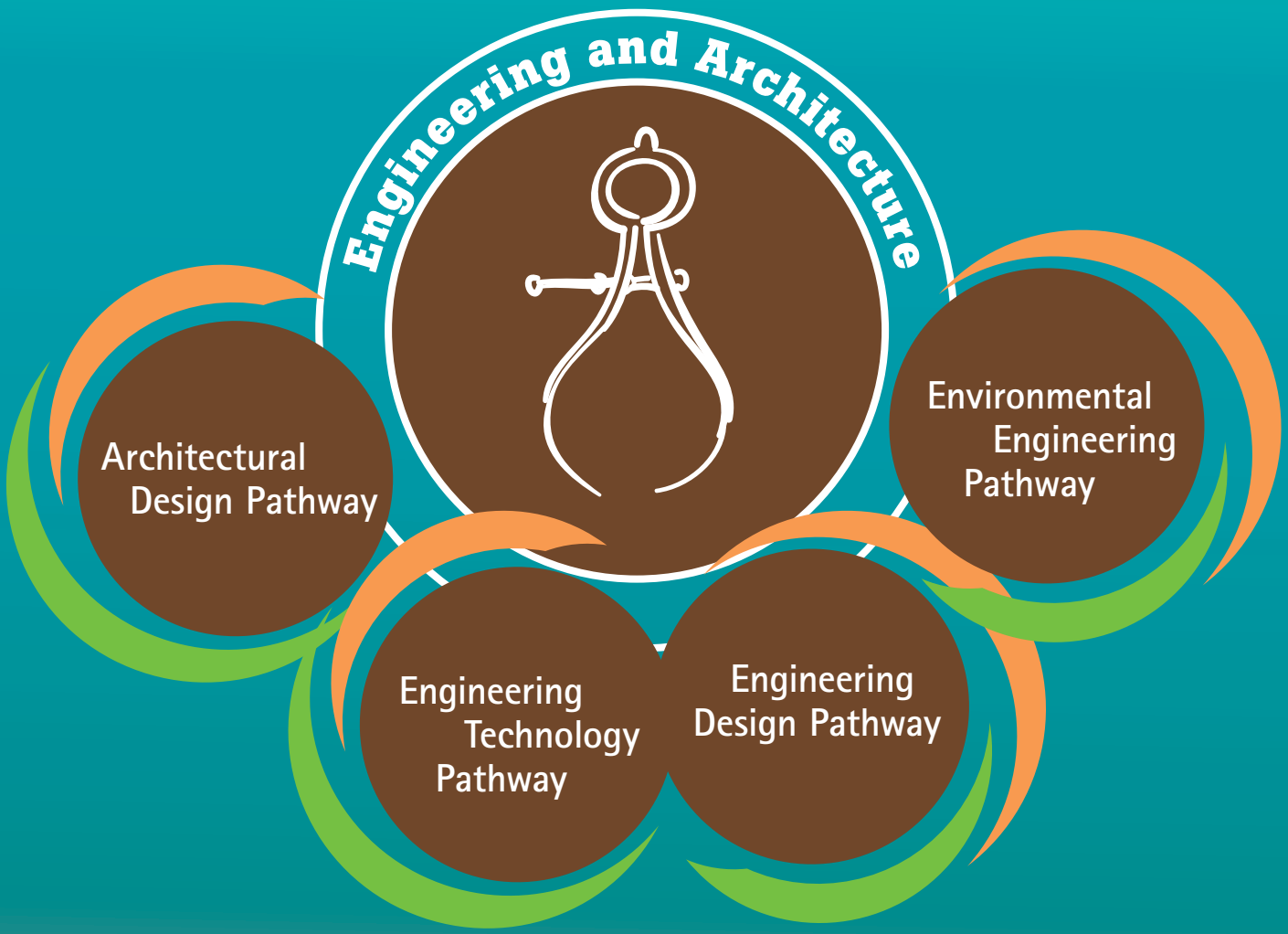
California Career Technical Education Model Curriculum Standards



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Overview

The Career Technical Education (CTE) Model Curriculum Standards publication is organized for use as a complete document or for access to individual industry sectors and pathways. The document includes Standards for Career Ready Practice—which describe the knowledge and skills that students need prior to entering a career technical education program—as part of the career technical education sequence or as integrated elements of other course work in preparation for careers and college.

Each of the 15 industry sector sections includes a description, anchor standards, pathway standards, and an academic alignment matrix. The standards can be adjusted to be part of the curriculum (grades seven through twelve), provided through adult education, or included in community college programs. The document also lists the representatives who participated in each sector's content development and the references that were consulted to revise the CTE standards.

Standards for Career Ready Practice

California's Standards for Career Ready Practice, which follow this overview, are based on the Career Ready Practices of the Common Career Technical Core (CCTC), a state-led initiative sponsored by the National Association of State Directors of Career Technical Education Consortium (NASDCTEc):

> Career Ready Practices describe the career-ready skills that educators should seek to develop in their students. These practices are not exclusive to a Career Pathway, program of study, discipline or level of education. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study. (NASDCTEc 2012, 2)

California's 12 Standards for Career Ready Practice align with the state's CTE anchor standards and reflect the expectations from business and industry, labor and community organizations, and secondary and postsecondary education representatives from 42 participating states.

Anchor Standards

The 11 anchor standards build on the Standards for Career Ready Practice and are common across the 15 industry sectors. Content for these standards was drawn from several documents: "Preparing Students for the 21st Century Economy" (American Association of Colleges for Teacher Education and the Partnership for 21st Century Skills 2010); *How Should Colleges Prepare Students to Succeed in Today's Global Economy?* (Association of American Colleges and Universities and Peter D. Hart Research Associates, Inc. 2006); "Importance of Skills and Knowledge for College and Career Readiness," from *The MetLife Survey of the American Teacher: Preparing Students for College and Careers* (MetLife, Inc. 2011); and *Are They Really Ready to Work? Employers' Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century U.S. Workforce* (The Conference Board et al. 2006).

Each anchor standard is followed by performance indicators using action verbs from the Beyond Knowledge Construct, presented in a hierarchical progression of simple tasks to more complex tasks. Performance indicators provide guidance for curriculum design and standards measurement.

The industry-sector anchor standards have been customized with selected additions to better reflect the needs and special conditions of each industry sector.

Anchor Standard 1 (Academics) guides users to sector-specific core academic standards related to each industry sector, which are listed in the alignment matrix at the end of each sector section. Anchor standards 2–10 are deliberately aligned with one of the Common Core English language arts standards, using similar language demonstrating the natural connections between the two subjects. Anchor Standard 11 (Demonstration and Application) highlights classroom, laboratory, and workplace learning specific to the individual sector and pathways.

Pathway Standards

All 15 industry sectors contain multiple pathways. In order to be identified and listed for an industry sector, each pathway had to meet the following criteria:

- unique to an industry sector
- has an occupational focus
- consistent in size and scope
- composed of similar functions
- inclusive of all aspects of the industry
- includes 8–12 pathway-specific standards
- demonstrates sequence potential
- reasonable and appropriate for high school
- leads to high-skill, high-wage, or high-demand jobs
- sustainable and viable over the next 10 years

Academic Alignment Matrix

Each sector includes an academic alignment matrix that displays where a natural, obvious alignment occurs. Compiled by five teams of academic content experts in collaboration with industry-sector consultants, teachers, and other advisers, the alignment was selected if it was determined that the pathway standard would enhance, reinforce, or provide an application for a specific academic subject standard.

The alignment matrices include the subjects of Common Core English language arts and mathematics standards, history/social studies standards, and Next Generation Science Core Ideas. To assist with further review and implementation, each academic alignment is notated with specific pathway standards codes.

Implementation

The Standards for Career Ready Practice can be integrated with a course or incorporated into several courses over multiple school years (grades seven through twelve). The practices are expectations for all students, whether they are enrolled in a CTE program or following a more generalized course sequence. It is expected that all students who exit high school will be proficient in these practices.

The anchor standards are the basis for each of the pathways within each sector. These standards are designed to assist with the development of course curricula and instructional lesson plans; they describe what is to be taught and measured. In most cases, the teacher determines the sequence and strategies to be used to meet the needs of the student population he or she is serving.

The performance indicators that follow each standard offer guidance for both course design and student assessment. They are intended to guide course work as it is developed. The pathways organize the standards with a career focus, but they are not designed to be offered as single courses. Rather, the standards from each pathway are collected and organized into a sequence of learning. To meet local demands of business and industry and particular student populations, standards can be collected from more than one sector to create a course.

Using the academic alignment matrices as a resource, academic and CTE teachers can see where enhancements and support for both sets of standards can be initiated. CTE teachers can quickly identify academic standards that have a substantial relationship to their instruction. Likewise, academic teachers can specify individual academic standards and quickly identify related CTE standards, which will assist them in incorporating application and technology in their curricula and lessons.

The CTE Model Curriculum Standards are intended to serve the entire education community—from middle schools and high schools to postsecondary colleges and career training programs. A major aim of these standards is to prepare students for postsecondary education and training and to help them make a smooth transition into the workforce. In order for both the people and the economy of California to prosper, it is essential for all students to emerge from schools ready to pursue their career and college goals. Equipping all high school students with the knowledge and skills necessary to plan and manage their education and careers throughout their lives will help to guarantee these important outcomes. Strong CTE programs will continue to provide important educational opportunities to assist students as they pursue their dreams and strive for economic prosperity. The CTE Model Curriculum Standards are a resource for educators and the business world for ensuring high-quality CTE learning experiences and improved student outcomes in the twenty-first-century economy.

California Standards for Career Ready Practice

Standards for Career Ready Practice describe the fundamental knowledge and skills that a career-ready student needs in order to prepare for transition to postsecondary education, career training, or the workforce. These standards are not exclusive to a career pathway, a CTE program of study, a particular discipline, or level of education. Standards for Career Ready Practice are taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study. Standards for Career Ready Practice are a valuable resource to CTE and academic teachers designing curricula and lessons in order to teach and reinforce the career-ready aims of the CTE Model Curriculum Standards and the Common Core State Standards.

1. Apply appropriate technical skills and academic knowledge.

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and other work-related practices.

2. Communicate clearly, effectively, and with reason.

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others, are active listeners who speak clearly and with purpose, and are comfortable with the terminology common to the workplace environment. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

3. Develop an education and career plan aligned with personal goals.

Career-ready individuals take personal ownership of their own educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process and understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

4. Apply technology to enhance productivity.

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

5. Utilize critical thinking to make sense of problems and persevere in solving them.

Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve the problem and, once agreed upon, follow through to ensure the problem is resolved.

6. Practice personal health and understand financial literacy.

Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

7. Act as a responsible citizen in the workplace and the community.

Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them and think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

8. Model integrity, ethical leadership, and effective management.

Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

9. Work productively in teams while integrating cultural and global competence.

Career-ready individuals positively contribute to every team as both team leaders and team members. They apply an awareness of cultural differences to avoid barriers to productive and positive interaction. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

10. Demonstrate creativity and innovation.

Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

11. Employ valid and reliable research strategies.

Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

12. Understand the environmental, social, and economic impacts of decisions.

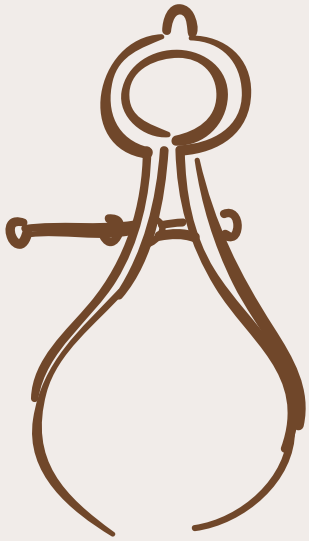
Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

Note: As stated previously, California's Standards for Career Ready Practice are based on the CCTC Career Ready Practices posted at https://careertech.org/ (accessed June 8, 2016).

Engineering and Architecture

Sector Description

This sector is designed to provide a foundation in engineering and architecture sector pathways and occupations for students in California. Students are engaged in an instructional program that integrates academic and technical preparation and focuses on career awareness, career exploration, and career preparation in four pathways that emphasize real-world, occupationally relevant experiences of significant scope and depth: Architectural Design; Engineering Technology; Engineering Design; and Environmental Engineering. To prepare students for continued training, advanced educational opportunities, and direct entry to a career, the Engineering and Architecture programs offer the following components: classroom, laboratory, and hands-on contextual learning; project- and work-based instruction; and leadership and interpersonal skills development.



1.0 Academics

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Engineering and Architecture academic alignment matrix for identification of standards.

2.0 Communications

Acquire and accurately use Engineering and Architecture sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats. (Direct alignment with LS 9-10, 11-12.6)

2.1 Recognize the elements of communication using a sender–receiver model.

2.2 Identify barriers to accurate and appropriate communication.

2.3 Interpret verbal and nonverbal communications and respond appropriately.

2.4 Demonstrate elements of written and electronic communication, such as accurate spelling, grammar, and format.

2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

2.6 Advocate and practice safe, legal, and responsible use of digital media information and communications technologies.

3.0 Career Planning and Management

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. (Direct alignment with SLS 11-12.2)

3.1 Identify personal interests, aptitudes, information, and skills necessary for informed career decision making.

3.2 Evaluate personal character traits, such as trust, respect, and responsibility, and understand the impact they can have on career success.

3.3 Explore how information and communication technologies are used in career planning and decision making.

3.4 Research the scope of career opportunities available and the requirements for education, training, certification, and licensure.

3.5 Integrate changing employment trends, societal needs, and economic conditions into career planning.

3.6 Recognize the role and function of professional organizations, industry associations, and organized labor in a productive society.

3.7 Recognize the importance of small business in the California and global economies.

3.8 Understand how digital media are used by potential employers and postsecondary agencies to evaluate candidates.

3.9 Develop a career plan that reflects career interests, pathways, and postsecondary options.

4.0 Technology

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Engineering and Architecture sector workplace environment. (Direct alignment with WS 11-12.6)

4.1 Use electronic reference materials to gather information and produce products and services.

4.2 Employ Web-based communications responsibly and effectively to explore complex systems and issues.

4.3 Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.

4.4 Discern the quality and value of information collected using digital technologies, and recognize bias and intent of the associated sources.

4.5 Research past, present, and projected technological advances as they impact a particular pathway.

4.6 Assess the value of various information and communication technologies to interact with constituent populations as part of a search of the current literature or in relation to the information task.

5.0 Problem Solving and Critical Thinking

Conduct short, as well as more sustained, research projects to create alternative solutions to answer a question or solve a problem unique to the Engineering and Architecture sector using critical and creative thinking; logical reasoning, analysis, inquiry, and problem-solving techniques. (Direct alignment with WS 11-12.7)

5.1 Identify and ask significant questions that clarify various points of view to solve problems.

5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.

5.3 Use systems thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.

5.4 Interpret information and draw conclusions, based on the best analysis, to make informed decisions.

6.0 Health and Safety

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Engineering and Architecture sector workplace environment. (Direct alignment with RSTS 9-10, 11-12.4)

6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.

6.2 Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities.

6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.

6.4 Practice personal safety when lifting, bending, or moving equipment and supplies.

6.5 Demonstrate how to prevent and respond to work-related accidents or injuries; this includes demonstrating an understanding of ergonomics.

6.6 Maintain a safe and healthful working environment.

6.7 Be informed of laws/acts pertaining to the Occupational Safety and Health Administration (OSHA).

7.0 Responsibility and Flexibility

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Engineering and Architecture sector workplace environment and community settings. (Direct alignment with SLS 9-10, 11-12.1)

7.1 Recognize how financial management impacts the economy, workforce, and community.

7.2 Explain the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.

7.3 Understand the need to adapt to changing and varied roles and responsibilities.

7.4 Practice time management and efficiency to fulfill responsibilities.

7.5 Apply high-quality techniques to product or presentation design and development.

7.6 Demonstrate knowledge and practice of responsible financial management.

7.7 Demonstrate the qualities and behaviors that constitute a positive and professional work demeanor, including appropriate attire for the profession.

7.8 Explore issues of global significance and document the impact on the Engineering and Architecture sector.

8.0 Ethics and Legal Responsibilities

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms. (Direct alignment with SLS 11-12.1d)

8.1 Access, analyze, and implement quality assurance standards of practice.

8.2 Identify local, district, state, and federal regulatory agencies, entities, laws, and regulations related to the Engineering and Architecture industry sector.

8.3 Demonstrate ethical and legal practices consistent with Engineering and Architecture sector workplace standards.

8.4 Explain the importance of personal integrity, confidentiality, and ethical behavior in the workplace.

8.5 Analyze organizational culture and practices within the workplace environment.

8.6 Adhere to copyright and intellectual property laws and regulations, and use and appropriately cite proprietary information.

8.7 Conform to rules and regulations regarding sharing of confidential information, as determined by Engineering and Architecture sector laws and practices.

9.0 Leadership and Teamwork

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organization. (Direct alignment with SLS 11-12.1b)

9.1 Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.

9.2 Identify the characteristics of successful teams, including leadership, cooperation, collaboration, and effective decision-making skills, as applied in groups, teams, and career technical student organization activities.

9.3 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.

9.4 Explain how professional associations and organizations and associated leadership development and competitive career development activities enhance academic preparation, promote career choices, and contribute to employment opportunities.

9.5 Understand that the modern world is an international community and requires an expanded global view.

9.6 Respect individual and cultural differences and recognize the importance of diversity in the workplace.

9.7 Participate in interactive teamwork to solve real Engineering and Architecture sector issues and problems.

10.0 Technical Knowledge and Skills

Apply essential technical knowledge and skills common to all pathways in the Engineering and Architecture sector, following procedures when carrying out experiments or performing technical tasks. (Direct alignment with WS 11-12.6)

10.1 Interpret and explain terminology and practices specific to the Engineering and Architecture sector.

10.2 Comply with the rules, regulations, and expectations of all aspects of the Engineering and Architecture sector.

10.3 Construct projects and products specific to the Engineering and Architecture sector requirements and expectations.

10.4 Collaborate with industry experts for specific technical knowledge and skills.

11.0 Demonstration and Application

Demonstrate and apply the knowledge and skills contained in the Engineering and Architecture anchor standards, pathway standards, and performance indicators in classroom, laboratory and workplace settings, and through the SkillsUSA career technical student organization.

11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Engineering and Architecture sector program of study.

11.2 Demonstrate proficiency in a career technical pathway that leads to certification, licensure, and/or continued learning at the postsecondary level.

11.3 Demonstrate entrepreneurship skills and knowledge of self-employment options and innovative ventures.

11.4 Employ entrepreneurial practices and behaviors appropriate to Engineering and Architecture sector opportunities.

11.5 Create a portfolio, or similar collection of work, that offers evidence through assessment and evaluation of skills and knowledge competency as contained in the anchor standards, pathway standards, and performance indicators.

A. Architectural Design Pathway

The Architectural Design pathway provides learning opportunities for students interested in preparing for careers in such areas as architecture, industrial design, and civil engineering.

Sample occupations associated with this pathway:

- Drafter
- Architect
- Structural Designer
- Building Department Plan Examiner
- City Planner

A1.0 Understand how history shaped architecture and know significant events in the history of architectural design.

- A1.1 Know significant historical architectural projects and their effects on society.
- A1.2 Understand the development of architectural systems in relation to aesthetics, efficiency, and safety.

A2.0 Compare the theoretical, practical, and contextual issues that influence design.

- A2.1 Describe the influence of community context and zoning requirements on architectural design.
- A2.2 Understand the ways in which sociocultural conditions and issues influence architectural design.
- A2.3 Compare the theoretical and practical effects of human and physical factors on the development of architectural designs.
- A2.4 Analyze project design and compile a cost analysis.

A3.0 Understand the sketching processes used in concept development.

- A3.1 Apply sketching techniques to a variety of architectural models.
- A3.2 Produce proportional two- and three-dimensional sketches and designs.
- A3.3 Present conceptual ideas, analysis, and design concepts using freehand graphic communication techniques.

A4.0 Understand the use of computer-aided drafting (CAD) in developing architectural designs.

- A4.1 Develop a preliminary architectural proposal using CAD software.
- A4.2 Analyze viability of a project as the design is developed using Building Information Modeling (BIM).

A5.0 Compare the relationship between architecture and the external environment.

- A5.1 Understand the significance of sustainable building design practices that incorporate beneficial energy and environmental design policies.
- A5.2 Develop a site analysis that considers passive energy techniques, sustainability issues, and landscaping.
- A5.3 Create a building design that incorporates passive and/or active energy-efficient technologies.

A6.0 Understand methods used to analyze simple structures.

- A6.1 Understand load transfer mechanisms.
- A6.2 Understand stress-strain relationships of building structures.
- A6.3 Interpret structural design considerations, including load-bearing relationships of shear walls, columns, and beams.
- A6.4 Design a simple structure by using structural analysis principles.

A7.0 Understand the properties of structural materials.

- A7.1 Understand the integration of architectural factors, such as soil mechanics, foundation design, engineering materials, and structure design.
- A7.2 Develop a stress analysis chart of typical structural components.
- A7.3 Evaluate available building materials (e.g., steel, concrete, and wood) by considering their properties and their effect on building form.
- A7.4 Develop a preliminary building plan using the appropriate materials.

A8.0 Systematically complete an architectural project.

- A8.1 Describe the various components of structures, including lighting; heating, ventilating, and air-conditioning (HVAC); mechanical; electrical; plumbing; communication; security; and vertical transportation systems.
- A8.2 Develop a preliminary proposal for presentation of an architectural design.
- A8.3 Read and interpret architectural and construction plans, drawings, diagrams, and specifications.
- A8.4 Develop a complete set of architectural plans and drawings.
- A8.5 Estimate the materials needed for a project by reading an architectural drawing.
- A8.6 Plan a project using site and building restrictions imposed by various entities (e.g., Planning, Zoning, Building, and Home Owners Association [HOA]).
- A8.7 Plan the sequence of events leading to an architectural project.

A9.0 Using various methods create both written and digital portfolios to represent architectural renderings.

- A9.1 Develop a binder or digital portfolio representative of completed work for presentation.
- A9.2 Prepare an effective oral presentation of the portfolio content.

B. Engineering Technology Pathway

The Engineering Technology pathway provides learning opportunities for students interested in preparing for careers in the design, production, or maintenance of mechanical, electrical, electronics, and computer and electromechanical systems and products.

Sample occupations associated with this pathway:

- Surveyor
- Research and Development Analyst
- Engineering Technologist
- Field Engineer
- Operations Engineer

B1.0 Communicate and interpret information clearly in industry-standard visual and written formats.

- B1.1 Explain the classification and use of various components, symbols, abbreviations, and media common to technical drawings.
- B1.2 Describe the current industry standards for illustration and layout.
- B1.3 Draw flat layouts of a variety of objects by using the correct drafting tools, techniques, and media.
- B1.4 Organize and complete an assembly drawing using information collected from detailed drawings.
- B1.5 Create reports and data sheets for writing specifications.

B2.0 Demonstrate the sketching process used in concept development.

- B2.1 Understand the process of producing proportional two- and three-dimensional sketches and designs.
- B2.2 Apply sketching techniques to a variety of architectural and engineering models.
- B2.3 Present conceptual ideas, analysis, and design concepts using freehand graphic communication techniques.

B3.0 Identify the fundamentals of the theory, measurement, control, and applications of electrical energy, including alternating and direct currents.

- B3.1 Understand the characteristics of alternating current (AC) and how it is generated; the characteristics of the sine wave; and of AC, tuned, and resonant circuits; and the nature of the frequency spectrum.
- B3.2 Analyze relationships between voltage, current, resistance, and power related to direct current (DC) circuits.
- B3.3 Calculate, construct, measure, and interpret both AC and DC circuits.
- B3.4 Understand how electrical control and protection devices are used in electrical systems.

B3.5 Calculate loads, currents, and circuit-operating parameters.

B3.6 Classify and use various electrical components, symbols, abbreviations, media, and standards of electrical drawings.

B3.7 Analyze, repair, or measure electrical and electronic systems, circuits, or components using appropriate electronic instruments.

B3.8 Predict the effects of circuit conditions on the basis of measurements and calculations of voltage, current, resistance, and power.

B4.0 Understand the concepts of physics that are fundamental to engineering technology.

B4.1 Describe Newton's laws and how they affect and define the movement of objects.

B4.2 Explain how the laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.

B4.3 Compare the effects and applications of heat transfer and thermal dynamic processes.

B4.4 Explore the fundamentals and properties of waveforms and how waveforms may be used to carry energy.

B4.5 Analyze how electric and magnetic phenomena are related and know common practical applications.

B5.0 Understand how the principles of force, work, rate, power, energy, and resistance relate to mechanical, electrical, fluid, and thermal engineering systems.

B5.1 Differentiate between scalars and vectors.

B5.2 Solve problems by using the concept of vectoring to predict resultants.

B5.3 Compare and explore the six simple machines and their applications.

B5.4 Evaluate how energy is transferred and predict the effects of resistance in mechanical, electrical, fluid, and thermal systems.

B5.5 Formulate and solve problems by using the appropriate units applied in mechanical, electrical, fluid, and thermal engineering systems.

B6.0 Employ the design process to solve analysis and design problems.

B6.1 Understand the steps in the design process.

B6.2 Determine what information and principles are relevant to a problem and its analysis.

B6.3 Choose between alternate solutions in solving a problem and be able to justify the choices made in determining a solution.

B6.4 Translate word problems into mathematical statements when appropriate.

B6.5 Demonstrate the process of developing multiple details, within design constraints, into a single solution.

B6.6 Construct a prototype from plans and test it.

B6.7 Evaluate and redesign a prototype on the basis of collected test data.

B7.0 Understand industrial engineering processes, including the use of tools and equipment, methods of measurement, and quality assurance.

- B7.1 Know the structure and processes of a quality assurance cycle.
- B7.2 Describe the major manufacturing processes.
- B7.3 Use tools, fasteners, and joining systems employed in selected engineering processes.
- B7.4 Estimate and measure the size of objects in both Standard International and United States units.
- B7.5 Apply appropriate geometric dimensioning and tolerancing (GD&T) practices.
- B7.6 Calibrate precision measurement tools and instruments to measure objects.

B8.0 Understand fundamental control system design and develop systems that complete preprogrammed tasks.

- B8.1 Identify the elements and processes necessary to develop a controlled system that performs a task.
- B8.2 Demonstrate the use of sensors for data collection and process correction in controlled systems.
- B8.3 Perform tests, collect data, analyze relationships, and display data in a simulated or modeled system using appropriate tools and technology.
- B8.4 Program a computing device to control systems or process.
- B8.5 Use motors, solenoids, and similar devices as output mechanisms in controlled systems.
- B8.6 Assemble input, processing, and output devices to create controlled systems capable of accurately completing a preprogrammed task.

B9.0 Understand the fundamentals of systems and market influences on products as they are developed and released to production.

- B9.1 Understand the process of product development.
- B9.2 Understand decision matrices and the use of graphic tools in illustrating the development of a product and the processes involved.

B10.0 Design and construct a culminating project effectively using engineering technology.

- B10.1 Use methods and techniques for employing all engineering technology equipment appropriately.
- B10.2 Apply conventional engineering technology processes and procedures accurately, appropriately, and safely.
- B10.3 Apply the concepts of engineering technology to the tools, equipment, projects, and procedures of the Engineering Technology Pathway.

B11.0 Understand the methods of creating both written and digital portfolios.

- B11.1 Develop a binder or digital portfolio representative of student work for presentation.
- B11.2 Give an effective oral presentation of a portfolio.

C. Engineering Design Pathway

The Engineering Design pathway provides learning opportunities for students interested in preparing for careers in the design and production of mechanical, electrical, and computer systems.

Sample occupations associated with this pathway:

- Mechanical/Electrical Drafter
- Design Engineer
- Manufacturing Design Engineer
- Project Architect

C1.0 Understand historical and current events related to engineering design and their effects on society.

- C1.1 Know historical and current events that have relevance to engineering design.
- C1.2 Interpret the development of graphic language in relation to engineering design.

C2.0 Understand the effective use of engineering design equipment.

- C2.1 Employ engineering design equipment using the appropriate methods and techniques.
- C2.2 Apply conventional engineering design equipment procedures accurately, appropriately, and safely.
- C2.3 Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway.

C3.0 Understand the sketching process used in concept development.

- C3.1 Apply sketching techniques to a variety of architectural models.
- C3.2 Produce proportional two- and three-dimensional sketches and designs.
- C3.3 Present conceptual ideas, analysis, and design concepts using freehand, graphic, communication techniques.

C4.0 Understand measurement systems as they apply to engineering design.

- C4.1 Know how the various measurement systems are used in engineering drawings.
- C4.2 Understand the degree of accuracy necessary for engineering design.

C5.0 Use proper projection techniques to develop orthographic drawings.

- C5.1 Understand the concepts and procedures necessary for producing drawings.
- C5.2 Develop multiview drawings using the orthographic projection process.
- C5.3 Understand the various techniques for viewing objects.
- C5.4 Use the concepts of geometric construction in the development of design drawings.
- C5.5 Apply pictorial drawings derived from orthographic multiview drawings and sketches.

C6.0 Understand the applications and functions of sectional views.

- C6.1 Understand the function of sectional views.
- C6.2 Clarify hidden features of an object using a sectional view and appropriate cutting planes.

C7.0 Understand the applications and functions of auxiliary views.

- C7.1 Understand the function of auxiliary views.
- C7.2 Use auxiliary views to clarify the true shape and size of an object.

C8.0 Understand and apply proper dimensioning standards to drawings.

- C8.1 Know a variety of drafting applications and understand the proper dimensioning standards for each.
- C8.2 Apply dimension to various objects and features.

C9.0 Understand the tolerance relationships between mating parts.

- C9.1 Understand what constitutes mating parts in engineering design.
- C9.2 Interpret geometric tolerancing symbols in a drawing.
- C9.3 Use tolerancing in an engineering drawing.

C10.0 Understand the methods of applying text to a drawing.

- C10.1 Describe the processes of lettering and/or text editing.
- C10.2 Implement standard methods of title block creation and use.
- C10.3 Develop drawings using notes and specifications.
- C10.4 Plan, prepare, and interpret drawings and models through traditional drafting or computer-aided design (CAD) techniques.

C11.0 Understand the methods of creating both written and digital portfolios.

- C11.1 Develop a binder or digital portfolio representative of completed work for presentation.
- C11.2 Give an effective oral presentation of a portfolio.

D. Environmental Engineering Pathway

The Environmental Engineering pathway includes design and development processes, equipment, and systems that are used to create, monitor, prevent, or correct environmental events and conditions.

Sample occupations associated with this pathway:

- Environmental Safety Technician
- Environmental Specialist
- Environmental Analyst
- Environmental Scientist
- Air Pollution Control Engineer

D1.0 Communicate and interpret information clearly in industry-standard visual and written formats.

- D1.1 Know the current industry standards for illustration and layout.
- D1.2 Understand the classification and use of various electronic components, symbols, abbreviations, and media common to electronic drawings.
- D1.3 Organize and complete site plans.

D2.0 Understand the design process and how to solve analysis and design problems.

- D2.1 Understand the steps in the design process.
- D2.2 Determine what information and principles are relevant to a problem and its analysis.
- D2.3 Choose between alternate solutions in solving a problem and be able to justify choices in determining a solution.
- D2.4 Understand the process of developing multiple details into a single solution.
- D2.5 Translate word problems into mathematical statements when appropriate.
- D2.6 Build a prototype from plans and test it.
- D2.7 Evaluate and redesign a prototype on the basis of collected test data.

D3.0 Understand the fundamentals of earth science as they relate to environmental engineering.

- D3.1 Know the fundamental stages of geochemical cycles.
- D3.2 Understand the effects of pollution on hydrological features.
- D3.3 Classify the three major groups of rocks, according to their origin, on the basis of texture and mineral composition.
- D3.4 Analyze the importance and use of soil and evaluate how soil may be preserved and conserved.
- D3.5 Assess and evaluate geological hazards.

D3.6 Interpret and evaluate topographical maps and images.

D3.7 Locate and evaluate soil or geological conditions or features using global positioning systems equipment and related technology.

D3.8 Analyze soil erosion and identify the causes.

D4.0 Understand the effects of the weather, the hydrosphere, and the atmosphere on the environment.

D4.1 Know the common causes of atmospheric contamination.

D4.2 Understand the effects of weather fronts on regional air pollution.

D4.3 Understand the relationship between the health of the marine environment and climate control.

D4.4 Understand the effects of human activity on the atmospheric environment.

D4.5 Analyze and predict conditions of meteorological events.

D4.6 Analyze the mechanisms for air mass movement.

D4.7 Analyze atmospheric pressure and weather systems.

D5.0 Understand how the principles of force, work, rate, power, energy, and resistance relate to mechanical, electrical, fluid, and thermal engineering systems.

D5.1 Know the six simple machines and their applications.

D5.2 Know how energy is transferred and the effects of resistance in mechanical, electrical, fluid, and thermal systems.

D5.3 Understand scalars and vect

D5.4 Solve problems by using the concept of vectoring to predict the resultant forces.

D5.5 Solve problems by using the appropriate units applied in mechanical, electrical, fluid, and thermal engineering systems.

D6.0 Evaluate regional interactive systems and elements that create harmful environmental effects.

D6.1 Describe the sources of, and impacts attributable to, pollution and contamination.

D6.2 Recognize the actions that cause resource depletion.

D6.3 Define the causes of erosion and soil depletion.

D6.4 Describe the attributes and proliferation of hardscape.

D6.5 Identify the sources of, and impacts attributable to, habitat alteration.

D7.0 Understand the concepts of physics that are fundamental to engineering technology.

D7.1 Understand Newton's laws and how they affect and define the movement of objects.

D7.2 Understand how the laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.

D7.3 Understand how electric and magnetic phenomena are related and know common practical applications.

D7.4 Analyze the fundamentals and properties of waveforms and how waveforms may be used to carry energy.

D8.0 Understand the effective use of environmental and natural science equipment.

D8.1 Use appropriate methods and techniques for employing environmental and natural science equipment.

D8.2 Apply conventional environmental and natural science processes and procedures accurately, appropriately, and safely.

D8.3 Apply the concepts of environmental and natural science to the tools, equipment, projects, and procedures of the Environmental Engineering Pathway.

D9.0 Identify the role and impact of waste management systems, and their operations, on the environment.

D9.1 Understand the role of waste and storm water management systems, their operation, and their impact on the environment.

D9.2 Explore the causes and effects of pollution linked to wastewater treatment facilities.

D9.3 Identify wastewater treatment processes that lessen environmental impacts and improve water reuse.

D9.4 Explain the types and sources of hazardous waste and associated safety practices and legal requirements for handling and disposing of such waste.

D9.5 Design solid waste disposal processes that lessen environmental impacts and improve recycling.

D10.0 Understand the field of land use management and its potential for environmental impact.

D10.1 Describe the need for and role of habitat preservation.

D10.2 Describe the composition, role, and function of ecosystems, including trends affecting viability.

D10.3 Explain the laws and regulations pertaining to ecosystem preservation and use.

D10.4 Demonstrate the need for, and methods of, land use planning.

D10.5 Identify the aspects of land use planning and describe current trends.

D10.6 Summarize the relationship between land use planning and energy use and distribution.

D10.7 Explain the laws and regulations pertaining to land use planning.

D10.8 Develop strategies to maximize the effectiveness of land use planning.

D11.0 Research the role of air quality management and systems, their operations, and their impact on the environment.

D11.1 Understand the elements that create outdoor air quality.

D11.2 Summarize the causes of air pollutants and their chemical composition.

D11.3 Research air pollutants and their threat to human health.

D11.4 Understand U.S. and California laws and regulations related to air pollution control programs and health effects of air pollution.

D11.5 Describe the basic U.S. Environmental Protection Agency (EPA) and California Air Resources Board (ARB) roles and regulations.

D12.0 Implement processes to support energy efficiency.

D12.1 Understand the relationship between power and energy efficiency.

D12.2 Outline how domestic and industrial appliances and systems affect the environment, such as water units and heating and cooling systems.

D12.3 Compare costs of alternate/renewable energy sources, systems, and appliances and traditional energy sources, systems, and appliances.

D12.4 Conduct an energy audit.

D13.0 Research drinking-water sources, systems, treatment, and conservation.

D13.1 Understand water reuse: issues, strategies, technologies, and applications.

D13.2 Analyze strategies for improving energy efficiencies in water collection and distribution.

D13.3 Describe the role of environmental engineering and green energy in water systems.

D13.4 Understand the functions and operations of water storage, reservoirs, aqueducts, and dams.

D13.5 Identify and explain the applicable codes and regulations.

D14.0 Evaluate the impact and flow management of storm water, rivers, and groundwater.

D14.1 Understand the designs and tools used in water flow management.

D14.2 Describe watershed modeling.

D14.3 Understand the principles and applications of drainage engineering.

D14.4 Use the Hydrologic Engineering Centers River Analysis System (HEC-RAS).

D14.5 Analyze and interpret contaminated harbor and river sediment.

D14.6 Describe the concerns and strategies for catastrophic storm water events and management.

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ENGLISH LANGUAGE ARTS				
Language Standards – LS (Standard Area, Grade Level, Standard #)				
11-12.1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.	A9.0	B1.0	C11.0	D1.0
11-12.2. Demonstrate command of the conventions of standard English capitalization, nctuation, and spelling when writing.	A9.0	B1.0	C11.0	D1.0
Reading Standards for Informational Text – RSIT (Standard Area, Grade Level, Standard #)				
11-12.2. Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.	A1.0, A2.0, A5.0, A8.0	B1.0	C1.0	D1.0
11-12.7. Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.	A1.0			
Reading Standards for Literacy in History/Social Studies – RHSS (Standard Area, Grade Level, Standard #)				
11-12.2. Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.	A1.0, A2.0		C1.0	
11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.	A1.0		C1.0	
11-12.10. By the end of grade 12, read and comprehend history/social studies texts in the grades 11-12 text complexity band independently and proficiently.	A1.0, A2.0		C1.0	
Reading Standards for Literacy in Science and Technical Subjects – RLST (Standard Area, Grade Level, Standard #)				
11-12.2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	A1.0, A5.0, A9.0	B4.0, B5.0, B7.0, B8.0, B9.0	C1.0, C4.0, C11.0	D2.0, D3.0, D4.0, D6.0

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Reading Standards for Literacy in Science and Technical Subjects – RLST (Standard Area, Grade Level, Standard #) *(continued)*				
11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.	A9.0	B11.0	C11.0	
11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	A1.0, A9.0	B9.0, B10.0, B11.0	C1.0, C11.0	
11-12.10. By the end of grade 12, read and comprehend science/technical texts in the grades 11-12 text complexity band independently and proficiently.	A1.0, A5.0	B1.0, B4.0, B5.0, B7.0, B8.0, B9.0	C1.0, C4.0	D1.0, D2.0, D3.0, D4.0, D3.0, D6.0
Writing Standards – WS (Standard Area, Grade Level, Standard #)				
11-12.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.		B11.0		
11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.	A9.0	B11.0	C11.0	
11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	A9.0		C11.0	
11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.	A9.0		C11.0	
11-12.6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.	A9.0		C11.0	
11-12.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	A9.0		C11.0	

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Writing Standards – WS (Standard Area, Grade Level, Standard #) *(continued)*				
11-12.8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation including footnotes and endnotes.	A9.0		C11.0	
Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects – WHSST				
11-12.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.	A9.0		C11.0	
11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.		B1.0		
11-12.6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.	A9.0	B1.0, B11.0	C11.0	
11-12.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.		B1.0		
11-12.8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.		B1.0		
MATHEMATICS				
Algebra – A-CED – Creating Equations				
Create equations that describe numbers or relationships				
1. Create equations and inequalities in one variable including ones with absolute value and use them to solve problems in and out of context, including equations arising from linear functions. 1.1 Judge the validity of an argument according to whether the properties of real numbers, exponents, and logarithms have been applied correctly at each step. (CA Standard Algebra II - 11.2)	A2.0, A6.0	B6.0, B10.0		D2.0

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Algebra – A-CED – Creating Equations *(continued)*				
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A2.0, A6.0	B6.0, B10.0		D2.0
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.	A2.0, A6.0	B6.0, B10.0		D2.0
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.	A6.0			
Algebra – A-REI – Reasoning with Equations and Inequalities				
Understand solving equations as a process of reasoning and explain the reasoning				
1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.	A2.0, A8.0	B3.0, B10.0		
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	A2.0, A8.0	B3.0, B10.0		
Solve equations and inequalities in one variable				
3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. 3.1 Solve equations and inequalities involving absolute value. (CA Standard Algebra I - 3.0 and CA Standard Algebra II - 1.0)	A2.0, A8.0	B3.0, B10.0		
4. Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.	A8.0	B3.0, B4.0, B10.0		D7.0

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Algebra – A-REI – Reasoning with Equations and Inequalities *(continued)*				
Solve systems of equations				
5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.	A8.0			
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	A8.0	B3.0, B10.0		
7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.	A8.0			
Functions – F-IF – Interpreting Functions				
Understand the concept of a function and use function notation				
1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y = f(x)*.	A3.0	B2.0, B10.0	C3.0	
Analyze functions using different representations				
7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.	A3.0	B2.0, B10.0	C3.0	

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8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.	A3.0	B2.0, B10.0	C3.0	
Functions – F-LE – Linear, Quadratic, and Exponential Models				
1. Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.				D5.0
Functions – F-TF – Trigonometric Functions				
Extend the domain of trigonometric functions using the unit circle				
1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. 1.1 Understand the notion of angle and how to measure it, in both degrees and radians. Convert between degrees and radians. (CA Standard Trigonometry - 1.0)	A6.0	B3.0, B4.0, B10.0	C4.0	D6.0, D7.0
2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	A6.0	B3.0, B4.0, B10.0		D7.0

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Functions – F-TF – Trigonometric Functions *(continued)*				
3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for π-x, π+x, and 2π-x in terms of their values for X, where x is any real number. 3.1 Know the definitions of the tangent and cotangent functions and graph them. (CA Standard Trigonometry - 5.0) 3.2 Know the definitions of the secant and cosecant functions and graph them. (CA Standard Trigonometry - 6.0)	A6.0	B3.0, B4.0, B10.0		D7.0
Model periodic phenomena with trigonometric functions				
5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.		B3.0, B4.0, B10.0		D2.0, D6.0
6. (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. 6.1 Know the definitions of the inverse trigonometric functions and graph the functions. (CA Standard Trigonometry - 8.0)				D6.0
Geometry – G-CO – Congruence				
Make geometric constructions				
12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	A3.0, A5.0, A7.0, A8.0	B2.0, B10.0	C3.0, C5.0	
13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.			C5.0	
Geometry – G-GMD – Geometric Measurement and Dimensions				
Explain volume formulas and use them to solve problems				
5. Determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.		B6.0, B7.0, B10.0	C8.0	D2.0

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Geometry – G-MG – Modeling with Geometry				
Apply geometric concepts in modeling situations				
3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).	A3.0, A5.0, A7.0, A8.0	B6.0, B10.0	C8.0, C9.0	D2.0
Geometry – G-SRT – Similarity, Right Triangles, and Trigonometry				
Understand similarity in terms of similarity transformations				
1. Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	A3.0, A5.0, A7.0, A8.0	B2.0, B10.0	C3.0	
Number and Quantity – N-Q – Quantities				
Reason quantitatively and use units to solve problems				
1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	A2.0, A6.0, A8.0	B3.0, B4.0, B10.0		D7.0
2. Define appropriate quantities for the purpose of descriptive modeling.	A2.0, A6.0, A8.0	B3.0, B4.0, B10.0		D7.0
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	A2.0, A6.0, A8.0	B3.0, B4.0, B10.0	C4.0	D7.0
Number and Quantity – N-VM – Vector and Matrix Quantities				
Represent and model with vector quantities				
1. (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, $\|v\|$, $\|\|v\|\|$, v).	A6.0	B5.0, B10.0	C8.0	D4.0, D5.0
2. (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.	A6.0	B5.0, B10.0	C8.0	D4.0, D5.0
3. (+) Solve problems involving velocity and other quantities that can be represented by vectors.	A6.0	B5.0, B10.0	C8.0	D4.0, D5.0

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Number and Quantity – N-VM – Vector and Matrix Quantities *(continued)*				
Perform operations on vectors				D4.0
4. (+) Add and subtract vectors. a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. c. Understand vector subtraction v – w as v + (-w), where -w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.	A6.0	B5.0, B10.0	C8.0	D4.0, D5.0
5. (+) Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_{x2}, cv_y)$. b. Compute the magnitude of a scalar multiple cv using $\|cv\| = \|c\|v$. Compute the direction of cv knowing that when $\|c\|v \neq 0$, the direction of cv is either along v (for $c > 0$) or against v (for $c < 0$).	A6.0	B5.0, B10.0	C8.0	D4.0, D5.0
Perform operations on matrices and use matrices in applications				D4.0, D5.0
6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.	A6.0	B5.0, B9.0, B10.0		D4.0, D5.0
7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.	A6.0	B5.0, B9.0, B10.0		D4.0, D5.0
8. (+) Add, subtract, and multiply matrices of appropriate dimensions.	A6.0	B5.0, B9.0, B10.0		D4.0, D5.0
9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.	A6.0	B5.0, B9.0, B10.0		D4.0, D5.0
10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.	A6.0	B5.0, B9.0, B10.0		D4.0, D5.0

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Number and Quantity – N-VM – Vector and Matrix Quantities *(continued)*				
11. (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.	A6.0	B5.0, B9.0, B10.0		D4.0, D5.0
12. (+) Work with 2 x 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.	A6.0	B5.0, B9.0, B10.0		D4.0, D5.0
Statistics and Probability – S-ID – Interpreting Categorical and Quantitative Data				
Summarize, represent, and interpret data on a single count or measurement variable				
1. Represent data with plots on the real number line (dot plots, histograms, and box plots).	A2.0	B1.0, B8.0, B10.0		
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.	A2.0	B1.0, B10.0		
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	A2.0	B1.0, B10.0		
4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	A2.0	B1.0, B10.0		
Summarize, represent, and interpret data on two categorical and quantitative variables				
5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.		B1.0, B8.0, B10.0		
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models. b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association.		B1.0, B10.0		

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Statistics and Probability – APPS – Advanced Placement Probability and Statistics				
1.0 Students solve probability problems with finite sample spaces by using the rules for addition, multiplication, and complementation for probability distributions and understand the simplifications that arise with independent events.		B5.0		D5.0
2.0 Students know the definition of conditional probability and use it to solve for probabilities in finite sample spaces.		B5.0		D5.0
3.0 Students demonstrate an understanding of the notion of discrete random variables by using this concept to solve for the probabilities of outcomes, such as the probability of the occurrence of five or fewer heads in 14 coin tosses.		B5.0		D5.0
4.0 Students understand the notion of a continuous random variable and can interpret the probability of an outcome as the area of a region under the graph of the probability density function associated with the random variable.		B5.0		D5.0
5.0 Students know the definition of the mean of a discrete random variable and can determine the mean for a particular discrete random variable.		B5.0		D5.0
6.0 Students know the definition of the variance of a discrete random variable and can determine the variance for a particular discrete random variable.		B5.0		D5.0
7.0 Students demonstrate an understanding of the standard distributions (normal, binomial, and exponential) and can use the distributions to solve for events in problems in which the distribution belongs to those families.		B5.0		D5.0
8.0 Students determine the mean and the standard deviation of a normally distributed random variable.		B5.0		D5.0
9.0 Students know the central limit theorem and can use it to obtain approximations for probabilities in problems of finite sample spaces in which the probabilities are distributed binomially.		B5.0		D5.0
10.0 Students know the definitions of the mean, median and mode of distribution of data and can compute each of them in particular situations.		B5.0		D5.0
11.0 Students compute the variance and the standard deviation of a distribution of data.		B5.0		D5.0
12.0 Students find the line of best fit to a given distribution of data by using least squares regression.		B5.0		D5.0
13.0 Students know what the correlation coefficient of two variables means and are familiar with the coefficient's properties.		B5.0		D5.0

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Statistics and Probability – APPS – Advanced Placement Probability and Statistics *(continued)*				
14.0 Students organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line graphs and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots.		B5.0		D5.0
15.0 Students are familiar with the notions of a statistic of a distribution of values of the sampling distribution of a statistic. And of the variability of a statistic.		B5.0		D5.0
16.0 Students know basic facts concerning the relation between the mean and the standard deviation of a sampling distribution and the mean and the standard deviation of the population distribution.		B5.0		D5.0
17.0 Students determine confidence intervals for a simple random sample from a normal distribution of data and determine the sample size required for a desired margin of error.		B5.0		D5.0
18.0 Students determine the P- value for a statistic for a simple random sample from a normal distribution.		B5.0		D5.0
19.0 Students are familiar with the chi- square distribution and chi- square test and understand their uses.		B5.0		D5.0
SCIENCE				
Scientific and Engineering Practices – SEP				
1. Asking questions (for science) and defining problems (for engineering)	A5.0, A8.0	B1.0, B3.0, B6.0, B8.0, B9.0, B10.0		D5.0, D7.0
2. Developing and using models	A4.0, A5.0, A6.0, A8.0	B1.0, B2.0, B3.0, B6.0, B8.0, B10.0		D3.0, D4.0, D5.0, D7.0
3. Planning and carrying out investigations		B2.0, B3.0, B6.0, B8.0, B10.0		D5.0, D7.0
4. Analyzing and interpreting data	A2.0, A4.0, A5.0, A6.0, A7.0, A8.0	B1.0, B2.0, B3.0, B6.0, B7.0, B8.0, B10.0	C3.0, C4.0, C7.0, C8.0, C9.0	D2.0, D3.0, D5.0, D7.0
5. Using mathematics and computational thinking	A2.0, A4.0, A5.0, A6.0, A7.0, A8.0	B1.0, B3.0, B4.0, B5.0, B6.0, B7.0, B8.0, B10.0	C3.0, C4.0, C5.0, C6.0, C7.0, C8.0, C9.0	D4.0, D5.0, D6.0, D7.0

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Scientific and Engineering Practices – SEP *(continued)*				
6. Constructing explanations (for science) and designing solutions (for engineering)	A5.0	B3.0, B4.0, B5.0, B6.0, B10.0	C2.0, C3.0, C4.0, C5.0, C6.0, C7.0, C8.0, C9.0	D5.0, D7.0
7. Engaging in argument from evidence	A9.0	B3.0, B6.0, B10.0, B11.0	C11.0	D5.0, D7.0
8. Obtaining, evaluating, and communicating information	A2.0, A4.0, A5.0, A6.0, A7.0, A8.0, A9.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0, B7.0, B9.0, B10.0, B11.0	C3.0, C5.0, C6.0, C7.0, C8.0, C9.0, C10.0, C11.0	D1.0, D2.0, D3.0, D4.0, D5.0, D6.0, D7.0
Crosscutting Concept – CC				
1. Patterns	A2.0, A3.0, A7.0	B3.0, B4.0, B5.0, B6.0, B8.0, B10.0		D1.0, D2.0, D3.0, D4.0, D5.0
2. Cause and effect: Mechanism and explanation	A1.0, A5.0, A7.0	B3.0, B4.0, B5.0, B6.0, B8.0, B10.0		D2.0, D3.0, D4.0, D5.0, D6.0
3. Scale, proportion, and quantity	A1.0, A2.0, A3.0, A4.0, A5.0, A7.0, A8.0	B1.0, B3.0, B4.0, B5.0, B6.0, B7.0, B8.0, B10.0	C2.0, C4.0, C5.0, C6.0, C7.0, C8.0, C9.0, C10.0	D1.0, D2.0, D3.0, D4.0, D5.0, D6.0
4. Systems and system models	A5.0	B3.0, B4.0, B5.0, B6.0, B8.0, B9.0, B10.0	C7.0	D2.0, D3.0, D4.0, D5.0, D6.0
5. Energy and matter: Flows, cycles, and conservation	A5.0	B3.0, B4.0, B5.0, B10.0		D2.0, D3.0, D4.0, D5.0, D6.0
6. Structure and function	A1.0, A2.0, A3.0, A5.0, A7.0, A8.0	B6.0, B7.0, B8.0, B10.0	C2.0	D2.0, D5.0
7. Stability and change	A5.0, A7.0	B3.0, B10.0	C2.0	D2.0, D3.0, D5.0, D6.0
Physical Sciences – PS				
PS1: Matter and Its Interactions				
PS1.A: Structure and Properties of Matter	A7.0	B3.0, B4.0, B5.0, B10.0		D2.0, D6.0
PS1.B: Chemical Reactions		B4.0, B5.0, B10.0		D2.0, D6.0
PS1.C: Nuclear Processes		B4.0, B5.0, B10.0		D6.0

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Physical Sciences – PS *(continued)*				
PS2: Motion and Stability: Forces and Interactions				
PS2.A: Forces and Motion	A6.0, A7.0	B4.0, B5.0, B10.0		D4.0, D5.0, D6.0 D7.0
PS2.B: Types of interactions	A6.0, A7.0	B4.0, B5.0, B10.0		D4.0, D5.0, D6.0 D7.0
PS2.C: Stability and Instability in Physical Systems	A1.0, A6.0, A7.0	B4.0, B5.0, B10.0		D4.0, D5.0, D6.0 D7.0
PS3: Energy				
PS3.A: Definitions of Energy	A5.0	B3.0, B4.0, B5.0, B8.0, B10.0		D4.0, D6.0
PS3.B: Conservation of Energy and Energy Transfer	A5.0	B3.0, B4.0, B5.0, B8.0, B10.0		D4.0, D6.0
PS3.C: Relationship Between Energy and Forces		B4.0, B5.0, B8.0, B10.0		D4.0, D6.0
PS3.D: Energy in Chemical Processes and Everyday Life	A5.0	B4.0, B5.0, B8.0, B10.0		D4.0, D6.0
PS4: Waves and Their Applications in Technologies for Information Transfer				
PS4.A: Wave Properties		B3.0, B4.0, B5.0, B10.0		D6.0, D7.0
PS4.B: Electromagnetic Radiation		B4.0, B5.0, B10.0		D6.0, D7.0
PS4.C: Information Technologies and Instrumentation		B3.0, B4.0, B5.0, B10.0		D6.0
Earth and Space Sciences – ESS				
ESS2: Earth's Systems				
ESS2.A: Earth Materials and Systems		B3.0		D2.0, D3.0, D7.0
ESS2.B: Plate Tectonics and Large-Scale System Interactions		B3.0		D2.0, D3.0, D4.0, D7.0
ESS2.C: The Roles of Water in Earth's Surface Processes		B3.0		D2.0, D3.0, D4.0, D7.0, D9.0, D13.0, D14.0
ESS2.D: Weather and Climate		B3.0		D3.0, D7.0, D10.0
ESS2.E: Biogeology				D11.0, D13.0

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Earth and Space Sciences – ESS *(continued)*				
ESS3: Earth and Human Activity				
ESS3.A: Natural Resources	A5.0	B3.0		D3.0, D7.0, D9.0
ESS3.B: Natural Hazards		B3.0		D2.0, D7.0
ESS3.C: Human Impacts on Earth Systems	A5.0	B3.0		D2.0, D3.0, D7.0, D9.0, D10.0, D12.0
ESS3.D: Global Climate Change	A5.0	B3.0		D3.0, D7.0, D10.0, D11.0, D12.0
Engineering, Technology, and the Applications of Science – ETS				
ETS1: Engineering Design				
ETS1.A: Defining and Delimiting an Engineering Problem	A5.0, A6.0, A8.0	B3.0, B6.0, B8.0, B10.0		D5.0
ETS1.B: Developing Possible Solutions	A5.0, A6.0, A8.0	B3.0, B6.0, B8.0, B10.0		D5.0
ETS1.C: Optimizing the Design Solution	A5.0, A6.0, A8.0	B3.0, B6.0, B8.0, B10.0		D5.0
ETS2: Links Among Engineering, Technology, Science, and Society				
ETS2.A: Interdependence of Science, Engineering, and Technology	A5.0, A6.0, A7.0	B3.0, B4.0, B5.0, B10.0	C2.0, C3.0, C4.0, C5.0, C7.0, C8.0, C9.0, C10.0, C11.0	D2.0, D4.0, D6.0
ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World	A1.0, A2.0, A5.0, A8.0	B9.0, B10.0	C11.0	
HISTORY/SOCIAL SCIENCE				
Principles of American Democracy and Economics – AD				
12.3 Students evaluate and take and defend positions on what the fundamental values and principles of civil society are (i.e., the autonomous sphere of voluntary personal, social, and economic relations that are not part of government), their Interdependence, and the meaning and importance of those values and principles for a free society.		B9.0	C1.0	D2.0

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Principles of American Democracy and Economics – AD *(continued)*				
12.7 Students analyze and compare the powers and procedures of the national, state, tribal, and local governments.	A1.0, A2.0, A5.0	B9.0	C1.0	D2.0
12.7.5. Explain how public policy is formed, including the setting of the public agenda and implementation of it through regulations and executive orders.	A2.0			D10.0, D11.0, D13.0
Principles of Economics – PE				
12.1 Students understand common economic terms and concepts and economic reasoning.	A1.0, A2.0, A5.0	B9.0	C1.0	D2.0, D3.0
12.1.4. Evaluate the role of private property as an incentive in conserving and improving scarce resources, including renewable and nonrenewable natural resources.				D10.0, D11.0, D13.0
12.2 Students analyze the elements of America's market economy in a global setting.	A2.0, A5.0	B9.0	C1.0	D3.0
12.6 Students analyze issues of international trade and explain how the U.S. economy affects, and is affected by, economic forces beyond the United States' borders.	A1.0	B9.0		
U.S. History and Geography – US				
11.2 Students analyze the relationship among the rise of industrialization, large-scale rural-to-urban migration, and massive immigration from Southern and Eastern Europe.	A1.0		C1.0	
11.5 Students analyze the major political, social, economic, technological, and cultural developments of the 1920s.	A1.0		C1.0	
11.5.7. Discuss the rise of mass production techniques, the growth of cities, the impact of new technologies (e.g., the automobile, electricity), and the resulting prosperity and effect on the American landscape.			C1.0	
11.6 Students analyze the different explanations for the Great Depression and how the New Deal fundamentally changed the role of the federal government.	A1.0, A5.0		C1.0	
11.6.4. Analyze the effects of and the controversies arising from New Deal economic policies and the expanded role of the federal government in society and the economy since the 1930s (e.g., Works Progress Administration, Social Security, National Labor Relations Board, farm programs, regional development policies, and energy development projects such as the Tennessee Valley Authority, California Central Valley Project, and Bonneville Dam).			C1.0	

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
U.S. History and Geography – US *(continued)*				
11.8 Students analyze the economic boom and social transformation of post-World War II America.	A1.0, A2.0, A5.0	B9.0	C1.0	
11.11 Students analyze the major social problems and domestic policy issues in contemporary American society.	A1.0, A2.0, A5.0	B9.0	C1.0	D3.0
11.11.5. Trace the impact of, need for, and controversies associated with environmental conservation, expansion of the national park system, and the development of environmental protection laws, with particular attention to the interaction between environmental protection advocates and property rights advocates.				D10.0, D11.0, D13.0
World History, Culture, and Geography – WH				
10.3 Students analyze the effects of the Industrial Revolution in England, France, Germany, Japan, and the United States.	A1.0, A2.0, A5.0	B9.0	C1.0	
10.9 Students analyze the international developments in the post-World World War II world.	A1.0	B9.0	C1.0	
10.10 Students analyze instances of nation-building in the contemporary world in at least two of the following regions or countries: the Middle East, Africa, Mexico and other parts of Latin America, and China.	A5.0	B9.0	C1.0	
10.11 Students analyze the integration of countries into the world economy and the information, technological, and communications revolutions (e.g., television, satellites, computers).	A1.0, A2.0, A3.0, A5.0	B9.0	C1.0	
Chronological and Spatial Reasoning – CSR				
1. Students compare the present with the past, evaluating the consequences of past events and decisions and determining the lessons that were learned.	A1.0		C1.0	
2. Students analyze how change happens at different rates at different times; understand that some aspects can change while others remain the same; and understand that change is complicated and affects not only technology and politics but also values and beliefs.	A1.0			
4. Students relate current events to the physical and human characteristics of places and regions.			C1.0	

Academic Alignment Matrix

ENGINEERING AND ARCHITECTURE	PATHWAYS			
	A. Architectural Design	B. Engineering Technology	C. Engineering Design	D. Environmental Engineering
Historical Research, Evidence, and Point of View – HR				
4. Students construct and test hypotheses; collect, evaluate, and employ information from multiple primary and secondary sources; and apply it in oral and written presentations.	A1.0			
Historical Interpretation – HI				
1. Students show the connections, causal and otherwise, between particular historical events and larger social, economic, and political trends and developments.	A1.0		C1.0	
3. Students interpret past events and issues within the context in which an event unfolded rather than solely in terms of present-day norms and values.	A1.0			

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