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Governance Brief

Supporting STEM Access, Equity, and Effectiveness: *STEM and CTE Work for California's Economic Future*

by Eric Hoyer

Introduction

Career and Technical Education (CTE) is an important element of California education, both in high school and community college. For secondary students, CTE is a career-oriented pathway or set of courses typically taken in high school, specializing in an industry. Career-focused education has moved away from emphasizing vocations or trades, as the terminology reflects an outmoded model; namely, that students enrolled in career track courses are not interested in post-secondary education. However, the need for graduates in CTE fields shows no sign of slowing down. Approximately one-third of new jobs in California require education beyond high school but less than a bachelor's degree.¹ Advanced manufacturing, transportation, information technology, and health care are some of California's most in-demand fields. CTE can lead to high-quality, well-paying careers for students with minimal post-secondary preparation. When that path includes community college, this can also mean significantly less debt than is incurred with a degree from a four-year institution. A recent study showed that the returns in wages for CTE certificates and degrees ranges from 14 to 45 percent above a high school diploma.²

A common misperception about CTE is that it provides a remedial path for students who are not college-ready. In fact, the coursework is intensive, demanding, and, in some fields, such as engineering or information technology, requires a solid background in math and science. An additional misperception is that students who enter CTE fields from high school, community college, or vocational school do not go on to college. Evidence indicates that higher education trajectories can vary for students, depending on age, field, and family situation. A recent study from the Council of Graduate Schools posited that the trend for the future is for a lifelong education model, where students

In this brief you will find:

- » The benefits of CTE for K-12 students
- » California's STEM needs that can be filled by CTE
- » How STEM and CTE complement each other
- » How CTE is funded in California
- » Strategies for successful STEM CTE programs

have on- and off-ramps to college, certificates, and graduate school depending on the requirements of their chosen career field.³ For students in CTE pathways to meet entrance requirements for college or certificate programs, they need solid foundations in math and science. Students who do not have the requisite high school coursework may be forced to take post-secondary remedial courses, and research has shown that this may be a barrier to successful program completion.⁴

What are California's CTE Needs?

California expects high growth in CTE fields such as advanced manufacturing, health care, renewable energy, and information and communication technologies.⁵ As a large and diverse state, California's CTE needs vary by region. In Los Angeles County, for example, aerospace engineering has been a staple industry. In the greater Sacramento area, food and beverage manufacturing have historically been high-demand career areas. Many of the current job

growth categories in California require strong science and math backgrounds. Whether programming an AutoCAD machine in a manufacturing plant or developing a watering schedule for a commercial farm, STEM disciplines (science, technology, engineering, and math) underpin many necessary competencies in current and future in-demand careers.

Priority Career and Technical Education Sectors by Region⁶



Greater Sacramento, Northern Coastal, Northern Inland

Agriculture, Water & Environmental Technologies; Business & Entrepreneurship; Health

North Bay

Agriculture, Water & Environmental Technologies; Business & Entrepreneurship; Retail/Hospitality/Tourism

East Bay

Advanced Manufacturing; Health; Life Sciences/Biotech

Mid-Peninsula

Energy, Construction & Utilities; Health; Information & Communication Technologies/Digital Media

Silicon Valley

Health; Information & Communication Technologies/Digital Media; Advanced Manufacturing

Santa Cruz/Monterey

Health; Information & Communication Technologies/Digital Media; Agriculture, Water & Environmental Technologies

Central Valley

Advanced Manufacturing; Agriculture, Water & Environmental Technologies; Health

Mother Lode

Business & Entrepreneurship; Information & Communication Technologies/Digital Media; Retail/Hospitality/Tourism

South Central Coast

Advanced Manufacturing; Health; Business & Entrepreneurship

Los Angeles

Advanced Manufacturing; Health; Advanced Transportation & Logistics

Orange County

Advanced Manufacturing; Health; Retail/Hospitality/Tourism

Inland Empire

Advanced Manufacturing; Health; Global Trade

San Diego

Health; Advanced Transportation & Logistics; Life Sciences/Biotech

What Does CTE Look Like in K-12?

Career and Technical Education is offered at both the high school and community college level in California, as well as at many private vocational schools. While there are 15 industry sectors defined by the California Department of Education (CDE) (shown in Table 1), there are a myriad of STEM careers within many of these sectors.

About 40 percent (close to 800,000) of California’s high school students were enrolled in a CTE course during the 2016–17 school year.⁸ The most popular industry sectors with CTE high school students were arts, media, and entertainment; information and communication technologies; and agriculture and natural resources. California’s most in-demand fields, such as manufacturing and transportation, have lower enrollment at both the high school and

community college levels. Health sciences and medical technology are popular at both types of institutions. Engineering and architecture, while relatively popular in high school (7.5 percent), do not remain so in community college (3 percent).

The success of CTE is a bright spot in California education. For example:

- » Graduation rates for CTE students in California were strong at 92 percent in 2017.⁹
- » A recent study showed a positive correlation between the number of CTE units taken and high school completion rates as well as on-time high school graduation rates.¹⁰
- » A Massachusetts study compared graduation rates among low-income students and found that CTE students from

Table 1: Enrollment in CTE Programs Varies Across Institutions and Industry Sectors (2016-17)⁷

Industry Sector (as defined by CDE)	Share of CTE enrollment	
	High school	Community college
Arts, media, and entertainment	20.4%	17.5%
Information and communication technologies	12.4%	7.8%
Agriculture and natural resources	10.0%	1.8%
Health science and medical technology	9.0%	11.3%
Engineering and architecture	7.5%	3.0%
Hospitality, tourism, and recreation	7.2%	3.2%
Business and finance	6.4%	12.3%
Education, child development, and family services	5.5%	12.9%
Building and construction trades	4.3%	2.4%
Manufacturing and product development	3.9%	4.3%
Public services	3.7%	9.3%
Transportation	3.7%	3.5%
Marketing, sales, and service	2.5%	3.0%
Energy, environment, and utilities	0.9%	1.2%
Fashion and interior design	0.8%	6.5%
Total CTE enrollment	772,350 (40%)	414,951 (35%)
Total high school student enrollment	1,945,402	1,183,114

low-income backgrounds showed a 21 percent gain in graduation rates over a 14-year period as compared to their non-CTE peers from similar backgrounds.¹¹

In addition, students and parents express positive views about the CTE programs in which they or their children have participated. Advance CTE, a leading nonprofit advocate for CTE in the United States, recently authored a study of parent and student satisfaction with their CTE experience. They found that 92 percent were either satisfied or very satisfied with their CTE programs.¹² These researchers went further and identified three areas of satisfaction: students and parents appreciated the opportunities to learn real world skills, earn college credit, and explore different career options.

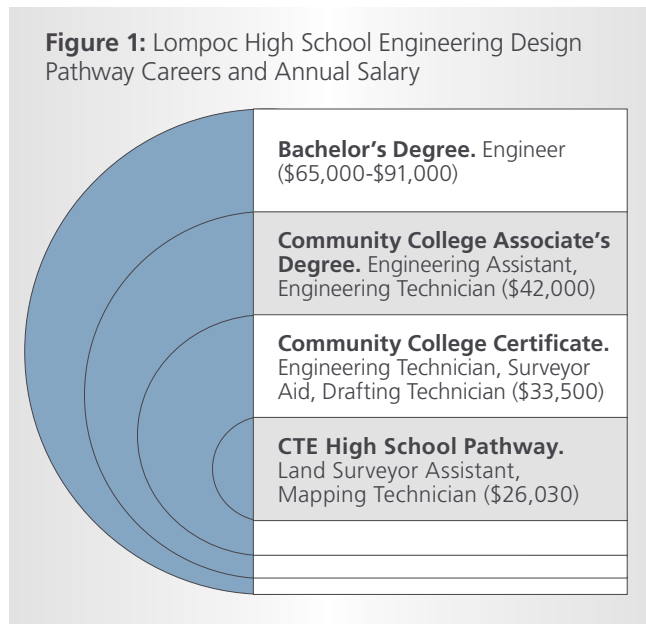
Connecting CTE and STEM

The California Department of Education adopted the latest CTE standards, called Standards for Career Ready Practice, in January 2013. CTE teachers subsequently contributed to the alignment of these standards with the Common Core State Standards in math and English language arts (adopted in 2010) and the California Next Generation Science Standards (adopted in 2013). The Standards for Career Ready Practice list the core knowledge and skills that students should obtain in a CTE pathway.¹³ Below (Table 2) is a sample indicating some of the greatest alignment areas between CTE, math, and science standards.

CTE Provides Pathways with Options

Lompoc High School in northern Santa Barbara County provides an example of how a STEM/CTE pathway can give students career options. The high school has a tiered Engineering Design pathway with multiple tracks to engineering careers. The science and math courses in these tracks must

be rigorous enough and provide students with adequate support to succeed in this demanding coursework so that they can meet any post-secondary entrance requirements for their degree or certificate programs of choice. This ensures that students are less likely to have to enroll in remedial courses in community college or university, which is associated with a greater likelihood of not completing their degrees.¹⁴



Sources of CTE Funding

State Funding

The Local Control Funding Formula (LCFF) transformed the California funding system for K-12 education in 2013. However, a significant portion of CTE support remains categorical or has been funded through one-time initiatives. The Regional Occupational Centers and Programs (ROCP), the largest block grant for CTE funding, was eliminated in

Table 2: Areas of Alignment Between CTE, Math, and Science Standards

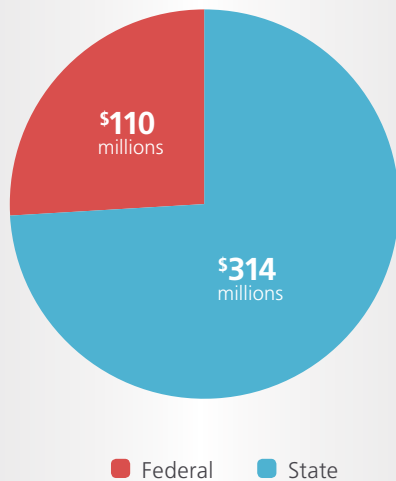
CTE Standards for Career Ready Practice	Common Core State Math (CCSM) Standards	California Next Generation Science (NGSS) Standards
Communicate clearly, effectively, and with reason	Construct viable arguments and critique the reasoning of others	Engage in argument from evidence
Utilize critical thinking to make sense of problems and persevere in solving them	Make sense of problems and persevere in solving them	Ask questions and define problems; construct explanations and define solutions
Employ valid and reliable research strategies	Use appropriate tools strategically	Analyze and interpret data

2013–14. Replacing this funding were limited-term grant funds through the CTE Incentive Grant (CTEIG) and the California Career Pathways Trust (CCPT). Proposition 51, passed in 2016, provided \$500 million in one-time funding to CTE facilities improvement projects. In his final state budget, Governor Jerry Brown approved continuing the CTEIG on a permanent basis, with \$150 million for 2018–19. The other state categorical program that funds CTE is the Strong Workforce Program, which allocated \$164 million to K-12. This program is managed by the community colleges and allows school districts and county offices of education (COEs) to apply for funding for their CTE programs.

Federal Funding

Modern federal CTE funding started in 1984 when Congress passed the Carl D. Perkins Vocational and Technical Education Act. This act has been reauthorized three times, most recently in 2018, with the Strengthening Career and Technical Education for the 21st Century Act, also known as “Perkins V.” California’s share of this \$1.2 billion program in 2018 was approximately \$110 million. The department of education in each state typically administers these funds, and California is no exception.

Figure 2: CTE Funding Sources for California Secondary Schools, 2018-19



Actions that School Leaders Can Take

Advance CTE conducts extensive research on career and technical education and has a variety of resources designed for school leaders. Below are a few recommended strategies for supporting CTE from various studies.

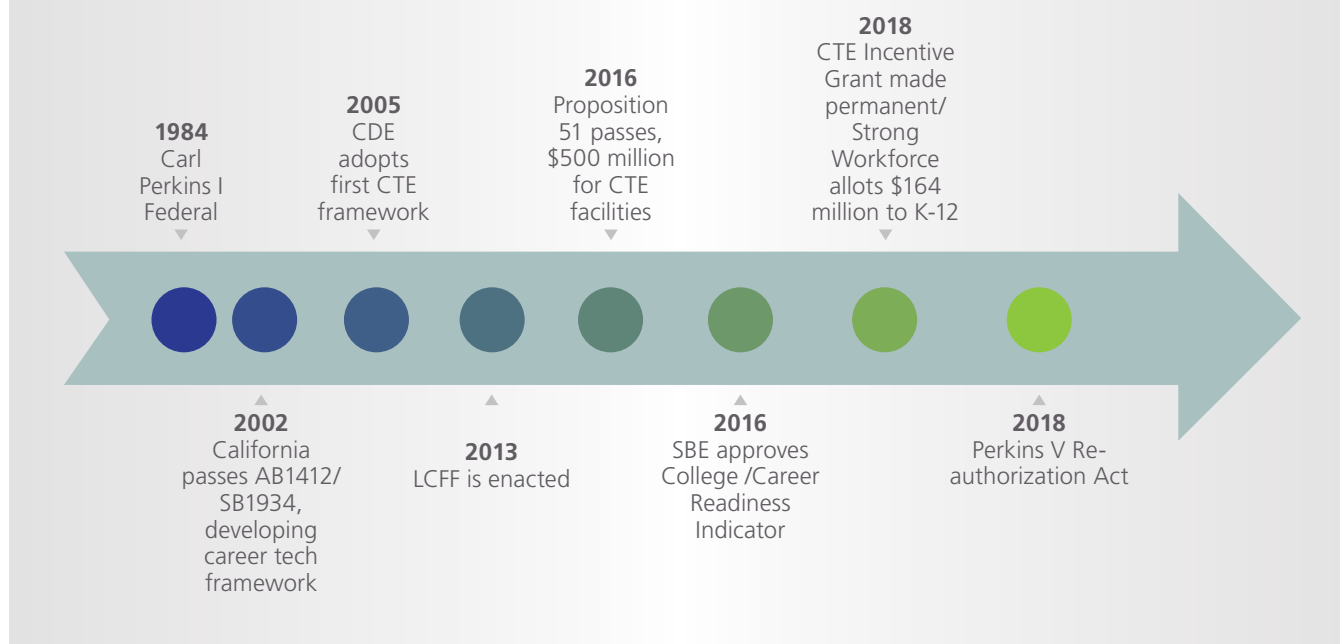
The Message

Start messaging about CTE by seventh grade. By the time students are in eighth grade, they have most likely decided on which high school to attend. Students should be aware of what CTE offerings their public comprehensive high school has and what may only be offered at a local public technical or career-oriented high school. Guidance counselors and school leaders should be able to assist students in navigating these choices. Middle school is also the time when math and science pathways for high school are decided upon. It is essential to ensure that students who choose CTE pathways are not put into math or science course sequences that do not meet A-G requirements (University of California and California State University standards) for college admissions or that might otherwise limit their post-secondary options.

Build awareness of CTE. Research indicates that only 47 percent of prospective students and parents are aware of what career and technical education is. In contrast, vocational education is recognized by 68 percent of students and parents. The CTE brand needs a greater marketing push by districts and county offices of education so that students see all career pathways as CTE. How do districts and COEs brand CTE? In an Advance CTE study, districts in four states piloted various themes for CTE in their middle and high schools. The most impactful messages, according to parents and students, among all student groups, were: “Preparation for the real world” and “Exploring career possibilities.” Students responded well to the messaging that used phrasing like “real-world skills,” “mentoring,” and “hands-on experience.” “Being passionate about a career” is also a motif that worked well with respondents. In contrast, messages that emphasized “investment,” “in-demand careers,” and “workforce” were not as successful. While districts, states, and industry may think in terms of workforce supply and demand, students respond to language invoking passion for a career and work experiences.¹⁵ Districts and COEs should examine their CTE pathways to ensure that their programs are providing the appropriate skills, mentoring, and hands-on experience and that the programs are marketed with themes that resonate with students and parents. Superintendents and site administrators can ensure that a clear vision and message are being sent out about CTE.

Know the best messengers. According to the pilot study, guidance counselors (83 percent) and teachers (78 percent) are the most effective messengers for CTE. Superintendents were near the bottom of the list at 51 percent. What does this mean for boards? Districts should prioritize learning sessions for guidance counselors and teachers on CTE. In addition, former students can connect with current students who are thinking

Figure 3: Timeline of CTE Funding in California



about CTE. For example, principals developing CTE days at their school might invite former CTE pathway alumni to connect with students about career options.

The Programs

Leverage data. District and COE leadership must be knowledgeable about the regional labor market in order to develop appropriate CTE programs. In California, community colleges have regional Centers for Excellence,¹⁶ which provide labor market data analysis and have specific recommendations for programs at area community colleges. High schools can develop programs in concert with these recommendations. Working with a neighboring community college allows districts and COEs to develop pathways and ensure students have a smooth transition to post-secondary education.

One barrier to successful CTE in California is that the state lacks a comprehensive data system to track students beyond high school. Tracking student outcomes will assist the state, local educational agencies, and schools in understanding how effective their CTE programs are in terms placement, graduate salaries, and further education. Governor Gavin Newsom has proposed allocating \$10 million to develop a comprehensive K-12 data tracking system. One estimate put the annual cost of a post-secondary tracking system at \$2 million.¹⁷

States that have developed an evaluation system of their CTE programs include Arkansas, Massachusetts, Michigan, and Tennessee. In addition, a comprehensive tracking system will assist research on CTE—a gap in education research discussed in a recent Getting Down to Facts II report.¹⁸

Support synergy between STEM and CTE. One of the myths about CTE is that students who graduate from CTE programs are not “college material.” The reality is that CTE students are more likely to have a post-high school plan, which includes college, than non-CTE students.¹⁹ In addition, CTE students can earn college credit in high school, which saves them time and money once in college. College and career readiness is not an either/or proposition.

Whether students see CTE as a pathway of possibilities, including college, largely depends upon their middle and high school experiences. Do they have the coursework in math and science to meet A-G requirements? What are the district’s or COE’s policies on A-G? Pasadena Unified School District requires that all students graduating high school meet A-G requirements, regardless of pathway. This model gives CTE students post-secondary options. For example, students who graduate with a manufacturing technician certificate from a community college can enter a four-year bachelor’s degree path more easily if their high school experience was A-G compliant.

A further step in ensuring that CTE students have a strong understanding of STEM subjects is by ensuring that CTE teachers are current in the Next Generation Science Standards and Common Core Math standards that are relevant to their industry sector. The Association for Career and Technical Education (ACTE) hosts an annual “STEM Is CTE Symposium” that brings together educators, industry, nonprofits, government, and advocates to collaborate on STEM/CTE learning.

Get involved in planning. Governing board members should inquire as to the district’s or COE’s input on workforce planning in the region. Community colleges have Strong Workforce task forces based on industry sector (e.g. advanced manufacturing) and region. These groups include industry leaders as well as community college representatives in order to plan academic programs around the local economy’s needs. Local educational agencies are typically represented at K-12 Strong Workforce Program Regional Engagement meetings.²⁰

Questions for Boards Members

1. What are the top industry sectors in the area? Do high school CTE offerings align with the needs of these sectors?
2. How are students enrolled in high school CTE programs? What is the district or COE doing to ensure CTE is not designated as a remedial track?
3. What post-graduation data does the district or COE have on CTE students to assist in program planning?
4. What collaboration is happening in high schools between science and math teachers and CTE educators? Are there opportunities for greater synergy so that CTE teachers can reinforce the standards-based math and science curricula?
5. What is the district or COE doing to promote STEM careers through CTE pathways? Are STEM/STEAM nights inclusive of those careers?
6. What collaboration is happening with area community colleges to make sure students are ready for the next wave of job growth?

Additional Resources

Dos and Don’ts for Engaging Students and Parents around CTE: <https://bit.ly/2GdtpDP>

Making a Winning Case for CTE: How Local Leaders Can Communicate the Value of CTE:: <https://bit.ly/2MDOiZS>

Summary of Messages to Engage Parents & Students: <https://bit.ly/2G8HORr>

The Value and Promise of Career and Technical Education Fact Sheet: <https://bit.ly/2zxJZfP>

State Profiles from the Association of Career & Technical Education: <https://bit.ly/2BaVEzA>

Best Practices in CTE Program Planning and Evaluation: <https://bit.ly/2TluVrd>

Rural CTE Strategy Guide: <https://bit.ly/2BbUjAv>

Endnotes

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- 7 See Endnote 1.
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- 9 CSBA Analysis. US Department of Education. Data retrieved December 15th, 2018 from <https://bit.ly/2ATFPNx>
- 10 Gottfried, M. & Stratte Plasman, J. (2017). Linking the Timing of Career and Technical Education Coursetaking With High School Dropout and College-Going Behavior. *American Educational Research Journal*, 5(2). Retrieved from <https://bit.ly/2MlgPU4>
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- 15 See Endnote 12.
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