.com) to ensure that students are aware of all of their options
- b. Provide tours of CTE programs available in the district, following the model of the Jefferson County Public Schools

4. K-12 districts should include CTE as a key tool for educational improvement in their schools. Districts should consider the following strategies:

- a. Opening new schools or restructuring existing schools as career academies or around other research-based CTE themes
- b. Adopting CTE content to improve traditional academic classes

Next Steps for Colorado's Business Community

Most of the recommendations referenced above will require the assistance and commitment of Colorado's business community for successful implementation. The following are priority recommendations for Colorado business at both the policy and program levels:

- **Be an active and vocal participant in the transformation of CTE in Colorado.**
 - Serve on and support the state-level CTE executive advisory committee that will be providing information to CCCS about economic and workforce trends
 - Monitor the Colorado State Plan process
 - Provide information about industry standards and expectations so that statewide CTE standards will reflect industry as well as academic standards
 - Make sure that business is at the table in all discussions of CTE
- **Monitor proposed legislation in the 2008 session to support the inclusion of rigorous and relevant CTE as a key strategy for education reform in Colorado.**
 - Play a prominent role in devising and monitoring policy recommendations from the P-20 Council to ensure that they are consistent with CTE
 - Support legislation that allows rigorous CTE coursework to be included as part of coursework requirements designed to improve college readiness
- **Monitor higher education entrance requirements adopted by the Colorado Commission on Higher Education to support the inclusion of rigorous CTE coursework.**
- **Support targeted funding to improve CTE offerings, including:**
 - Grant-based public-private funding for implementation of innovative and research-based CTE programs such as Project Lead the Way
- **Participate in a statewide public awareness campaign to bring attention to opportunities in CTE. Bring business's unique perspective to support investment in human capital through career and technical education.**
- **Commit to serving on program advisory committees as part of the civic responsibility of a business leader to the next generation. Make sure that advisory committees are forward thinking, and not just about compliance.**
- **As regional business organizations and economic development corporations, develop regional strategies for ensuring that CTE programs have access to the latest technologies, expertise, space, job shadowing, and internships for students.**
- **Commit to teacher development by providing summer externships for teachers and participating in teacher training.**