MEETING LABOR MARKET DEMAND THROUGH CTE PROGRAMMING – UNITED STATES AND CALIFORNIA

In the following report, Hanover Research identifies high-demand occupations in career and technical education (CTE) fields. Hanover Research also provides recommendations for curriculum, instruction, staffing, and community partnerships for CTE programs in these high-demand areas.

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September 2017

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INTRODUCTION

Advocates and researchers clearly identify career and technical education (CTE) as an essential avenue to fill jobs in an evolving labor market. Often, "high-need—and frequently high-paying—skilled worker vacancies" remain unfilled due to disconnects in student preparation and in-demand skills and competencies.[1] Research shows that CTE participants are better prepared to obtain these positions than students who do not possess experience in CTE.[2] Consequently, CTE advocates urge district and school administrators to identify and partner with growth industries at the national, state, and local levels so that students are ready to assume available positions in expanding career fields.[3]

In the following report, Hanover Research (Hanover) examines labor market trends nationally and within California using data from the Bureau of Labor Statistics (BLS), Georgetown University's Center on Education and the Workforce (CEW), ManpowerGroup (Manpower), and the California Labor Market Information Division (LMID). Hanover also investigates secondary literature on curriculum, instruction, staffing, and community partnerships to support implementation of these programs. The report proceeds in three sections:

- **Section I: High Demand Occupations** examines employment projections data for the United States and California.
- **Section II: Refining and Expanding CTE Programs** discusses best practices in industry and higher education partnerships and staffing to support existing and additional CTE programs.
- **Section III: Designing Effective CTE Programs** identifies resources and best practices that districts can use in three high-demand CTE career clusters: health science and medical technology; building and construction trades; and hospitality, tourism, and recreation.

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[1] Richmond, E. "Study: Big Benefits to Career and Technical Education." Education Writers Association, April 15, 2016. http://www.ewa.org/blog-educated-reporter/study-big-benefits-career-and-technical-education

[2] Dougherty, S.M. "Career and Technical Education in High School: Does It Improve Student Outcomes?" Thomas B. Fordham Institute, 2016. p. 12. http://edex.s3-us-west-2.amazonaws.com/publication/pdfs/%282016.04.07%29%20Career%20and%20Technical%20Education%20in%20High%20School.pdf

[3] [1] "Retooling Career Technical Education." National Governors Association Center for Best Practices, 2007. pp. 1, 5–6, 11. http://www.mpc.edu/home/showdocument?id=6403 [2] Moore, J. "The Importance and Relevance of CTE." Psychology Today, March 4, 2015. https://www.psychologytoday.com/blog/putting-america-work/201503/the-importance-and-relevance-cte

KEY FINDINGS

- **At the national and state levels, demand for employees with an associate's degree or lower is strong in health science and medical technology, building and construction trades, and hospitality, tourism, and recreation.** Specifically:
  - ***The need for health professionals is prominent at the national and state levels.*** Nationally, health science and medical technology careers comprise the six highest demand occupations for high school diploma holders and individuals with no formal education credential, and 16 of 21 high-demand occupations requiring an associate's degree, postsecondary certificate, or some college coursework. In California, healthcare jobs are the fastest growing occupation cluster.
  - ***Skilled trade positions have been the hardest positions to fill nationally for seven consecutive years.*** In the United States, 10 of 35 high-demand fields requiring a high school diploma or no formal education credential fall within the building and construction trades cluster. In California, six related occupations have an expected growth rate of 30 percent or higher from 2014 to 2024.
  - ***Hospitality positions are in greater demand in California than in the United States overall.*** The CEW reports that food and personal services have a projected growth rate of 18 percent nationwide, compared to 22 percent in California. LMID data show that six of California's high-demand occupations are in hospitality, tourism, and recreation.

SECTION I: HIGH-DEMAND OCCUPATIONS

In the following section, Hanover analyzes data from the BLS, CEW, Manpower, and LMID to identify high-demand occupations in CTE disciplines. The section begins with an overview of labor market projections before analyzing United States and California trends.

OVERVIEW OF LABOR MARKET PROJECTIONS

Based on Hanover's analysis of the national and state labor markets, **the health science and medical technology, building and construction trades, and hospitality, tourism, and recreation career clusters are the highest demand CTE fields**, as shown in Figure 1.1 below. On the next page, Figure 1.2 displays the criteria used to determine the intensity of labor market demand for each career cluster at the national and state levels.[4] Using these indicators, Hanover determined that:

- Health science and medical technology workers are highly demanded at the national and state levels;
- Building and construction workers are highly demanded at the national level and moderately demanded in California;
- Hospitality, tourism, and recreation workers are highly demanded in California and moderately demanded at the national level; and
- Manufacturing and product development workers are moderately demanded nationally, but experience low demand in the California labor market.

Figure 1.1: National and State Demand for Career Clusters

Career Cluster	National	State	Related California School District Offerings	
Health Science and Medical Technology	High	High	▪ Intro to Nursing ▪ Medical Core 1 ▪ EKG Monitor Technician ▪ Medical Assisting ▪ Sports Medicine 1	▪ Emergency Responder ▪ Firefighting 1: Wildland Fire and Emergency Medical Response
Building and Construction Trades	High	Moderate	▪ Woodworking Occupations ▪ Cabinetry/Furniture-Making	▪ Construction Safety ▪ Construction 1 ▪ Construction 2
Hospitality, Tourism, and Recreation	Moderate	High	▪ Restaurant 1	▪ Restaurant 2
Manufacturing and Product Development	Moderate	Low	None	

Note: Labor market summary synthesized from information presented throughout this report.

[4] Aviation occupations did not appear in Hanover's labor market scan under the designated criteria, so demand analysis will not include aviation. However, Section III does present information regarding curriculum, instruction, and credentialing for aviation.

Figure 1.2: Criteria for Determining Demand

NATIONAL 	Career clusters were *high-demand* if they met two of the following criteria, *moderate-demand* if they met one criterion, and *low-demand* if they met none: ▪ Six or more high-demand occupations requiring an associate's degree or less in the United States using **BLS** data ▪ A projected national occupational growth rate above 20 percent using **CEW** data ▪ An occupation within a cluster listed in **Manpower**'s talent shortage areas
STATE 	Career clusters were *high-demand* if they met both of the following criteria, *moderate-demand* if they met one criterion, and *low-demand* if the met none: ▪ A projected occupational growth rate above 20 percent using **CEW** data ▪ Three or more high-demand occupations in California using **LMID** data

Note: Figure criteria developed to establish multiple indicators for the intensity of labor market demand at each level.

The need for **health professionals** is prominent across the national and state labor markets. Nationally, health science and medical technology careers represent the six highest demand occupations for high school diploma holders and individuals with no formal education credential. Sixteen of 21 high-demand occupations requiring an associate's degree, postsecondary certificate, or some college coursework also fall under this category. Moreover, the CEW cites healthcare professional and technical jobs and healthcare support as the two fastest growing occupations in California.

Skilled positions in **building and construction trades** represent 10 high-demand fields requiring a high school diploma or no formal education credential at the national level. Similarly, Manpower identifies skilled trades vacancies as the hardest positions to fill for seven consecutive years nationwide. In California, six building and construction occupations have projected growth rates over 30 percent.

Hospitality, tourism, and recreation occupations compose five of the 35 high-demand jobs for high school diploma holders and those without a formal education credential nationwide, and the CEW projects an 18 percent growth rate in food and personal services nationally and a 22 percent growth rate in California. In addition, Manpower cites restaurant and hotel staff as the fifth most difficult position to fill in the United States. LMID data identify six high-demand hospitality, tourism, and recreation positions at the state level.

Furthermore, **manufacturing and product development** occupations feature two jobs in high demand for the U.S. labor market: industrial machinery mechanics and computer-controlled machine tool operators. Laborers—a related field—also appears in Manpower's list of talent shortages. However, only one manufacturing and product development position is in high demand in the California state labor market: Industrial Machinery Mechanics.

U.S. LABOR MARKET

BLS Occupational Outlook

In our investigation of high-demand CTE careers, Hanover used data from the BLS's Employment Projections Data database (EPD). First, Hanover searched the EPD for occupations typically requiring entry-level education of a high school diploma or lower, yielding 444 entries. Hanover isolated 35 high-demand fields by limiting the occupation list to jobs with projected growth rates above or equal to ten percent and projected increases in volume of 10,000 new positions or more between 2014 and 2024. Below, Figure 1.3 displays these occupations and associated data for each, ordered by projected growth.

Based on these criteria, Hanover identifies health science and medical technology, building and construction trades, and hospitality, tourism, and recreation as the three highest demand career clusters for workers with a high school diploma or no formal education credential. Seven high-demand jobs are in health science and medical technology fields—including the top six occupations by projected growth rate. Ten positions fall within building and construction trades, and five are hospitality, tourism, and recreation positions. Two other positions belong to the manufacturing and product development career cluster.

Figure 1.3: U.S. High-Demand Occupations Requiring a High School Diploma or No Formal Education Credential, 2014-2024

Occupation	Total Jobs 2014	Total Jobs 2024	Projected Number of New Jobs	Projected Growth Rate	Projected Openings Due to Growth and Turnover	Median Annual Wage
Physical Therapist Aides	50,000	69,500	19,500	39.0%	34,000	$25,680
Home Health Aides	913,500	1,261,900	348,400	38.1%	554,800	$22,600
Personal Care Aides	1,768,400	2,226,500	458,100	25.9%	601,100	$21,920
Opticians, Dispensing	75,200	93,000	17,800	23.7%	37,900	$35,530
Health Technologists and Technicians, All Other	102,200	125,900	23,600	23.1%	33,800	$41,070
Medical Secretaries	527,600	635,800	108,200	20.5%	163,800	$33,730
Brickmasons and Blockmasons	78,100	92,600	14,500	18.6%	21,000	$49,250
Helpers—Electricians	69,000	81,500	12,500	18.0%	21,100	$29,530
Industrial Machinery Mechanics	332,200	391,900	59,700	18.0%	145,900	$50,040
Computer-Controlled Machine Tool Operators, Metal and Plastic	148,800	174,800	26,000	17.5%	71,200	$37,880
Self-Enrichment Education Teachers	348,700	402,200	53,500	15.4%	119,200	$37,330
Cooks, Restaurant	1,109,700	1,268,700	158,900	14.3%	452,500	$24,140
Electricians	628,800	714,700	85,900	13.7%	181,800	$52,720
Residential Advisors	103,700	117,900	14,100	13.6%	45,700	$25,570
Food Servers, Nonrestaurant	253,100	287,000	33,800	13.4%	96,000	$21,240

Occupation	Total Jobs 2014	Total Jobs 2024	Projected Number of New Jobs	Projected Growth Rate	Projected Openings Due to Growth and Turnover	Median Annual Wage
Cement Masons and Concrete Finishers	155,200	175,500	20,300	13.1%	39,200	$39,180
Taxi Drivers and Chauffeurs	233,700	264,400	30,600	13.1%	74,800	$24,300
Billing and Posting Clerks	514,600	581,100	66,500	12.9%	174,100	$36,150
Roofers	123,400	139,300	15,800	12.8%	34,700	$37,760
Construction Laborers	1,159,100	1,306,500	147,400	12.7%	378,600	$33,430
Bus and Truck Mechanics and Diesel Engine Specialists	263,900	295,500	31,600	12.0%	76,900	$45,170
Healthcare Support Workers, All Other	102,700	114,700	12,000	11.7%	33,400	$36,330
Plumbers, Pipefitters, and Steamfitters	425,000	474,100	49,100	11.5%	105,200	$51,450
Social and Human Service Assistants	386,600	430,800	44,200	11.4%	120,000	$31,810
Automotive and Watercraft Service Attendants	105,800	117,600	11,700	11.1%	53,800	$22,420
Electrical Power-Line Installers and Repairers	118,600	131,600	13,000	11.0%	60,300	$68,010
Combined Food Preparation and Serving Workers, including Fast Food	3,159,700	3,503,200	343,500	10.9%	1,364,600	$19,440
First-Line Supervisors of Personal Service Workers	255,800	283,800	28,000	10.9%	76,400	$36,700
Sales and Related Workers, All Other	103,000	114,000	11,000	10.7%	25,400	$37,190
Nonfarm Animal Caretakers	204,800	226,400	21,600	10.6%	63,800	$21,990
Bartenders	580,900	640,900	60,100	10.3%	278,300	$20,800
Recreation Workers	379,300	418,300	38,900	10.3%	108,900	$23,870
Operating Engineers and Other Construction Equipment Operators	363,400	400,600	37,200	10.2%	97,800	$45,890
First-Line Supervisors of Construction Trades and Extraction Workers	578,400	636,100	57,700	10.0%	103,600	$62,980
Color Codes for CTE Career Clusters						
Health Science and Medical Technology	Building and Construction Trades	Hospitality, Tourism, and Recreation	Manufacturing and Product Development	Other		

Source: BLS[5]

[5] Figure data taken directly from: "Employment Projections | U.S." Bureau of Labor Statistics. https://data.bls.gov/projections/occupationProj

In our second search using the EPD, Hanover targeted occupations requiring entry-level education of an associate's degree, postsecondary nondegree award, or some college but no earned degree, yielding 99 job titles. Hanover isolated 21 high-demand fields by limiting the occupation list to jobs with a projected growth rate above or equal to ten percent and a projected increase in volume of 10,000 or more positions between 2014 and 2024. Below, Figure 1.4 displays these high-demand occupations and associated data for each.

Hanover's analysis identifies health science and medical technology as the highest demand career cluster for workers with an associate's degree, postsecondary nondegree award, or some college. Sixteen high-demand jobs are in health science and medical technology fields, with two occupations—occupational therapy assistants and physical therapist assistants—having projected growth rates that exceed 40 percent. Just one position falls in the building and construction trades career cluster.

Figure 1.4: U.S. High-Demand Occupations Requiring an Associate's Degree, Postsecondary Certificate, or Some College, 2014-2024

Occupation	Total Jobs 2014	Total Jobs 2024	Projected Number of New Jobs	Projected Growth Rate	Projected Openings Due to Growth and Turnover	Median Annual Wage
Occupational Therapy Assistants	33,000	47,100	14,100	42.8%	23,600	$59,010
Physical Therapist Assistants	78,700	110,700	31,900	40.6%	54,700	$56,610
Web Developers	148,500	188,000	39,500	26.6%	58,600	$66,130
Diagnostic Medical Sonographers	60,700	76,700	16,000	26.4%	27,500	$69,650
Phlebotomists	112,700	140,800	28,100	24.9%	51,600	$32,710
Emergency Medical Technicians and Paramedics	241,200	299,600	58,500	24.2%	98,000	$32,670
Medical Assistants	591,300	730,200	138,900	23.5%	262,100	$31,540
Cardiovascular Technologists and Technicians	52,000	63,500	11,500	22.2%	21,400	$55,570
Massage Therapists	168,800	205,200	36,500	21.6%	49,000	$39,860
Veterinary Technologists and Technicians	95,600	113,600	17,900	18.7%	27,400	$32,490
Dental Hygienists	200,500	237,900	37,400	18.6%	70,300	$72,910
Dental Assistants	318,800	377,400	58,600	18.4%	137,500	$36,940
Medical and Clinical Laboratory Technicians	163,400	192,400	29,000	17.8%	68,100	$38,950
Nursing Assistants	1,492,100	1,754,100	262,000	17.6%	599,000	$26,590
Licensed Practical and Licensed Vocational Nurses	719,900	837,200	117,300	16.3%	322,200	$44,090

Occupation	Total Jobs 2014	Total Jobs 2024	Projected Number of New Jobs	Projected Growth Rate	Projected Openings Due to Growth and Turnover	Median Annual Wage
Medical Records and Health Information Technicians	188,600	217,600	29,000	15.4%	71,200	$38,040
Surgical Technologists	99,800	114,500	14,700	14.8%	24,600	$45,160
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	292,000	331,600	39,600	13.6%	84,200	$45,910
Computer User Support Specialists	585,900	661,000	75,100	12.8%	150,500	$49,390
Respiratory Therapists	120,700	135,500	14,900	12.3%	43,300	$58,670
Manicurists and Pedicurists	113,600	125,300	11,700	10.3%	20,600	$22,150
Color Codes for CTE Career Clusters						
Health Science and Medical Technology		Building and Construction Trades		Other		

Source: BLS[6]

CEW Occupational Outlook

The CEW is a "research and policy institute[…]that studies the link between education, career qualifications, and workforce demands" with the "goal of better aligning education and training with workforce and labor market demand."[7] CEW's occupational outlook provides an alternative forecast of the U.S. economy to that predicted by BLS projections, making it useful for comparative analysis.[8] In its 2013 report "Recovery: Projections of Jobs and Education Requirements through 2020," the CEW found that healthcare occupations will experience the fastest growth through 2020, followed by jobs in community services and the arts and science, technology, engineering and mathematics (STEM) fields (see Figure 1.5).

[6] Figure data taken directly from: Ibid.
[7] "About the Center." Georgetown University Center on Education and the Workforce. https://cew.georgetown.edu/about-the-center/
[8] Carnevale, A.P., N. Smith, and J. Strohl. "Recovery: Job Growth and Education Requirements through 2020." Georgetown University Center on Education and the Workforce, 2013. p. 5. https://cew-7632.kxcdn.com/wp-content/uploads/2014/11/Recovery2020.FR_.Web_.pdf

Figure 1.5: U.S. Fastest Growing Occupations, 2010-2020

Occupation	Total Jobs 2010	Total Jobs 2020	Projected Number of New Jobs	Projected Growth Rate
Healthcare Professional and Technical	6,480,000	8,490,000	2,010,000	31%
Healthcare Support	3,660,000	4,610,000	950,000	26%
Community Services and Arts	6,290,000	7,920,000	1,630,000	26%
STEM	6,050,000	7,600,000	1,550,000	26%
Education	8,160,000	10,120,000	1,960,000	24%
Managerial and Professional Office	19,980,000	24,740,000	4,760,000	24%
Social Science	700,000	830,000	130,000	19%
Food and Personal Services	23,220,000	27,380,000	4,160,000	18%
Sales and Office Support	37,660,000	42,130,000	4,470,000	12%
Blue Collar*	28,400,000	30,750,000	2,350,000	8%
Color Codes for CTE Career Clusters				
Health Science and Medical Technology	Building and Construction Trades	Hospitality, Tourism, and Recreation	Manufacturing and Product Development	Other

*Blue collar encompasses jobs in: farming, fishing, and forestry; construction and extraction; installation, maintenance, and repair; production; and transportation and material moving. Thus, blue collar occupations exist for building and construction trades and manufacturing and product development.[9]
Source: CEW[10]

The CEW also projects the number of total jobs in specific fields by educational attainment. On the next page, Figure 1.6 shows the total number of jobs available for workers at various education levels, ranging from less than a high school diploma to an associate's degree. Healthcare occupations (i.e., healthcare professional and technical, healthcare support) will have 7,910,000 total positions for workers possessing an associate's degree or less by 2020. The next two fastest growing categories—community services and the arts and STEM—will have 2,490,000 and 2,250,000 jobs respectively for workers with an associate's degree or less.

[9] Ibid., pp. 90–103.
[10] Figure data taken directly from: Ibid., p. 13.

Figure 1.6: Projected U.S. Educational Distribution of Total Jobs, 2020

Occupation	Less Than High School	High School Diploma	Some College/ No Degree	Associate's Degree	Total Jobs Requiring an Associate's Degree or Less
Healthcare Professional and Technical	60,000	450,000	880,000	2,450,000	3,840,000
Healthcare Support	530,000	1,380,000	1,360,000	800,000	4,070,000
Community Services and Arts	160,000	590,000	950,000	790,000	2,490,000
STEM	70,000	420,000	830,000	930,000	2,250,000
Education	100,000	530,000	790,000	660,000	2,080,000
Managerial and Professional Office	640,000	2,790,000	3,440,000	2,580,000	9,450,000
Social Science	No data	No data	10,000	10,000	20,000
Food and Personal Services	6,590,000	8,900,000	5,370,000	2,810,000	23,670,000
Sales and Office Support	3,050,000	11,330,000	10,420,000	5,790,000	30,590,000
Blue Collar*	7,990,000	12,390,000	5,420,000	2,670,000	28,470,000
Color Codes for CTE Career Clusters					
Health Science and Medical Technology	Building and Construction Trades	Hospitality, Tourism, and Recreation	Manufacturing and Product Development	Other	

*Blue collar encompasses jobs in: farming, fishing, and forestry; construction and extraction; installation, maintenance, and repair; production; and transportation and material moving. Thus, blue collar occupations exist for building and construction trades and manufacturing and product development.[11]
Source: CEW[12]

Manpower-Identified Talent Shortages

In 2016, Manpower—a human resources firm that assists businesses with staffing and talent management development—completed its 11th Annual Talent Shortage Survey of over 2,200 U.S. hiring managers to identify occupations with supply shortages.[13] Per respondents, skilled trades (e.g., electricians, plumbers) have been the hardest vacancies to fill nationally for seven consecutive years, and nurses and restaurant and hotel staff were also shortage areas.[14] The ten hardest job areas to fill identified by the survey are displayed in Figure 1.7.

Figure 1.7: Top Ten Talent Shortage Areas

1. Skilled Trades*	2. Drivers	3. Sales Representatives	4. Teachers	5. Restaurant and Hotel Staff
6. Accounting and Finance Staff	7. Nurses	8. Laborers	9. Engineers	10. Technicians+

*Skilled trades include electricians, carpenters, welders, bricklayers, plasterers, plumbers, masons, and more.
+Technicians to include production, operations, and maintenance technicians.
Source: Manpower[15]

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[11] Ibid., pp. 90–103.
[12] Figure data taken directly from: Ibid., p. 70.
[13] "Workforce Solutions." ManpowerGroup. http://www.manpowergroup.com/workforce-solutions
[14] "2016/2017 U.S. Talent Shortage Survey." ManpowerGroup, 2016. p. 2, 5. http://www.manpowergroup.us/campaigns/talent-shortage/assets/pdf/2016-Talent-Shortage-Whitepaper.pdf
[15] Figure adapted from: Ibid., p. 5.

CALIFORNIA LABOR MARKET

CEW OCCUPATIONAL OUTLOOK

The CEW's state level projections for job growth and education requirements find that health science and medical technology is the career cluster with the highest anticipated growth rate in California. Healthcare support jobs are expected to increase by 32 percent or 112,920 total jobs from 2010 to 2020, and healthcare professional and technical jobs are expected to increase by 26 percent or 159,710 total jobs in that period of time. Other fields anticipating job growth greater than 20 percent include social sciences, food and personal services, and STEM (see Figure 1.8 below).

Figure 1.8: California Fastest Growing Occupations, 2010-2020

Occupation	Total Jobs 2010	Total Jobs 2020	Projected Number of New Jobs	Projected Growth Rate
Healthcare Support	352,750	465,670	112,920	32%
Healthcare Professional and Technical	608,250	767,960	159,710	26%
Social Sciences	97,330	119,380	22,050	23%
Food and Personal Services	2,774,240	3,374,460	600,220	22%
STEM	790,080	967,510	177,430	22%
Education	903,220	1,074,270	171,050	19%
Managerial and Professional Office	2,415,440	2,876,040	460,600	19%
Community Services and Arts	868,740	1,019,710	150,970	17%
Sales and Office Support	4,302,480	4,917,110	614,630	14%
Blue Collar*	3,000,160	3,332,220	332,060	11%

Color Codes for CTE Career Clusters				
Health Science and Medical Technology	Building and Construction Trades	Hospitality, Tourism, and Recreation	Manufacturing and Product Development	Other

*Blue collar encompasses jobs in: farming, fishing, and forestry; construction and extraction; installation, maintenance, and repair; production; and transportation and material moving. Thus, blue collar occupations exist for building and construction trades and manufacturing and product development.[16]
Source: CEW[17]

CEW projections for the number of total jobs in specific fields by educational attainment conclude healthcare occupations (i.e., healthcare professional and technical, healthcare support) will have 231,000 total positions for workers possessing an associate's degree or less by 2020 in California. The next three fastest growing categories—social sciences, food and personal services, and science, technology, engineering, and math (STEM)—will have 1,000, 993,000, and 77,000 total positions respectively, as shown in Figure 1.9 on the next page.

[16] Carnevale, A.P., N. Smith, and J. Strohl. "Recovery: Job Growth and Education Requirements through 2020, State Report." Georgetown University Center on Education and the Workforce, 2013. p. 19. https://cew.georgetown.edu/wp-content/uploads/StateProjections_6.1.15_agc_v2.pdf
[17] Figure data taken directly from: Ibid., p. 18.

Figure 1.9: Projected California Educational Distribution of Total Jobs, 2020

Occupation	Less Than High School	High School Diploma	Some College/ No Degree	Associate's Degree	Total Jobs Requiring an Associate's Degree or Less
Healthcare Support	14,000	41,000	55,000	21,000	131,000
Healthcare Professional and Technical	3,000	12,000	35,000	50,000	100,000
Social Sciences	0	0	1,000	0	1,000
Food and Personal Services	358,000	305,000	249,000	81,000	993,000
STEM	2,000	12,000	43,000	20,000	77,000
Education	3,000	8,000	36,000	18,000	65,000
Managerial and Professional Office	25,000	91,000	178,000	69,000	363,000
Community Services and Arts	6,000	21,000	58,000	26,000	111,000
Sales and Office Support	133,000	385,000	524,000	154,000	1,196,000
Blue Collar*	383,000	357,000	236,000	60,000	1,036,000
Color Codes for CTE Career Clusters					
Health Science and Medical Technology	Building and Construction Trades	Hospitality, Tourism, and Recreation	Manufacturing and Product Development	Other	

*Blue collar encompasses jobs in: farming, fishing, and forestry; construction and extraction; installation, maintenance, and repair; production; and transportation and material moving. Thus, blue collar occupations exist for building and construction trades and manufacturing and product development.[18]
Source: CEW[19]

LMID Occupational Outlook

The California Labor Market Information Division (LMID), part of the state's Employment Development Department, "collect[s], analyze[s], and publish[es] data and reports on California's labor force, industries, occupations, employment projections, wages, and other important labor market and economic data,[20] including a list of statewide occupational employment projections from 2014 to 2024. Hanover searched this data set to identify high-demand occupations, controlling for several factors: educational requirements of an associate's degree or lower; a job growth rate greater than or equal to 25 percent; and an absolute change in the number of new jobs greater than or equal to 5,000. These parameters yielded 21 high-demand fields. On the next page, Figure 1.10 displays these high-demand occupations and associated data for each. **Nine high-demand positions fall in the building and construction trades career cluster, six fall in the hospitality, tourism, and recreation career cluster, and three others relate to health science and medical technology.** Just one high-demand occupation relates to manufacturing and product development: Industrial Machinery Mechanics.

[18] Ibid., p. 19.
[19] Figure data taken directly from: Ibid., p. 18.
[20] "Labor Market Information." State of California Employment Development Department. http://www.labormarketinfo.edd.ca.gov/

Figure 1.10: California High-Demand Occupations, 2014-2024

Occupation	Total Jobs 2014	Total Jobs 2024	Projected Change	Projected Growth Rate	Projected Annual Openings Due to Growth and Turnover	Median Annual Wage
Roofers	16,400	24,400	8,000	48.8%	1,050	$50,698
Web Developers	24,200	35,900	11,700	48.3%	1,480	$77,568
Home Health Aides	32,900	45,700	12,800	38.9%	2,030	$24,209
Cement Masons and Concrete Finishers	19,200	26,400	7,200	37.5%	950	$48,370
Cooks, Restaurant	122,100	167,100	45,000	36.9%	7,730	$25,218
Personal Care Aides	525,200	713,300	188,100	35.8%	23,050	$22,210
Drywall and Ceiling Tile Installers	24,900	33,100	8,200	32.9%	980	$51,592
Electricians	58,400	77,400	19,000	32.5%	2,790	$63,758
Painters, Construction and Maintenance	53,200	70,300	17,100	32.1%	2,560	$43,146
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	22,300	29,400	7,100	31.8%	1,050	$51,700
Combined Food Preparation and Serving Workers, including Fast Food	329,700	432,800	103,100	31.3%	20,960	$20,140
First-Line Supervisors of Food Preparation and Serving Workers	91,600	118,100	26,500	28.9%	5,380	$31,561
Plumbers, Pipefitters, and Steamfitters	40,300	51,900	11,600	28.8%	1,690	$55,434
Carpenters	119,900	153,100	33,200	27.7%	4,700	$51,430
Medical Assistants	80,900	103,300	22,400	27.7%	3,920	$34,518
Chefs and Head Cooks	19,900	25,200	5,300	26.6%	830	$42,054
Self-Enrichment Education Teachers	35,300	44,700	9,400	26.6%	1,600	$38,033
Construction Laborers	114,800	145,000	30,200	26.3%	5,310	$38,389
Bartenders	56,700	71,600	14,900	26.3%	3,620	$24,647
Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop	44,000	55,200	11,200	25.5%	4,250	$20,119
Industrial Machinery Mechanics	24,400	30,600	6,200	25.4%	1,250	$57,242
Color Codes for CTE Career Clusters						
Health Science and Medical Technology	Building and Construction Trades	Hospitality, Tourism, and Recreation	Manufacturing and Product Development	Other		

Source: LMID[21]

[21] Figure data taken directly from: "California Occupational Employment Projects 2014-2024." State of California Employment Development Department, August 2016. http://www.labormarketinfo.edd.ca.gov/data/employment-projections.html

SECTION II: REFINING AND EXPANDING CTE PROGRAMS

This section discusses best practices to support new and existing CTE programs, including establishing relationships with industry partners and higher education institutions and recruiting and retaining CTE teachers.

ESTABLISHING INDUSTRY PARTNERSHIPS

Collaborative partnerships between schools and businesses are a fundamental aspect of effective CTE programming. In forming these partnerships, districts obtain access to professional organizations that can advise students, offer work-based learning experiences, and possibly provide financial and material support to CTE programs.[22] Students benefit from connecting learning to the professional sphere, and teachers gain access to specialized resources. Furthermore, partners benefit from having input in CTE curricula and positive publicity (see Figure 2.1 below).

Figure 2.1: Benefits of School-Business-Community CTE Partnerships

Stakeholder	Benefits	
Students	▪ Connecting "learning to earning" ▪ Work-based learning and internships	▪ Job training ▪ Gaining understanding of industry
Teachers	▪ Access to resources ▪ Classroom volunteers	▪ Guest speakers ▪ Ability to showcase classroom
Businesses	▪ Positive publicity	▪ A better-prepared workforce

Source: Public Schools of North Carolina[23]

Partnering with businesses can help school districts provide students with more rigorous CTE programming. Outside partners may offer students opportunities for practical experience through job shadowing, mentorships, and internships. Importantly, these experiences allow students to practice technical skills and "soft skills" such as communication and teamwork.[24] Furthermore, CTE practica help students "learn how to conduct themselves in the business world and [make professional] connections that may lead to future employment."[25]

At the outset of any district investigation into potential industry partnerships, administrators and teachers should self-assess the needs of their CTE programs and explore

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[22] Baron, K. "Seven Steps to Building School-to-Industry Partnerships." Edutopia, September 27, 2010. https://www.edutopia.org/stw-career-technical-education-community-partnerships

[23] Figure adapted from: "Developing High Quality CTE Programs through Business Engagement." Public Schools of North Carolina. pp. 9–10. https://www.jcpsnc.org/uploaded/Documents/Departments/CTE/Developing_High_Quality_CTE_Programs_Through_Business_Engagement.pdf

[24] "How Schools Can Successfully Partner with Local Businesses." Asia Society. http://asiasociety.org/education/how-schools-can-successfully-partner-local-businesses

[25] Baron, Op. cit.

#1 ASSESS CTE PROGRAM NEEDS

whether these needs could be met through an industry partnership.[26] During self-assessment, districts should examine priorities and identify areas of improvement related to instructional resources and student opportunities. Furthermore, stakeholders should "be clear about what [they] want to achieve and [what] activities are manageable."[27] By clarifying goals and plausible ventures, a district should be more capable of assessing potential industry contributions to its CTE programs.[28]

#2 IDENTIFY POTENTIAL PARTNERS

Once preliminary assessment is complete, a district should begin identifying and investigating potential industry partners. District staff can start this process by brainstorming a list of businesses, non-profits, government agencies, and community organizations located within commutable proximity to the district.[29] In addition, administrators and teachers can research potential partners to determine:[30]

- What services they provide or products they manufacture;
- Whether they are currently active in the community or local schools;
- Whether they are financially healthy enough to sustain a partnership;
- What their reputation is in the local community; and
- Whether their employees have connections to the district (e.g., parents, alumni).

Importantly, school officials can tap into community resources and create a foundation for partnerships by acquainting themselves with local business leaders and networking with community organizations. District representatives may consider joining organizations such as the chamber of commerce or contacting entities such as the Rotary Club and Lions Club to identify potential industry partners.[31]

#3 CONTACT POTENTIAL PARTNERS

After identifying potential industry partners, a district representative should contact the organization in writing, by phone, or in person to present a preliminary partnership proposal. This initial proposal should highlight possible contributions the partner can make to district CTE programs—such as judging school competitions, sponsoring interns, or providing speakers—and ways that the district can reciprocate these contributions (see Figure 2.2).[32]

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[26] "A How-To Guide for School-Business Partnerships." The Council for Corporate and School Partnerships. p. 3. http://www.nhscholars.org/School-Business%20How_to_Guide.pdf

[27] "Toolkit for Building Partnerships between Schools and Businesses or Organizations across South Washington County Schools." South Washington County Schools (Minnesota). p. 3. http://www.sowashco.org/files/community/partnerships/Toolkit.pdf

[28] "A How-To Guide for School-Business Partnerships," Op. cit., p. 3.

[29] "Toolkit for Building Partnerships between Schools and Businesses or Organizations across South Washington County Schools," Op. cit., p. 3.

[30] Bulleted text adapted from: "A How-To Guide for School-Business Partnerships," Op. cit., p. 4.

[31] Ibid., p. 5.

[32] "Toolkit for Building Partnerships between Schools and Businesses or Organizations across South Washington County Schools," Op. cit., pp. 3–5.

The complexity of any proposal will vary depending on the size of the partner, the desired duration of the partnership, and the intended exchange of services and resources. For example, a small local business that a district would like to judge a CTE competition may only require a short letter requesting their participation, whereas a local hospital that the district wants to establish a multi-year job shadowing program with will likely need an extensive initial proposal.[33]

Figure 2.2: Potential Industry Partner Contributions and District Reciprocations

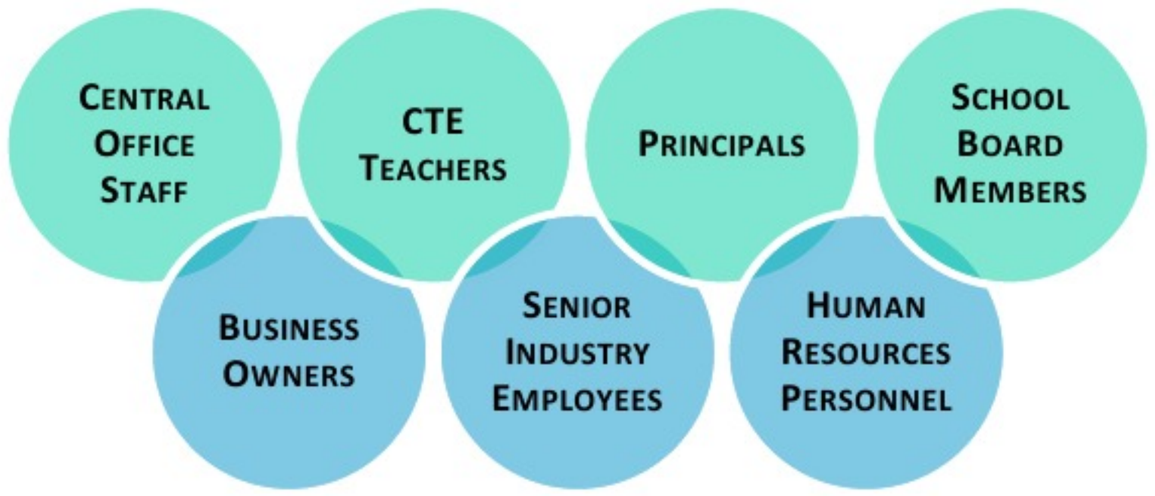
Partner Contributions	
▪ Sponsor field trips and site visits	▪ Serve as judges for CTE competitions
▪ Mentor students	▪ Provide skills demonstrations
▪ Create internship opportunities	▪ Offer career shadowing opportunities
▪ Fund scholarships	▪ Give teachers grants for special projects
▪ Participate in committee work	▪ Assist in district fundraising efforts
District Reciprocations	
▪ Recognize partners at public events	▪ Nominate partners for awards
▪ Publicize partnerships in news releases	▪ Host appreciation gatherings
▪ Provide volunteers for partner events	▪ Offer partners free tickets to district events

Source: South Washington County Schools (Minnesota)[34]

Having made initial contact, and provided the potential partner is interested in meeting, a district should then establish a representative committee with the partner to develop parameters for the relationship and begin planning. Including key individuals from the district and industry partner (see Figure 2.3 on the next page) will help minimize miscommunication and facilitate effective problem-solving and collaboration.[35] Thus, the committee can facilitate a collaborative dialogue around the district's and partner's shared objectives.[36] The committee can also establish clear expectations (e.g., duration, provided services) for the partnership, giving all stakeholders a vision to work toward and a set of outcomes that they seek to help students attain. In addition, the committee should outline short- and long-term goals for the partnership and specific action steps to achieve these goals.[37] Importantly, the committee should "ensure that partnership activities are integrated into the school and business culture" and that they provide "opportunities for students, teachers, and business employees to interact with each other and at community, school[,] and business sites."[38]

[33] "A How-To Guide for School-Business Partnerships," Op. cit., p. 7.
[34] Figure adapted from: "Toolkit for Building Partnerships between Schools and Businesses or Organizations across South Washington County Schools," Op. cit., pp. 4–5.
[35] Ibid., p. 3.
[36] Holle, T.L. "Effective & Sustainable Business and Industry Partnerships." *Techniques*, December 2012. p. 20. http://www.nxtbook.com/ygsreprints/ACTE/g29846_acte_techniques_novdec2012/index.php#/20
[37] "Developing High Quality CTE Programs through Business Engagement," Op. cit., pp. 8–9.
[38] "A How-To Guide for School-Business Partnerships," Op. cit., p. 11.

Figure 2.3: Potential District-Industry Partnership Committee Members



Source: Public Schools of North Carolina[39]

Finally, after outlining the parameters of a partnership and reaching a contractual agreement with an industry partner, **districts should actively monitor the relationship and take steps to keep it healthy and productive.**[40] To accomplish this, the district should openly advocate for the partnership among its staff and highlight the benefits to community members to foster support. Furthermore, the district should design a communications plan to keep the partner and other interested stakeholders informed about progress and activities. Possible communication tools include:[41]

#5 MAINTAIN A STRONG RELATIONSHIP

- Emailed or written newsletters describing successes and upcoming partner activities;
- A website devoted to the CTE partnership; and
- Posters and flyers publicizing the partnership.

Formally and informally expressing gratitude on a regular basis is also important for a sustained and productive partnership.[42] At a minimum, administrators and teachers should send industry partners "thank you" letters for services rendered or donated resources. Similarly, a district may consider having public events to honor all industry partners and awarding partners that have made a particularly vital contribution to students.[43]

ESTABLISHING HIGHER EDUCATION PARTNERSHIPS

Districts looking to bolster their CTE programs should also seek to form partnerships with postsecondary institutions to gain access to qualified teachers in CTE fields, offer students opportunities for dual enrollment (DE) courses, or establish articulation agreements that

[39] Figure adapted from: "Developing High Quality CTE Programs through Business Engagement," Op. cit., p. 42.
[40] "Toolkit for Building Partnerships between Schools and Businesses or Organizations across South Washington County Schools," Op. cit., p. 3.
[41] Preceding and bulleted text adapted from: "A How-To Guide for School-Business Partnerships," Op. cit., pp. 13–14.
[42] "Toolkit for Building Partnerships between Schools and Businesses or Organizations across South Washington County Schools," Op. cit., p. 3.
[43] "A How-To Guide for School-Business Partnerships," Op. cit., p. 15.

assign credit to high school courses.[44] DE programs give "students an opportunity to complete college-level coursework to earn college credits while they are pursuing their high school diplomas."[45] Likewise, articulation agreements formalize a process by which students can earn college credits through the successful completion of "high school courses where students achieve learning outcomes, skills[,] and abilities comparable to those covered in a college course."[46] However, it is important to note that college credit earned via articulation agreements may only be awarded at the partner institution after the student has been enrolled there for a set number of terms or earned a set number of institutional credits depending on the parameters of the agreement.[47]

In California, school districts can partner with community colleges to provide vocational training and CTE coursework to secondary students via DE programming and articulation agreements.[48] Moreover, these institutions can help districts establish links with industry professionals and adjunct faculty who can fill vacancies in the district's CTE programs. Partnering with postsecondary institutions also allows districts to align high school curricula with college-level instruction so students have a better chance for success in higher education. Aligning curricula can help create a steady progression between secondary and postsecondary studies to prepare students to pursue industry credentials.[49]

Establishing a higher education partnership requires districts to consider multiple factors, including program configuration, shared responsibility for implementation, and state regulations governing DE coursework and articulation agreements (see Figure 2.4 on the next page). Specifically, interested districts should first identify and research potential partners and then examine state regulations for establishing partnerships. Following this preliminary work and after soliciting commitment from a postsecondary institution, the district and its partner should mutually determine course logistics, create a plan to cover the costs of partnership activities, and develop strategies to promote and sustain collaborative programming.

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[44] [1] "CTE Fact Sheet for School Leaders." California Department of Education, February 14, 2017. http://www.cde.ca.gov/ci/ct/gi/cteschoolleaderfacts.asp [2] "Career Technical Education." Victor Valley College, August 23, 2016. http://www.vvc.edu/offices/career-technical-education/

[45] Purnell, R. "A Guide to Launching and Expanding Dual Enrollment Programs for Historically Underserved Students in California." Research and Planning Group for California Community Colleges, California Community Colleges Chancellor's Office, and San Joaquin Delta Community College District, 2014. p. 5. http://r-d-p-consulting.com/wp-content/uploads/2016/03/Dual-Enrollment-Toolkit-Updated-Dec2015.pdf

[46] "Articulation and Dual Credit." National FFA Organization. https://www.ffa.org/sitecollectiondocuments/lps_sapg02_dualcredit.pdf

[47] Ibid.

[48] "Dual Enrollment: Considerations for AB 288 Agreements and Non-AB 288 Partnership." Career Ladders Project, Research and Planning Group for California Community Colleges, and California Community Colleges Chancellor's Office. p. 1. http://extranet.cccco.edu/Portals/1/AA/MCHS/Dual%20Enrollment/V7_AB288vsnon-onepager.docx.pdf

[49] Brand, B., A. Valent, and A. Browning. "How Career and Technical Education Can Help Students Be College and Career Ready: A Primer." College and Career Readiness and Success Center, American Institutes for Research, 2013. pp. 8, 12. https://eric.ed.gov/?id=ED555696

Figure 2.4: Considerations for Higher Education Partnerships

- What colleges and universities are available to partner with?
- Does the college provide courses, programs, and degrees in CTE?
- Does the district have an existing relationship with the college?
- What are the state regulations regarding DE and articulation agreements?
- Are there any additional district or college regulations (e.g., student eligibility, placement tests)?
- Where and when should DE classes be held, and who should teach them?
- What are the costs of implementing a partnership?
- Will the partner waive tuition and/or fees for high school students?
- What activities can help recruit students into college courses? Who should be responsible for these?
- What other stakeholders should be targeted in promotional efforts?
- How might successful promotion help sustain DE opportunities and articulation agreements?

Source: University of California at Berkeley[50]

These determinations should be included in a formal contractual agreement between the district and postsecondary partner.[51] DE agreements commonly mandate that course listings, grading practices, and learning standards are consistent between both partners.[52] Likewise, articulation agreements identify the specific high school courses that can qualify students for college credit, align high school courses with college courses, and establish minimum criteria students must fulfill to earn credit through the agreement.[53] Importantly, these CTE partnerships should ground curricula and instruction in industry standards to prepare students to either gain credentials upon completion of their course of study or progress toward acquiring a license in their field.[54]

RECRUITING AND RETAINING INSTRUCTIONAL STAFF

Multiple educational agencies recognize the difficulty in staffing CTE programs. On a national scale, the National Association of State Directors of Career Technical Education Consortium claims that there is a deficit in CTE teachers relative to current demand.[55] As recently as the 2011-2012 school year, the U.S. Department of Education (U.S. DOE) has listed industrial arts—a CTE field—as a teacher shortage area in California.[56] Other states, such as Maryland

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[50] Figure adapted from: Edwards, L. and K. Hughes. "Dual Enrollment for High School Students." University of California at Berkeley, 2011. pp. 6–13. http://eric.ed.gov/?id=ED521460

[51] Klopfenstein, K. and K. Lively. "Dual Enrollment in the Broader Context of College-Level High School Programs." 2012:158, Summer 2012. p. 62. Accessed via EBSCOhost.

[52] "Standards for Successful Dual Enrollment Initiatives." *University Business*, 17:4, April 2014. p. 41. Accessed via EBSCOhost.

[53] deCastro, B.S. and M.M. Karp. "A Typology of Community College-Based Partnership Activities." Community College Research Center, Columbia University. pp. 3–4. https://ccrc.tc.columbia.edu/media/k2/attachments/typology-community-college-partnerships.pdf

[54] Zinth, J.D. "CTE Dual Enrollment: A Strategy for College Completion and Workforce Investment." Education Commission of the States, 2014. p. 4. https://www.ecs.org/clearinghouse/01/11/50/11150.pdf

[55] "Teacher Shortage Undermines CTE." State Directors of Career Technical Education Consortium, 2009. p. 1. https://careertech.org/sites/default/files/TeacherShortageUnderminesCTE-August2009.pdf

[56] "Teacher Shortage Areas Nationwide Listing: 1990-1991 through 2016-2017." U.S. Department of Education-Office of Postsecondary Education, 2016. p. 24. https://www2.ed.gov/about/offices/list/ope/pol/tsa.pdf

and Maine, have had CTE teacher shortages for nearly two decades.[57] These shortages result from a number of factors, including increasing demand for CTE and staff retirement.[58]

Districts can begin their faculty search by contacting professional associations of CTE teachers for referrals or to advertise openings. In California, organizations such as the California Association for Career and Technical Education (CACTE), Association of Career and College Readiness Organizations (CAROCP), California Industrial and Technology Education Association (CITEA), and California Community College Association for Occupational Education (CCCAOE) can be potential resources for recruiting CTE teacher applicants.[59] Partnering with these groups, as well as industry partners, can give districts access to a pool of experts who are familiar with current trends and practices in CTE.[60]

CTE Teacher Shortages

School districts across the nation encounter a limited supply of potential CTE teachers when hiring for open positions. A combination of strategies—financial incentives, alternative working arrangements, and helping current staff earn CTE credentials—can help alleviate the deficit of available candidates.

Schools should also actively look for avenues to attract potential career-changers to open CTE positions.[61] Providing financial incentives is one way to lure experts away from industry. For example, a district may allow career-changers to apply past work experience as years of teaching experience for higher placement in salary schedules. Schools can also consider employing potential career-changers as part-time teachers or co-teachers to work alongside certified teachers of record or as guest speakers, mentors, and career advisors to establish a relationship between potential future hires and secondary schools.[62]

If outside recruitment is unsuccessful, **schools might consider opening opportunities to current staff and encouraging current students to become CTE teachers in the future.** Districts can encourage teachers who lack appropriate industry experience to participate in externships or professional experience to learn more about a CTE field and progress them

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[57] "States Want More Career and Technical Training, but Struggle to Find Teachers." PBS NewsHour, April 6, 2017. http://www.pbs.org/newshour/rundown/states-want-career-technical-training-struggle-find-teachers/

[58] "Teacher Shortage Undermines CTE," Op. cit., p. 1.

[59] [1] "California Association for Career and Technical Education." Association for Career and Technical Education. https://www.acteonline.org/california/#.WZSc01GGOM9 [2] "Our Work." The Association of Career and College Readiness Organizations. http://www.rocpinspire.org/our_work.asp [3] "Home." California Industrial and Technology Education Association. http://citea.org/ [4] "Home." California Community College Administrators of Occupational Education. https://www.cccaoe.org/

[60] "Teacher Shortage Undermines CTE," Op. cit., p. 4.

[61] Fensterwald, J. "Supply Lags Booming Demand for Career Technical Teachers." EdSource, April 28, 2016. https://edsource.org/2016/supply-lags-booming-demand-for-career-technical-teachers/563476

[62] "The State of Career Technical Education: Increasing Access to Industry Experts in High Schools." Council of Chief State School Officers, Advance CTE, and New Skills for Youth, 2016. pp. 9–10. https://cte.careertech.org/sites/default/files/files/resources/State_of_CTE_Industry_Experts_2016_0.pdf

toward obtaining an additional certification in the given discipline.[63] Districts should also be aware of their staff's employment background, as California allows substitutions to meet the required three years of industry experience for a Preliminary CTE Teaching credential. For example, an individual with "24 or 48 units of postsecondary vocational training in an appropriate field may substitute for one or two years, respectively, of industry work experience."[64]

CTE programs can also emphasize teaching as a career option so current students consider education as a profession, potentially creating a pool of future job candidates.[65] One successful iteration of this strategy is New York City's Success Via Apprenticeship (SVA) Program.[66] In the SVA Program, recent high school graduates complete a five-year sequence consisting of college-level coursework, classroom internships, and industrial work experience to prepare them for initial teaching certification. SVA graduates must teach in New York City's public schools for three years following graduation.[67]

Once a CTE teacher has been hired, **they must receive support and training to be successful and persist in their position.**[68] Professional development offerings such as the California State Department of Education's Leadership Development Institute can help new and current CTE teachers learn more about CTE administration, trends, and delivery. Furthermore, the CTE TEACH program helps transition industry professionals into teaching through a series of online orientation and developmental modules.[69] California districts might also investigate the CCCAOE's More and Better CTE forums to gain insights into successful CTE programming from community college professionals.[70]

Furthermore, schools should help new teachers manage challenge areas such as funding, resources, supplies, scheduling, student motivation, and community connections.[71] For

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[63] Jacques, C. and A. Potemski. "21st Century Educators: Developing and Supporting Great Career and Technical Education Teachers." Center on Great Teachers and Leaders at American Institutes for Research, 2014. pp. 16-17. http://eric.ed.gov/?id=ED555675

[64] Zachary, C. and B. Loux. "Dual Certification for Single Subject and Designated Subjects Career Technical Education Teaching Credentials." California Department of Education, 2017. p. 3. https://www.ctc.ca.gov/docs/default-source/commission/agendas/2017-02/2017-02-2d.pdf?sfvrsn=87454eb1_2

[65] "Teacher Shortage Undermines CTE," Op. cit., p. 4.

[66] Wilkin, T. and G.I. Nwoke. "Career and Technical Education Teacher Shortage: A Successful Model for Recruitment and Retention." *Journal of STEM Education*, 48:1, 2011. p. 30. http://scholar.lib.vt.edu/ejournals/JSTE/v48n1/wilkin.html

[67] "Success Via Apprenticeship (SVA) Program." New York City College of Technology. http://www.citytech.cuny.edu/teacher-education/sva.aspx

[68] "Teacher Shortage Undermines CTE," Op. cit., p. 4.

[69] [1] "CTE Teacher Coaching and Support." The Association of Career and College Readiness Organizations. http://www.rocpinspire.org/cte_teachers.asp [2] "Welcome CTE TEACH Participants!" CTE Online. https://www.cteonline.org/cms/page/cteteach

[70] [1] "More & Better CTE Local Forums." California Community College Administrators of Occupational Education. https://www.cccaoe.org/sites/default/files/staff/MBCTEFlyer.pdf [2] "More & Better CTE." California Community College Administrators of Occupational Education. /professional-development/more-better-cte

[71] "The Voices of Career and Technical Education Teachers: A Report of the American Federation of Teachers 2014 Survey." American Federation of Teachers, 2014. p. 10. https://www.aft.org/sites/default/files/cte_surveyreport.pdf

example, a district may provide teachers with training and materials from Fuel Education—an organization that offers purchasable online and blended learning content for California's CTE pathways—to ease the burden of designing original instructional materials.[72]

[72] [1] "California CTE: Prepare Students for the Workforce." Fuel Education. https://www.fueleducation.com/curriculum/curriculum-focus/career-pathways/california-cte.html [2] "The Story." Fuel Education. https://www.fueleducation.com/why-fueled/the-story.html

SECTION III: DESIGNING EFFECTIVE CTE PROGRAMS

In this section, Hanover identifies curricular and instructional resources and best practices that districts can utilize in the identified high-demand CTE career clusters: health science and medical technology; building and construction trades; and hospitality, tourism, and recreation.

PROGRAM ENROLLMENT

Though Hanover could not determine an "ideal" student enrollment for CTE programs, there is some guidance from state departments of education regarding minimum and maximum enrollments. For example, the North Dakota Department of Career and Technical Education mandates the following minimum enrollments for high school CTE courses:[73]

- Minimum of seven students in each course for schools with more than 100 students;
- Minimum average of seven students per course for schools with 50 to 100 students; and
- No minimum CTE course enrollment for schools with fewer than 50 students.

Conversely, the Virginia Department of Education (VDOE) mandates maximum class sizes for CTE courses, including those specially designed for students with disabilities or students from disadvantaged populations. The primary guideline is that course enrollment should not exceed the number of individual work stations available to the CTE class. In addition, the VDOE determines that CTE laboratory classes that "use equipment that has been identified by the U.S. Department of Labor for hazardous occupations" should not enroll more than 20 students.[74]

HEALTH SCIENCE AND MEDICAL TECHNOLOGY

CURRICULUM AND INSTRUCTION

California CTE programs in health science and medical technology encompass six individual fields: biotechnology, patient care, healthcare administrative services, healthcare operational support services, public and community health, and mental and behavioral health.[75]

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[73] Bulleted text quoted verbatim, with minor adaptations, from: "Program Approval Policy." North Dakota Department of Career and Technical Education, December 2014. p. 1. http://www.nd.gov/cte/forms/docs/ProgramApprovalPolicy.pdf

[74] "Career and Technical Education Requirements: Maximum Class Size." Virginia Department of Education, August 10, 2016. pp. 1, 6–7. http://www.doe.virginia.gov/instruction/career_technical/administration/regulations/cte_class_size.pdf

[75] "California Career Technical Education Model Curriculum Standards: Health Science and Medical Technology." California Department of Education, 2017. p. i. http://www.cde.ca.gov/ci/ct/sf/documents/healthmedical.pdf

Associated curriculum standards target the academic and technical skills and knowledge students need to pursue health and medical careers.[76]

California districts should consider resources and suggestions from national health science organizations to frame CTE programs in health science and medical technology. For example, Applied Educational Systems (AES)—a vendor that provides curriculum resources for health science teachers—offers high-level advice for organizing and delivering a curriculum.[77] Broadly, AES recommends that health science teachers base instruction in a standards framework and an established curriculum.[78] AES also advises teachers to use blended learning and hands-on strategies in instruction.[79] Moreover, the AES offers curricular resources, lesson plans, and an online course to further assist teachers with health science course design.[80]

Likewise, the National Consortium for Health Science Education (NCHSE)—a partnership of public and private agencies devoted to guiding and improving health science education—has developed a framework of health science standards "to provide the essential knowledge common across health professions to prepare and increase the number of students that are college and career ready."[81] Figure 3.1 displays the eleven foundational standards proposed by the NCHSE.

Figure 3.1: NCHSE Health Science Standards

- Understand human anatomy, physiology, common diseases and disorders, and medical math.
- Demonstrate methods of delivering and obtaining information, while communicating effectively.
- Identify how key systems affect services performed and quality of care.
- Utilize employability skills to enhance employment opportunities and job satisfaction.
- Describe legal responsibilities, limitations, and implications on healthcare worker actions.
- Understand accepted ethical practices with respect to cultural, social, and ethnic differences within the healthcare environment.
- Identify existing and potential hazards to clients, co-workers, and self. Employ safe work practices and follow health and safety policies and procedures to prevent injury and illness.
- Identify roles and responsibilities of individual members as part of the healthcare team.
- Differentiate between wellness and disease. Promote prevention and model healthy behaviors.

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[76] "Health Careers Education." California Department of Education, May 18, 2017. http://www.cde.ca.gov/ci/ct/hc/index.asp

[77] "About AES." Applied Educational Systems. http://www.aeseducation.com/about-us

[78] "Health Science Curriculum: Keeping CTE Courses Relevant." Applied Educational Systems. http://www.aeseducation.com/healthcenter21/health-science-curriculum

[79] Ibid.

[80] [1] Inc, A.E.S. "Health Science Curriculum Resources." Applied Educational Systems. http://www.aeseducation.com/health-science-curriculum-resources [2] Inc, A.E.S. "Health Science Lesson Plans." Applied Educational Systems. http://www.aeseducation.com/healthcenter21/health-science-lesson-plans/ [3] Inc, A.E.S. "HealthCenter21: Health Science Curriculum." Applied Educational Systems. http://www.aeseducation.com/healthcenter21

[81] [1] "About NCHSE." National Consortium for Health Science Education. http://www.healthscienceconsortium.org/about-nchse/ [2] "National Health Science Standards." National Consortium for Health Science Education, 2015. p. 1. http://www.healthscienceconsortium.org/wp-content/uploads/2015/07/NATIONAL-HEALTH-SCIENCE-STANDARDS-May-2015f1-PE2.pdf

- Apply technical skills required for all specialties and demonstrate skills and knowledge appropriately.
- Utilize and understand information technology applications common across health professions.

Source: NCHSE[82]

INDUSTRY CREDENTIALS

HOME HEALTH AIDES CERTIFICATION

The California Department of Public Health handles the certification of home health aides (HHAs). [83] No minimum education requirement exists for HHAs, so high school graduates may be eligible to obtain certification with proper preparation. [84] Training is available through community colleges, HHA agencies, and other state programs.[85] HHA programs must consist of 120 hours of training in:[86]

- Clinical work;
- Personal care services;
- An aide's and agency's role;
- Nutrition;
- Interpreting the medical and social needs of individuals being served; and
- Home-based cleaning and care tasks.

Health Science Credentials

High school graduates can earn certifications as home health aides, medical assistants, or medical administrative assistants with some combination of targeted training, practical work, and licensure exams.

MEDICAL ASSISTANT LICENSING

The National Healthcareer Association (NHA) offers a Certified Clinical Medical Assistant (CCMA) exam that covers key content areas (e.g., basic pharmacology, clinical patient care) in a three-hour assessment consisting of 150 scored items.[87] Successfully passing the exam

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[82] Figure text taken directly, with minor adaptations, from: Ibid., pp. 1–7.
[83] "Licensing and Certification Program: Home Health Aide." California Department of Public Health. https://www.cdph.ca.gov/Programs/CHCQ/LCP/Pages/HHA.aspx
[84] "California CNA and HHA Certification Requirements." HealthAide Training. http://www.healthaidetraining.org/california-cna-and-hha-certification-requirements
[85] [1] "Home Health Care Guide for California." HomeHealthAide.Com. http://homehealthaide.com/in-california/and-training-in-california/ [2] "Home Health Aide Training Programs." California Department of Public Health, February 2017. https://archive.cdph.ca.gov/services/training/Documents/HHP-JULY2016.pdf
[86] Preceding and bulleted text adapted from: "California HHA Requirements." HomeHealthAideGuide. http://www.homehealthaideguide.com/hha-training/states/california-hha/
[87] "NHA Certified Clinical Medical Assistant (CCMA) Detailed Test Plan." National Healthcareer Association, 2016. pp. 1–19. http://www.nhanow.com/docs/default-source/pdfs/exam-documentation/test-plans/2017-ccma-test-plan-documents/nha-2017-ccma-test-plan_public_detail--final.docx?sfvrsn=10

and acquiring certification allows test-takers to become a CCMA.[88] The certificate allows holders to perform some or all of the following tasks:[89]

- Assist physicians during exams;
- Interview and educate patients;
- Measure and record vital signs; and/or
- Administer injections.

Medical Administrative Assistant Licensing

The NHA also offers a Certified Medical Administrative Assistant (CMAA) exam for candidates aspiring to work as CMAAs or medical office secretaries. Earning the CMAA credential provides job applicants with a recognized healthcare qualification.[90] AES specifically notes that CMAA programs are easily incorporated into high school settings since clinical externships are not required to sit for the exam. Instead, the foundational knowledge obtained in health science coursework can prepare students for the CMAA exam.[91] Upon obtaining certification, candidates may be able to perform some or all of the following administrative tasks:[92]

- Review and answer practice correspondence;
- Operate computer systems to accomplish office tasks;
- Answer calls, schedule appointments, greet patients, and maintain files;
- Update and maintain patient and other practice-specific information; and/or
- Coordinate operation reports such as time and attendance.

BUILDING AND CONSTRUCTION TRADES

Curriculum and Instruction

California programs in building and construction trades encompass four pathways: cabinet making and wood products; engineering and heavy construction; mechanical construction; and residential and commercial construction.[93] Associated curriculum standards target the

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[88] "Medical Assistant Certification (CCMA)." National Healthcareer Association. http://www.nhanow.com/certifications/clinical-medical-assistant
[89] Bulleted text quoted verbatim from: Ibid.
[90] "Certified Medical Administrative Assistant (CMAA)." National Healthcareer Association. http://www.nhanow.com/certifications/medical-administrative-assistant
[91] "How to Run a Strong CMAA Certification Program." Applied Educational Systems. http://www.aeseducation.com/healthcenter21/cmaa-certification/
[92] Bulleted text quoted verbatim from: "Certified Medical Administrative Assistant (CMAA)," Op. cit.
[93] "Building and Construction Trades." California Department of Education, March 9, 2017. http://www.cde.ca.gov/ci/ct/ie/bldgconst.asp

academic and technical skills and knowledge students need to pursue jobs in building and construction trades.[94]

In addition to state-provided resources, **California districts should consider resources and suggestions from national health science organizations to frame CTE programs in building and construction trades.** For example, the Home Builders Institute (HBI) publishes a residential construction textbook series—supplemented by CDs, resources aides, and other materials—to "teach industry-driven skills standards in the basics of residential construction, carpentry, house wiring, HVAC, building construction technology, plumbing[,] and masonry."[95] In addition, the HBI's Pre-Apprenticeship Certification Training (PACT) prepares secondary students for entry-level employment in fields such as landscaping, weatherization, and electrical work.[96] Other organizations such as the Associated General Contractors of America (AGC) and the National Center for Construction Education and Research (NCCER) also offer curricular resources.[97]

California districts can also consider standards from national CTE organizations in designing their building and construction trades programming. Advance CTE—the longest-operating U.S. nonprofit devoted to CTE—publishes the Common Career Technical Core (CCTC) standards, knowledge and skills statements, and plans of study for the building and construction trades career cluster.[98] Below, Figure 3.2 presents a sample of the Advance CTE standards related to building and construction trades.

Figure 3.2: Sample Standards for Building and Construction Trades

- Comply with regulations and applicable codes to establish and manage a legal and safe job site.
- Read, interpret, and use technical drawings, documents, and specifications to plan a project.
- Understand contractual relations with all parties involved in the building process.
- Understand approval procedures to ensure effective flow of information in the construction process.
- Understand and implement testing and inspection procedures to ensure project completion.
- Understand the purpose of scheduling as it relates to the successful completion of a project.
- Manage relationships with internal and external parties to successfully complete projects.
- Safely use and maintain tools, machinery, equipment, and resources to accomplish project goals.

Source: Advance CTE[99]

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[94] "California Career and Technical Education Model Curriculum Standards: Building and Construction Trades." California Department of Education, 2017. pp. 2–6. http://www.cde.ca.gov/ci/ct/sf/documents/buildingconstruct.pdf

[95] "Residential Construction Academy (RCA)." Home Builders Association. http://www.hbi.org/Products-Services/Residential-Construction-Academy-RCA

[96] "PACT Programs." Home Builders Association. http://www.hbi.org/Programs/Training-Programs/PACT-Programs

[97] [1] "Education & Training." Associated General Contractors of America. https://www.agc.org/learn/education-training [2] "NCCER Home." National Center for Construction Education & Research. https://www.nccer.org/

[98] [1] "Who We Are." Advance CTE. https://www.careertech.org/who-we-are [2] "Architecture & Construction | Advance CTE." Advance CTE. https://www.careertech.org/architecture-construction

[99] Figure text taken directly, with minor adaptations, from: "Common Career Technical Core Standards with Performance Elements for Architecture & Construction." Advance CTE. pp. 2–7. https://cte.careertech.org/sites/default/files/AC-CCTC_PerformanceElements.pdf

INDUSTRY CREDENTIALS

PLUMBING CONTRACTOR LICENSE

In California, classification as a plumbing contractor qualifies individuals to complete a variety of tasks related to water supply and waste, including piping, installing water-heating equipment, and maintaining health and safety devices such as gas earthquake valves and back flow preventers.[100] Any individual or business that is legally responsible for a plumbing contract exceeding $500 must hold a license; however, apprentice and journeyman plumbers who work for licensed contractors do not need their own licenses.[101]

Apprentice plumbers participate in a four- to five-year program that combines work experience, on-the-job training, and schooling. Apprentices usually complete this program of studies through a Joint Apprenticeship Committee (JAC), Unilateral Apprenticeship Committee (UAC), an individual employer, or a plumbing union. Typically, apprentices are 18 years old and hold a high school diploma or GED. Comparatively, a journeyman plumber has completed an apprenticeship and can perform the trade without supervision.[102]

To obtain a Plumbing Contractor's License, applicants must complete an exam in business and law and the trade-specific California Plumbing Contractor exam. Before sitting for the exam, individuals must have four years of experience as a journeyman plumber or in a related role.[103] While high school students cannot immediately acquire state credentials in the field, CTE programs can prepare students with the basic knowledge and skills to begin a plumbing apprenticeship during or following high school.[104]

Building and Construction Credentials

California contractor's licenses require candidates to complete an exam on law and business and one specific to their trade. Applicants must have four years of experience, typically completing an apprenticeship beforehand. Thus, CTE programs can best prepare students for building and construction work by providing the foundational knowledge and skills needed to be successful as an apprentice.

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[100] "C-36-Plumbing Contractor." Contractors State License Board, State of California. http://www.cslb.ca.gov/About_Us/Library/Licensing_Classifications/C-36_-_Plumbing.aspx
[101] "California Plumbing License Requirements-Overview." EPlumbing Courses. http://www.eplumbingcourses.com/plumbing-license/california-plumbing-license/
[102] Ibid.
[103] "California Plumbing Contractor License (C-36)." @HomePrep. https://www.contractor-licensing.com/california/plumbing-license.html
[104] "California Plumbing License Requirements-Overview," Op. cit.

General Building Contractor License

General building contractors typically oversee construction projects and coordinate specialized contractors such as plumbers and electricians.[105] California codes state that general building contractors may enter a contract for framing or carpentry but cannot take a contract involving other trades, unless that contract involves two specialties unrelated to framing and carpentry (e.g., heating, ventilation, and air conditioning).[106]

Like the process for becoming a plumbing contractor, applicants must have four years of work experience beyond any apprenticeship before sitting for required assessments. General building contractors take the business and law exam and the California General Building Contractor exam, which assesses students in five major areas such as safety and structural components (see Figure 3.3).

Figure 3.3: General Building Contractor Exam Content Areas

Content Area	Sample Concepts	
Planning and Estimation	▪ Scope of work and code compliance ▪ Shop drawings, plans, and specifications	▪ Field inspection performance ▪ Coordination of project
Framing and Structural Components	▪ Subfloor and wall framing ▪ Seismic and load requirements	▪ Decks ▪ Siding and stucco
Core Trades	▪ Roofing	▪ Earthwork and surveying
Finish Trades	▪ Plaster, drywall, and ceilings	▪ Windows, skylights, and doors
Safety	▪ Personnel safety	▪ Environmental safety

Source: Contractors State License Board[107]

HOSPITALITY, TOURISM, AND RECREATION

Curriculum and Instruction

California programs in hospitality, tourism, and recreation encompass three industry sector pathways: food science, dietetics, and nutrition; food service and hospitality; and hospitality, tourism, and recreation. Associated curriculum standards target the academic and technical skills and knowledge students need to pursue jobs in building and construction trades.[108]

In addition to state-provided resources, **California districts should consider resources from national hospitality, tourism, and recreation organizations to frame CTE programs.** For example, the district might use the Hospitality and Tourism Management Program (HTMP)—developed by the American Hotel and Lodging Educational Institute (AHLEI)—to provide

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[105] "Who Needs a California Contractors License?" Contractors State License Schools. https://www.contractorslicensingschools.com/contractors-license-requirements.cfm

[106] "B-General Building Contractor." Contractors State License Board, State of California. http://www.cslb.ca.gov/About_Us/Library/Licensing_Classifications/B_-_General_Building_Contractor.aspx

[107] Figure text taken directly from: "License Examination Study Guide: General Building (B)." Contractors State License Board, State of California, December 2016. http://www.cslb.ca.gov/Resources/StudyGuides/BStudyGuide.pdf

[108] "California Career Technical Education Model Curriculum Standards: Hospitality, Tourism, and Recreation." California Department of Education, 2017. pp. 1–6. http://www.cde.ca.gov/ci/ct/sf/documents/hosptourrec.pdf

students with knowledge of sales, marketing, hospitality operations, and culinary services.[109] Advance CTE also publishes standards (see Figure 3.4), knowledge and skills statements, and plans of study for hospitality, tourism, and recreation.[110] Common elements in the standards relate to career skills, coordinating operations, and customer service.

Figure 3.4: Sample Standards for Hospitality, Tourism, and Recreation

- Describe the components of marketing and promoting hospitality and tourism products and services.
- Demonstrate hospitality and tourism customer service skills that meet customers' needs.
- Explain various check-in and check-out procedures used in the lodging industry.
- Develop marketing strategies for recreation, amusement, and attractions venues.
- Demonstrate safety and sanitation procedures in food and beverage service facilities.

Source: Advance CTE[111]

INDUSTRY CREDENTIALS

MANAGEFIRST PROFESSIONAL CREDENTIAL

The ManageFirst Professional (MFP) credential offered by the National Restaurant Association (NRA) "recognizes students as having the academic and practical knowledge they need to succeed in the restaurant, foodservice, and hospitality industry."[112] To earn an MFP credential, students must pass four topic exams and one elective foundation exam (see Figure 3.5 on the next page). They must also complete 800 hours of industry work experience.[113]

Figure 3.5: Required and Elective Exams for MFP Credential

Core Credential Topic Exams	Program Foundation Topic Exams (Choice of One)	
▪ Controlling Foodservice Costs ▪ Hospitality and Restaurant Management ▪ Hospitality Human Resources Management and Supervision ▪ ServSafe	▪ Customer Service ▪ Principles of Food and Beverage Management ▪ Purchasing ▪ Hospitality Accounting ▪ ServSafe Alcohol	▪ Bar and Beverage Management ▪ Nutrition ▪ Hospitality and Restaurant Marketing

Source: NRA[114]

CERTIFIED GUEST SERVICE PROFESSIONAL

As an AHLEI Certified Guest Service Professional (CGSP), students gain recognition of their knowledge of the lodging industry. Candidates must complete a Guest Service Gold training

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[109] "High School Program (HTMP)." American Hotel and Lodging Educational Institute. https://www.ahlei.org/Programs/High-School-Program-(HTMP)/

[110] "Hospitality & Tourism | Advance CTE." Advance CTE. https://www.careertech.org/hospitality-tourism

[111] Figure text taken, with minor adaptations, from: "Common Career Technical Core Standards with Performance Elements for Hospitality & Tourism." Advance CTE. pp. 1, 7, 15, 17. https://cte.careertech.org/sites/default/files/HT-CCTC-PerformanceElements.pdf

[112] "ManageFirst Professional (MFP) Credential." National Restaurant Association. https://managefirst.restaurant.org/student/credential.aspx

[113] Ibid.

[114] Figure adapted from: Ibid.

program and pass the 30-question CGSP exam with a score of 70 percent or higher.[115] The training program focuses on relevant attributes in the field of hospitality and can be completed in approximately two hours.[116]

Hospitality Professional Certificate

The American Hospitality Academy (AHA) offers a sequence of online seminars and activities for students interested in the hospitality industry, leading to a Hospitality Professional Certificate (HPC). HPC coursework focuses on topics such as etiquette, time management, and diversity, and possessing the credential increases holders' employability in hospitality.[117]

Certified Fundamentals Cook/Certified Fundamentals Pastry Cook

Students can become a Certified Fundamentals Cook (CFC) or a Certified Fundamentals Pastry Cook (CFPC) through the American Culinary Federation (ACF) with a high school diploma and completion of 30-hour courses in nutrition and food safety and sanitation. They must also pass the CFC or CFPC written and performance exams with scores of 70 and 75 percent respectively.[118] Holding this credential indicates fundamental culinary knowledge.[119]

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[115] "Certified Guest Service Professional (CGSP®)." American Hotel and Lodging Educational Institute. https://www.ahlei.org/CGSP/

[116] "Guest Service Gold Online Program: CGSP Certification." American Hotel and Lodging Educational Institute. https://www.ahlei.org/Products/Online-Learning/Guest-Service-Gold%C2%AE-Making-Connections-Online-Program-and-Certification/

[117] [1] "Hospitality Professional Certificate (HPC) Program Overview." American Hospitality Academy. http://www.americanhospitalityacademy.com [2] "Hospitality Professional Course (HPC) Course Overview and Syllabus." American Hospitality Academy. pp. 6–7. http://www.americanhospitalityacademy.com

[118] [1] "Certified Fundamentals Cook." American Culinary Federation. https://www.acfchefs.org/ACF/Certify/Levels/CFC/ACF/Certify/Levels/CFC/ [2] "Certified Fundamentals Pastry Cook." American Culinary Federation. https://www.acfchefs.org/ACF/Certify/Levels/CFPC/ACF/Certify/Levels/CFPC/

[119] "Certification Designations." American Culinary Federation. http://www.acfchefs.org/ACF/Certify/Levels/ACF/Certify/Levels/default.aspx?section=certify&hkey=af89c90f-1a3a-45f5-9c0f-b875c5421ee8

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