

Energy, Environment, and Utilities



Environmental Resources Pathway

Telecommunications Pathway

Energy and Power Technology Pathway

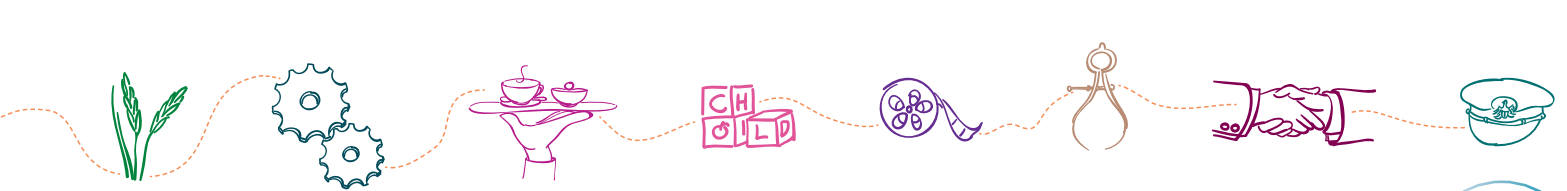




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# Energy, Environment, and Utilities



## *Sector Description*

This sector is designed to provide a foundation of knowledge and skills in careers related to energy, environment, and utilities. The pathways emphasize real-world, occupationally relevant knowledge, skills, and experiences of significant scope and depth in Environmental Resources, Energy and Power Technology, and Telecommunications. The standards integrate academic and technical preparation and focus on career awareness, career exploration, preparation for entry to technical-level employment, and alignment with postsecondary programs focused on energy, utilities, and related fields.





# Energy, Environment, and Utilities Knowledge and Performance Anchor Standards

## 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 Energy, Environment, and Utilities academic alignment matrix for identification of standards.

## 2.0 Communications

Acquire, and accurately use Energy, Environment, and Utilities 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 Energy, Environment, and Utilities 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 to create alternative solutions to answer a question or solve a problem unique to the Energy, Environment, and Utilities 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 Energy, Environment, and Utilities 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 Review the responsibility of the Occupational Safety and Health Administration (OSHA) to ensure workplace safety.
- 6.8 Identify both potential hazards and accident scenarios in the work environment.
- 6.9 Follow established safety procedures (OSHA regulations and utility company procedures).
- 6.10 Evaluate changes in the environment with respect to their impact on safety of self and others.
- 6.11 Comply with energy industry safety procedures and proper ways to perform work.
- 6.12 Use safety equipment as specified by user manuals and safety training.
- 6.13 Use personal protective equipment (PPE), including safety glasses, hearing protection, gloves, work boots, and hard hats.
- 6.14 Keep personal safety equipment in good working order.
- 6.15 Use tools and equipment in compliance with user manuals and training.
- 6.16 Recognize potential and actual hazardous conditions as they arise.

## 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 Energy, Environment, and Utilities 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 Energy, Environment, and Utilities 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 Energy, Environment, and Utilities industry sector.
- 8.3 Demonstrate ethical and legal practices consistent with Energy, Environment, and Utilities 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 Energy, Environment, and Utilities 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 Energy, Environment, and Utilities sector issues and problems.

## 10.0 Technical Knowledge and Skills

Apply essential technical knowledge and skills common to all pathways in the Energy, Environment, and Utilities sector.

- 10.1 Interpret and explain terminology and practices specific to the Energy, Environment, and Utilities sector.
- 10.2 Comply with the rules, regulations, and expectations of all aspects of the Energy, Environment, and Utilities sector.



- 10.3 Construct projects and products specific to the Energy, Environment, and Utilities sector requirements and expectations.
- 10.4 Coordinate with industry experts for specific technical knowledge and skills.
- 10.5 Maintain and troubleshoot equipment used in the energy, environment, and utilities industry.
- 10.6 Identify and evaluate questions that require skilled investigation to solve current problems cited in literature or media, or observed through personal observations.

### **11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Energy, Environment, and Utilities 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 Energy, Environment, and Utilities 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 Energy, Environment, and Utilities 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. Environmental Resources Pathway

The Environmental Resources pathway prepares students for employment, postsecondary education, and/or training in a variety of environmental industries.

Sample occupations associated with this pathway:

-  Air Quality Technician
-  Climatologist
-  Environmental Biologist/Technician/Scientist
-  Environmental Health and Safety Officer
-  Hazardous Waste Operations and Emergency Response Technician

- A1.0 Identify energy resources and the effects of these resources on the environment.
  - A1.1 Classify energy resources by type: depletable, nondepletable, renewable, and nonrenewable.
  - A1.2 Discover new and emerging energy resources.
  - A1.3 Compare the advantages and disadvantages of energy resources in terms of the effects on the environment.
  - A1.4 List jobs in the community that result from, or are influenced by, processing and using energy resources.
- A2.0 Identify and describe the global interactive systems and elements that create and sustain climate.
  - A2.1 Describe the natural elements that interact to create climate.
  - A2.2 Identify world climate patterns and summarize factors that affect climate.
  - A2.3 Analyze the impact of climate upon human activities and needs.
  - A2.4 Identify the greenhouse effect and climate change.
  - A2.5 Explain how greenhouse gases are generated.
  - A2.6 Assess impacts of greenhouse gases on the environment.
- A3.0 Evaluate regional interactive systems and elements that create harmful environmental effects.
  - A3.1 Describe the sources of, and impacts attributable to, pollution and contamination.
  - A3.2 Recognize the actions that cause resource depletion.
  - A3.3 Define the causes of erosion and soil depletion.
  - A3.4 Describe the attributes and proliferation of hardscape.
  - A3.5 Identify the sources of, and impacts attributable to, habitat alteration.



- A4.0 Research the environmental implications of energy conversion processes and energy transmission systems.
  - A4.1 Define the basic terms, characteristics, and concepts of physical and chemical processes related to energy conversion.
  - A4.2 Identify the basic principles of energy systems, including chemical, hydraulic, pneumatic, electrical, nuclear, solar, wind, and geothermal.
  - A4.3 Analyze the impacts of energy conversion processes as they relate to activities across the environment.
  
- A5.0 Identify the role and impact of waste management systems and their operations on the environment.
  - A5.1 Understand the role of waste and storm water management systems, their operation, and their impact on the environment.
  - A5.2 Explore the causes and effects of pollution linked to wastewater treatment facilities.
  - A5.3 Identify wastewater treatment processes that lessen environmental impacts and improve water reuse.
  - A5.4 Explain the types and sources of hazardous waste and associated safety practices and legal requirements for handling and disposing of such waste.
  - A5.5 Design solid waste disposal processes that lessen environmental impacts and improve recycling.
  
- A6.0 Understand the field of land use management and its potential for environmental impact.
  - A6.1 Describe the need for, and role of, habitat preservation.
  - A6.2 Describe the composition, role, and function of ecosystems, including trends affecting viability.
  - A6.3 Demonstrate the need for, and methods of, land use planning.
  - A6.4 Identify the aspects of land use planning and describe current trends.
  - A6.5 Summarize the relationship between land use planning and energy use and distribution.
  - A6.6 Explain the laws and regulations pertaining to land use planning.
  - A6.7 Develop strategies to maximize the effectiveness of land use planning.
  
- A7.0 Research the role of air quality management and systems, their operations, and their impact on the environment.
  - A7.1 Understand the elements that create outdoor air quality.
  - A7.2 Summarize the causes of air pollutants and their chemical composition.
  - A7.3 Research air pollutants and their threat to human health.
  - A7.4 Understand U.S. and California laws and regulations related to air pollution control programs and health effects of air pollution.
  - A7.5 Describe the basic U.S. Environmental Protection Agency (EPA) and California Air Resources Board (ARB) roles and regulations.



- A8.0 Implement processes to support energy efficiency.
  - A8.1 Understand the relationship between power and energy efficiency.
  - A8.2 Outline how domestic and industrial appliances and systems affect the environment, such as water units and heating and cooling systems.
  - A8.3 Compare costs of alternate/renewable energy sources, systems, and appliances and traditional energy sources, systems, and appliances.
  - A8.4 Conduct an energy audit.
- A9.0 Research drinking-water sources, systems, treatment, and conservation.
  - A9.1 Understand water reuse: issues, strategies, technologies, and applications.
  - A9.2 Analyze strategies for improving energy efficiencies in water collection and distribution.
  - A9.3 Describe the role of environmental engineering and green energy in water systems.
  - A9.4 Understand the functions and operations of water storage, reservoirs, aqueducts, and dams.
- A10.0 Evaluate the impact and flow management of storm water, rivers, and groundwater.
  - A10.1 Understand the designs and tools used in water flow management.
  - A10.2 Describe watershed modeling.
  - A10.3 Understand the principles and applications of drainage engineering.
  - A10.4 Use the Hydrologic Engineering Centers River Analysis System (HEC-RAS).
  - A10.5 Analyze and interpret contaminated harbor and river sediment.
  - A10.6 Describe the concerns and strategies for catastrophic storm water events and management.
- A11.0 Prepare an efficient solar heated water design and installation plan.
  - A11.1 Identify the characteristics of solar heated water design and installation.
  - A11.2 Describe the requirements of solar water heaters that meet regulations.
  - A11.3 Describe solar hot water financial support programs and regulations.
  - A11.4 Analyze efficient solar water heating systems.
- A12.0 Identify and analyze issues, legislation, and regulations related to energy and the environment.
  - A12.1 Identify and discuss major environmental laws and policies, including the regulatory and legislative processes used to create such laws.
  - A12.2 Understand current regulations concerning recycling, solid waste, land use management, water quality, and renewable and nonrenewable energy.
  - A12.3 Compare and contrast environmental laws and regulations that may have a positive or negative impact on the environment and the economy.
  - A12.4 Create an environmental law or regulation and explain how it will impact the environment.








## Energy, Environment, and Utilities Pathway Standards

### B. Energy and Power Technology Pathway

The Energy and Power Technology pathway provides learning opportunities for students interested in preparing for careers in the energy and power industries.

Sample occupations associated with this pathway:

-  Energy Efficiency Evaluation Specialist
-  Energy Engineer
-  Energy Generation/Power Distribution, Maintenance, Inspection, and Repair Technicians
-  Energy/Building Retrofit Specialist
-  Plant/Field Weatherization Installer

- B1.0 Explore the basic conventional and emerging principles and concepts of the energy industry, including energy production, energy transmission, and alternative energy technologies.
  - B1.1 Describe the past, present, and anticipated demand for, and use of, energy.
  - B1.2 Identify the differences and challenges in energy needs, sources, and uses in developing regions.
  - B1.3 Explain the flow of energy from generation through distribution to the customer.
  - B1.4 Demonstrate an understanding of basic direct current (DC) electrical-circuit skills.
  - B1.5 Identify the role and function of generation, transmission, and distribution organizations.
  - B1.6 Explain the different structures of energy companies, including investor-owned utilities, municipalities (and associated utility practices, such as water/wastewater), electric cooperatives, and independent power producers and the different lines of energy business, including electric and gas.
  - B1.7 Explain the role of regulatory bodies in the energy industry (Federal Energy Regulatory Commission, Public Utilities Commission [PUC]).
  - B1.8 Describe the process of electric metering and billing for energy consumption.
- B2.0 Identify various conventional electric power generation fuel sources and the cost and efficiency issues associated with each.
  - B2.1 Explain the conventional electric power generation system and process (coal, oil, natural gas, solar, wind, geothermal, and hydroelectric).
  - B2.2 Explain how each source was created and is used to produce electricity.
  - B2.3 Evaluate and list the advantages and disadvantages for each energy source.
  - B2.4 Describe how cost and efficiency rates are determined for each source.
- B3.0 Investigate emerging and alternative electric power generation technologies and fuel sources.
  - B3.1 Explain biomass conversion, including thermal and chemical processes used to produce electric energy.



- B3.2 Describe the major sources, scale, and impacts of biomass energy.
- B3.3 Define biofuels use and production.
- B3.4 Explain how nuclear power is used to produce electric energy.
- B3.5 Explain the process of nuclear fission.
- B3.6 Explain how ocean wave energy is used to produce electric energy.
- B3.7 Describe how wave power is harnessed in near shore, offshore, and far shore locations.
- B3.8 Explain wave energy technologies (terminator devices, oscillating water column, point absorbers, attenuators, and overtopping devices).
- B3.9 Compare and contrast the advantages and disadvantages of using ocean wave energy technologies for energy.
  
- B4.0 Understand nonnuclear power generation plant operations (coal, oil, natural gas, solar, wind, geothermal power, hydroelectric, or biofuel).
  - B4.1 Explain and use the fundamental laws and principles of electricity and magnetism.
  - B4.2 Classify the components of electrical generating systems, including boilers, generators, alternators, turbines, motors, engines, pumps, and switchgear.
  - B4.3 Discriminate the differences and similarities of power generation, including use of different fuel types and different power plant uses.
  - B4.4 Summarize the basic operating principles of fossil, hydroelectric, and internal combustion systems.
  - B4.5 Describe the location of equipment in the plant, how the equipment operates, and normal operating parameters.
  - B4.6 Describe the theory, construction, and application of the mechanical components of various types of power generation systems.
  
- B5.0 Understand and apply basic knowledge and skills necessary for nuclear power generation and nuclear power plant personnel.
  - B5.1 Use the fundamental concepts associated with electricity (e.g., electric charge, electric current).
  - B5.2 Understand the components of electrical systems, including switchyard construction, transformers, relays, circuit breakers, and motors.
  - B5.3 Explain the basic atomic and nuclear physics terms, unit, definitions, and basic concepts, including atomic structure, nuclear interactions and reactions, sources of residual heat/decay heat, and reactor operation.
  - B5.4 Understand reactor theory and operations.
  - B5.5 Explain the general design overview of the basic reactor types.
  - B5.6 Demonstrate understanding of reactor startup and shutdown procedures.
  - B5.7 Explain the fission process, including the construction of fission product barriers.








- B5.8 Operate, repair, and test machines, devices, and equipment based on electrical or mechanical principles in order to diagnose machine malfunctions, using basic hand and small electric tools and equipment.
- B5.9 Conduct tests and inspections of products, services, or processes to evaluate quality or performance.
- B6.0 Research methods of energy procurement, transmission, distribution, and storage.
  - B6.1 Describe the electric power transmission principles and processes.
  - B6.2 Explain the need for electric distribution systems and how they are designed to operate.
  - B6.3 Understand the emerging technologies in electric power transmission.
  - B6.4 Identify electric power transmission equipment and systems.
- B7.0 Understand the interrelationships among components of systems.
  - B7.1 Understand the components and workings of the electric transmission and distribution network.
  - B7.2 Understand the components and workings of the gas transmission and distribution network.
  - B7.3 Define and explain *voltage, current, resistance, power, and energy*.
  - B7.4 Measure voltage, amperage, and resistance using a volt-ohm meter (VOM) and a digital volt-ohm meter (DVM).
  - B7.5 Explain and apply Ohm's Law.
  - B7.6 Design and construct an electrical circuit with a power generation source.



## C. Telecommunications Pathway

The Telecommunications pathway prepares students for employment and postsecondary education and training in the wireless and fixed-line communications industries. The sharing of information is essential for personal, commercial, educational, government, and military functions. Information is stored, sent, and accessed primarily via the telecommunications industries.

Sample occupations associated with this pathway:

-  Cable/Telecommunications Installation and Maintenance Technicians
-  Line Workers
-  Network Operators, Technicians, Designers, and Managers
-  Network Security Administrator
-  Satellite Systems Installation/Engineers

- C1.0 Understand the basic principles and concepts that impact the telecommunications industry, including systems, concepts, and regulations.
  - C1.1 Understand the relationship between telecommunications and society.
  - C1.2 Evaluate the effects of telecommunications media and networks (telephone, television, cellular, social networking, etc.).
  - C1.3 Understand the fundamentals of voice telephony and voice characteristics.
  - C1.4 Compare analog transmission concepts (bandwidth, voiceband, modulation), analog circuits and sounds, and plain ordinary telephone service (POTS).
  - C1.5 Understand digital transmission concepts (capacity, bits-per-second), converting sound to digital signals (PCM, CODECS), and compensating for transmission impairments (attenuation, noise, delay, jitter).
  - C1.6 Define *voice over IP* (VoIP).
  - C1.7 Describe public switched telephone network (PSTN) and signaling system 7 (SS7).
  - C1.8 Understand signaling: pulse dialing and dual tone multiple frequency (DTMF).
- C2.0 Demonstrate understanding and use of the basic and emerging technologies that impact the telecommunications industry.
  - C2.1 Describe the differences between analog and digital transmission and the migration to a converged digital/optical network for voice, data, and video.
  - C2.2 Compare and contrast the components of voice networks, such as carrier switches, routing, PBXs, T1 trunks, switched versus dedicated circuits, and packet and wireless networks.
  - C2.3 Define the components of data networks, such as modems, virtual circuits, hubs, switches, and routers.
  - C2.4 Evaluate the differences between the various access methods, including DSL, cable modems, wireless (cellular, WiMax, Wi-Fi), T1, and carrier Ethernet.



- C2.5 Compare private voice network design alternatives using tie-lines, Centrex, virtual private networks (VPN), and hosted services.
- C2.6 Understand the basics of local, metropolitan, and wide area networks (LANs, MANs, and WANs), including the differences between network bridging/switching and routing.
- C2.7 Recognize technologies such as frame relay, ATM, MLPS, Ethernet, and TCP/IP and determine each technology's impact on network design, communication capabilities, and quality of service (QOS).
- C2.8 Compare the benefits, drawbacks, and technology behind voice over IP (VoIP) using IP PBXs, IP phones and Internet telephony service providers (ITSP), and IPTV.
- C2.9 Obtain a working knowledge of communications protocols and standards with an emphasis on their importance in network engineering and network operation.
- C2.10 Understand the uses and effects of new technologies, such as social networking and cloud computing, on the network.
- C3.0 Examine the role and functions of satellites in telecommunications.
  - C3.1 Understand the evolution of satellite communications.
  - C3.2 Analyze the limitations of terrestrial communications and the advantages and disadvantages of satellites.
  - C3.3 Illustrate and describe the basic elements of satellite communications.
  - C3.4 Describe common types of satellites and their respective functions.
  - C3.5 Learn the vocabulary and acronyms associated with satellite communications.
  - C3.6 Understand satellite orbits, including launch vehicles and the launching of satellites.
  - C3.7 Understand satellite systems, including geo-synchronous earth orbiting (GEO), low-earth orbiting (LEO), medium-earth orbiting (MEO), high-earth orbiting (HEO), and mobile satellite systems.
  - C3.8 Analyze satellite system architecture, including the network configuration, remotes, satellite subsystems, ground stations, and network management.
  - C3.9 Understand frequency bands and those used in satellite communications.
  - C3.10 Understand the importance of modulation, multiplexing, and multiple access.
  - C3.11 Explain propagation and interference, including radio noise, ionosphere effects, troposphere effects, interference between satellite networks, and interference with terrestrial networks.
  - C3.12 Research applications and trends in satellite communications, including personal, commercial, military and government, and global applications.
- C4.0 Research the components, interaction, and operations of wireless telecommunications systems.
  - C4.1 Understand mobile wireless services and applications.
  - C4.2 Demonstrate device management.





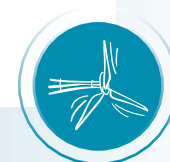
- C4.3 Describe access technologies, including wireline and wireless end-to-end switching and signaling.
- C4.4 Identify switching, routing, and security systems and technologies for wireless and Internet networking.
- C4.5 Understand radio frequency (RF), air interface, and radio access network (RAN).
- C4.6 Explain code division multiple access (CDMA), wireless technologies, services, and applications.
- C4.7 Research the different functions and uses of wireless and cable networks.
- C4.8 Describe mobile network components and basic operation, including cellular principles and AMPS (1G), 2G; digital radio voice communications and digital cellular; data communications and spectrum-sharing technologies; frequency division multiple access (FDMA), time division multiple access (TDMA), CDMA, orthogonal frequency division multiplexing (OFDM) and 3G cellular; CDMA and 4G mobile cellular; LTE, wireless local area networks (LANs) and WiFi.
- C4.9 Understand the function and basic operations of communications satellites.
- C5.0 Research the components, interaction, and operations of fixed-wire telecommunications systems.
  - C5.1 Demonstrate and apply safety procedures and practices for traffic control, pole climbing, roadside safety, electrical hazards, and data line safety checks.
  - C5.2 Demonstrate proficiency in making electrical connections, splices, and basic field repair.
  - C5.3 Understand the differences between function and uses of wireless and cable networks.
  - C5.4 Understand access technologies, including wireline and wireless end-to-end switching and signaling.
  - C5.5 Practice troubleshooting and repairing telecommunication system wiring.
  - C5.6 Demonstrate proficiency in basic AC and DC circuits.
  - C5.7 Inspect and demonstrate proficiency in the use of tools, equipment, and test equipment used in the voice and data communications industry.
  - C5.8 Install, repair, terminate, and test network cabling.
  - C5.9 Demonstrate cable repair techniques.
  - C5.10 Prepare work site plans to demonstrate proficiency in site requirements and considerations.
  - C5.11 Understand the theory of twisted pair design and shielding.
- C6.0 Consider privacy and security issues of the telecommunications systems.
  - C6.1 Understand switching, routing, and security systems and technologies for wireless and Internet networking.
  - C6.2 Explain the need and strategies for network security and integrity.



- C6.3 Demonstrate the appropriate applications of network and user data mining and behavior profiling.
- C6.4 Explain industry code of conduct.
- C7.0 Demonstrate proficiency in customer relations.
  - C7.1 Demonstrate appropriate personal hygiene and professional attire.
  - C7.2 Apply techniques for instilling customer confidence and satisfaction.
  - C7.3 Apply techniques for keeping the customer informed.
  - C7.4 Describe and demonstrate effective follow-up techniques.
  - C7.5 Demonstrate discretion in interacting with customers in field and retail environments.
  - C7.6 Illustrate basic conflict-resolution practices.

## Academic Alignment Matrix

<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>ENGLISH LANGUAGE ARTS</b>			
<b>Language Standards – LS – (Standard Area, Grade Level, Standard #)</b>			
11-12.1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.	A1.0, A 2.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0	C1.0, C2.0, C3.0, C4.0, C5.0
11-12.2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.	A1.0, A2.0		C1.0, C2.0, C3.0, C4.0, C5.0
11-12.6. Acquire and accurately use general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.	A1.0, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A9.0, A10.0, A12.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0	C1.0, C2.0, C3.0, C4.0, C5.0
<b>Reading Standards for Informational Text – RSIT – (Standard Area, Grade Level, Standard #)</b>			
11-12.1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.	A1.0, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A9.0, A10.0, A12.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0	
11-12.3. Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.	A1.0, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A9.0, A10.0, A12.0		C1.0, C2.0, C3.0, C4.0, C5.0
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, A2.0, A3.0, A4.0, A5.0, A7.0		C5.0, C7.0
11-12.8. Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning (e.g., in U.S. Supreme Court majority opinions and dissents) and the premises, purposes, and arguments in works of public advocacy (e.g., <i>The Federalist</i> , presidential addresses).	A 7.0, A12.0	B4.0	





## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Reading Standards for Literacy in Science and Technical Subjects – RLST – (Standard Area, Grade Level, Standard #) (continued)</b>			
11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.	A8.0	B1.0, B5.0, B7.0	C6.0, C7.0
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.	A2.0, A3.0, A4.0, A5.0, A7.0	B3.0	C5.0, C7.0
11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	A2.0, A3.0, A4.0, A5.0, A7.0	B1.0, B5.0, B7.0	C1.0, C2.0, C3.0, C4.0, C5.0
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, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A9.0, A10.0, A12.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0, B7.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
<b>Writing Standards – WS – (Standard Area, Grade Level, Standard #)</b>			
11-12.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.		B1.0, B2.0, B3.0, B4.0, B5.0, B6.0, B7.0	
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.	A1.0, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A9.0, A10.0, A12.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0, B7.0	C2.0, C3.0
11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	A1.0, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A9.0, A10.0, A12.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0, B7.0	C3.0, C6.0
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.	A5.0, A6.0, A7.0, A9.0, A11.0	B1.0, B5.0, B7.0	C1.0, C4.0, C5.0

## Academic Alignment Matrix

<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>Writing Standards – WS – (Standard Area, Grade Level, Standard #) (continued)</b>			
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.		B1.0, B2.0, B3.0, B4.0, B5.0, B6.0, B7.0	C1.0, C4.0, C5.0
11-12.9. Draw evidence from literary or informational texts to support analysis, reflection, and research.	A5.0, A6.0, A7.0, A9.0, A11.0		C1.0, C4.0, C5.0
<b>Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects – WHSST –(Standard Area, Grade Level, Standard #)</b>			
11-12.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.		B1.0	C2.0, C3.0
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.	A5.0, A8.0	B5.0, B7.0	C1.0, C4.0, C5.0
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.			C1.0, C4.0, D5.0
11-12.9. Draw evidence from informational texts to support analysis, reflection, and research.	A5.0, A8.0	B5.0, B7.0	C1.0, C4.0, C5.0
<b>MATHEMATICS</b>			
<b>Algebra – A-SSE – Seeing Structure in Expressions</b>			
<i>Interpret the structure of expressions</i>			
1. Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret <math>P(1+r)^n</math> as the product of P and a factor not depending on P.</i>	A2.0, A3.0, A5.0, A6.0, A8.0, A9.0, A10.0, A11.0		C1.0



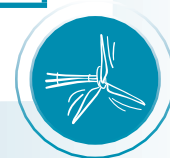


## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Algebra – A-SSE – Seeing Structure in Expressions</b> <i>(continued)</i>			
<i>Write expressions in equivalent forms to solve problems</i>			
<p>3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*</p> <p>a. Factor a quadratic expression to reveal the zeros of the function it defines.</p> <p>b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p> <p>c. Use the properties of exponents to transform expressions for exponential functions. For example the expression <math>1.15^t</math> can be rewritten as <math>(1.15^{1/12})^{12t} = 1.012^{12t}</math> to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</p> <p>d. Prove simple laws of logarithms. (CA Standard Algebra II - 11.0)</p> <p>e. Use the definition of logarithms to translate between logarithms in any base. (CA Standard Algebra II - 13.0)</p> <p>f. Understand and use the properties of logarithms to simplify logarithmic numeric expressions and to identify their approximate values. (CA Standard Algebra II - 14.0)</p>	A10.0		
4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.	A10.0		
<b>Algebra – A-CED – Creating Equations</b>			
<i>Create equations that describe numbers or relationships</i>			
<p>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.</p> <p>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)</p>	A2.0		
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A2.0	B1.0	C1.0, C2.0
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		C2.0

## Academic Alignment Matrix

<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>Algebra – A-CED – Creating Equations</b> <i>(continued)</i>			
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 $R$ .			C2.0
<b>Algebra – A-REI – Reasoning with Equations and Inequalities</b>			
<i>Understand solving equations as a process of reasoning and explain the reasoning</i>			
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		C1.0, C2.0
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	A10.0		
<i>Solve equations and inequalities in one variable</i>			
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		
<i>Solve systems of equations</i>			
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	A6.0		
<b>Functions – F-IF – Interpreting Functions</b>			
<i>Interpret functions that arise in applications in terms of the context</i>			
4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.	A2.0		
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	A2.0		





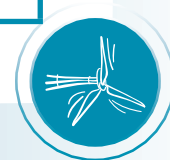
## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Functions – F-IF – Interpreting Functions</b> <i>(continued)</i>			
<i>Analyze functions using different representations</i>			
<p>7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.</p> <p>a. Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.</p> <p>c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.</p> <p>d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.</p> <p>e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.</p>	A10.0		
9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.	A6.0	B1.0	C2.0
10. Demonstrate an understanding of functions and equations defined parametrically and graph them. (CA Standard Math Analysis – 7.0)		B1.0	
<b>Functions – F-BF – Building Functions</b>			
<i>Build a function that models a relationship between two quantities</i>			
<p>1. Write a function that describes a relationship between two quantities.</p> <p>a. Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <p>b. Combine standard function types using arithmetic operations. <i>For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.</i></p> <p>c. (+) Compose functions. <i>For example, if <math>T(y)</math> is the temperature in the atmosphere as a function of height, and <math>h(t)</math> is the height of a weather balloon as a function of time, then <math>T(h(t))</math> is the temperature at the location of the weather balloon as a function of time.</i></p>			C2.0



## Academic Alignment Matrix

<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Functions – F-LE – Linear, Quadratic, and Exponential Models</b>			
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.	A2.0		
2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).		B1.0	C2.0
3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. <i>Interpret expressions for functions in terms of the situation they model</i>			C2.0
5. Interpret the parameters in a linear or exponential function in terms of a context.		B1.0	C2.0
<b>Functions – F-TF – Trigonometric Functions</b>			
<i>Extend the domain of trigonometric functions using the unit circle</i>			
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)			C3.0
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. <i>Model periodic phenomena with trigonometric functions</i>			C3.0
5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.			C3.0
7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.			C3.0





## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Geometry – G–C – Circles</b>			
<i>Understand and apply theorems about circles</i>			
2. Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	A10.0		C3.0
4. (+) Construct a tangent line from a point outside a given circle to the circle.			C3.0
<i>Find arc lengths and areas of sectors of circles</i>			
5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.			C3.0
<b>Geometry – G–CO – Congruence</b>			
<i>Experiment with transformations in the plane</i>			
1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.			C3.0
2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).			C3.0
<i>Make geometric constructions</i>			
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.			C3.0

## Academic Alignment Matrix

<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>Geometry – G–GMD – Geometric Measurement and Dimensions</b>			
<i>Explain volume formulas and use them to solve problems</i>			
1. Give an informal argument for the formulas for the circumference of a Circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments. 2. (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. 3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.			C3.0
<b>Geometry – G–GPE – Expressing Geometric Properties with Equations</b>			
<i>Translate between the geometric description and the equation for a conic section</i>			
3. (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.  3.1 Demonstrate and explain how the geometry of the graph of a conic section (e.g, asymptotes, foci, eccentricity} depends on the coefficients of the quadratic equation representing it. (CA Standard Algebra II - 16.0) 3.2 Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$ , use the method for completing the square to put the equation into standard form and recognize whether the graph of the equation is a circle, ellipse, parabola, or hyperbola. Then graph the equation. (CA Standard Algebra II - 17.0) 3.3 Be familiar with conic sections both analytically and geometrically. (CA Standard Math Analysis - 5.0)			C3.0
<b>Geometry – G–MG – Modeling with Geometry</b>			
<i>Apply geometric concepts in modeling situations</i>			
1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder.	A2.0		C2.0
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	A2.0, A6.0		
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)	A2.0, A6.0		C2.0



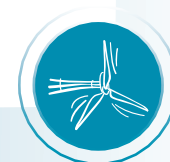


## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Geometry – G–SRT – Similarity, Right Triangles, and Trigonometry</b>			
<i>Apply trigonometry to general triangles</i>			
11. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).			C3.0
<b>Geometry – G–PCC – Polar Coordinates and Curves</b>			
<i>Graph polar coordinates and curves.</i>			
1. Be familiar with polar coordinates. In particular, determine polar coordinates of a point given in rectangular coordinates and vice versa. (CA Standard Trigonometry – 15.0)	A2.0		
<b>Number and Quantity – N–Q – Quantities</b>			
<i>Reason quantitatively and use units to solve problems</i>			
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.	A6.0		
2. Define appropriate quantities for the purpose of descriptive modeling.	A2.0, A6.0		
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	A2.0, A6.0		
<b>Number and Quantity – N–VM – Vector and Matrix Quantities</b>			
<i>Represent and model with vector quantities</i>			
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., $\mathbf{v}$ , $ \mathbf{v} $ , $\ \mathbf{v}\ $ , $v$ ).			C3.0
3. (+) Solve problems involving velocity and other quantities that can be represented by vectors.			C3.0

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<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>Number and Quantity – N-VM – Vector and Matrix Quantities</b> <i>(continued)</i>			
<i>Perform operations on vectors</i>			
<p>4. (+) Add and subtract vectors.</p> <p>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.</p> <p>b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.</p> <p>c. Understand vector subtraction <math>v - w</math> as <math>v + (-w)</math>, where <math>-w</math> is the additive inverse of <math>w</math>, with the same magnitude as <math>w</math> and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.</p>			C3.0
<b>Statistics and Probability – S-IC – Making Inferences and Justifying Conclusions</b>			
<i>Understand and evaluate random processes underlying statistical experiments</i>			
1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.	A2.0, A8.0	B1.0	C6.0
2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?	A2.0, A8.0	B5.0	C6.0
<i>Make inferences and justify conclusions from sample surveys, experiments, and observational studies</i>			
3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	A8.0	B5.0	C6.0
5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	A8.0	B5.0	
6. Evaluate reports based on data.	A2.0, A8.0	B1.0, B5.0	C6.0
<b>Statistics and Probability – S-ID – Interpreting Categorical and Quantitative Data</b>			
<i>Summarize, represent, and interpret data on a single count or measurement variable</i>			
1. Represent data with plots on the real number line (dot plots, histograms, and box plots).	A2.0, A8.0	B5.0	



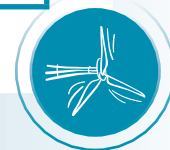


## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Statistics and Probability – S-ID – Interpreting Categorical and Quantitative Data</b> <i>(continued)</i>			
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, A8.0	B5.0	
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, A8.0	B5.0	
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.	A8.0	B5.0	
<i>Summarize, represent, and interpret data on two categorical and quantitative variables</i>			
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.	A2.0, A8.0	B1.0	
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. <ul style="list-style-type: none"> <li>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.</li> <li>b. Informally assess the fit of a function by plotting and analyzing residuals.</li> <li>c. Fit a linear function for a scatter plot that suggests a linear association.</li> </ul>	A2.0, A8.0	B1.0	
<i>Interpret linear models</i>			
7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	A2.0	B1.0	
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.	A8.0		
9. Distinguish between correlation and causation.	A2.0		

## Academic Alignment Matrix

<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>Statistics and Probability – S-CP – Conditional Probability and the Rules of Probability</b>			
<i>Understand independence and conditional probability and use them to interpret data</i>			
5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.		B1.0	
<b>Statistics and Probability – S-MD – Using Probability to Make Decisions</b>			
<i>Use probability to evaluate outcomes of decisions</i>			
5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant. b. Evaluate and compare strategies on the basis of expected values. For example, compare a high deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.		B1.0	C6.0
6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).		B1.0	C6.0
7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	A6.0, A9.0	B1.0, B2.0, B5.0	C6.0
<b>Statistics and Probability – APPS – Advanced Placement Probability and Statistics</b>			
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.	A2.0, A9.0	B1.0, B5.0	C6.0
<b>Calculus – C</b>			
6.0 Students find the derivatives of parametrically defined functions and use implicit differentiation in a wide variety of problems in physics, chemistry, economics, and so forth.	A10.0	B2.0	
11.0 Students use differentiation to solve optimization (maximum–minimum problems) in a variety of pure and applied contexts.	A6.0, A9.0, A10.0	B2.0	C3.0
12.0 Students use differentiation to solve related rate problems in a variety of pure and applied contexts.	A6.0, A9.0, A10.0	B2.0	C3.0
16.0 Students use definite integrals in problems involving area, velocity, acceleration, volume of a solid, area of a surface of revolution, length of a curve, and work.	A9.0, A10.0	B2.0	C3.0





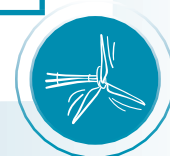
## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>SCIENCE</b>			
<b>Scientific and Engineering Practices – SEP</b>			
1. Asking questions (for science) and defining problems (for engineering)	A1.0, A2.0, A3.0, A4.0, A5.0, A9.0, A10.0, A12.0	B1.0, B2.0, B3.0, B4.0, B6.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C8.0
2. Developing and using models	A10.0, A11.0	B1.0, B7.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
3. Planning and carrying out investigations	A2.0, A5.0, A8.0, A10.0, A11.0	B5.0, B7.0	C3.0, C4.0, C5.0, C6.0
4. Analyzing and interpreting data	A1.0, A2.0, A3.0, A8.0, A10.0, A11.0	B1.0, B2.0, B3.0, B5.0, B7.0	C3.0, C4.0, C5.0, C6.0, C7.0
5. Using mathematics and computational thinking	A8.0, A11.0	B2.0, B7.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
6. Constructing explanations (for science) and designing solutions (for engineering)	A2.0, A5.0, A6.0, A7.0, A10.0, A12.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0, B7.0	C3.0, C4.0, C5.0, C6.0, C7.0
7. Engaging in argument from evidence	A1.0, A2.0, A4.0, A7.0, A10.0, A12.0	B3.0, B4.0	C3.0, C4.0, C5.0, C6.0
8. Obtaining, evaluating, and communicating information	A1.0, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A8.0, A10.0, A11.0	B1.0, B2.0, B3.0, B4.0, B5.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
<b>Crosscutting Concept – CC</b>			
1. Patterns	A1.0, A2.0, A4.0, A5.0, A9.0	B2.0, B4.0, B7.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
2. Cause and effect: Mechanism and explanation	A1.0, A2.0, A3.0, A4.0, A5.0, A6.0, A7.0, A10.0	B1.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
3. Scale, proportion, and quantity	A2.0, A4.0, A8.0	B1.0, B2.0, B6.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
4. Systems and system models	A2.0, A4.0, A5.0, A9.0, A10.0, A11.0	B4.0, B5.0, B6.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
5. Energy and matter: Flows, cycles, and conservation	A1.0, A2.0, A4.0, A5.0, A7.0, A8.0, A9.0, A11.0	B1.0, B2.0, B3.0, B4.0, B5.0, B6.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
6. Structure and function	A6.0, A10.0		C1.0, C2.0, C3.0, C4.0, C5.0, C6.0



## Academic Alignment Matrix

<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>Physical Sciences – PS</b>			
PS1: Matter and Its Interactions			
PS1.A: Structure and Properties of Matter	A2.0, A3.0	B2.0, B5.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
PS1.B: Chemical Reactions	A2.0, A4.0, A7.0	B3.0, B4.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
PS1.C: Nuclear Processes		B3.0, B5.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
PS2: Motion and Stability: Forces and Interactions			
PS2.A: Forces and Motion	A10.0	B3.0	C5.0, C6.0
PS2.B: Types of interactions	A10.0	B1.0, B3.0, B7.0	
PS2.C: Stability and Instability in Physical Systems	A10.0	B3.0	
PS3: Energy			
PS3.A: Definitions of Energy	A1.0, A4.0, A8.0	B1.0, B2.0, B3.0, B5.0, B7.0	C3.0, C4.0, C5.0, C6.0
PS3.B: Conservation of Energy and Energy Transfer	A1.0, A4.0, A8.0	B1.0, B2.0, B3.0	C3.0, C4.0, C5.0, C6.0
PS3.C: Relationship Between Energy and Forces	A10.0	B2.0, B3.0, B4.0	C3.0, C4.0, C5.0, C6.0
PS3.D: Energy in Chemical Processes and Everyday Life	A1.0, A2.0	B3.0, B4.0	C3.0, C4.0, C5.0, C6.0
PS4: Waves and Their Applications in Technologies for Information Transfer			
PS4.A: Wave Properties		B3.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
PS4.B: Electromagnetic Radiation	A2.0	B2.0	C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
PS4.C: Information Technologies and Instrumentation			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0
<b>Life Sciences – LS</b>			
LS2: Ecosystems: Interactions, Energy, and Dynamics			
LS2.A: Interdependent Relationships in Ecosystems	A3.0, A6.0		
LS2.B: Cycles of matter and Energy Transfer in Ecosystems	A2.0	B3.0	
LS2.C: Ecosystems Dynamics, Functioning, and Resilience	A3.0, A6.0		
LS4: Biological Evolution: Unity and Diversity			
LS4.C: Adaptation	A6.0		
LS4.D: Biodiversity and Humans	A6.0		





## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>Earth and Space Sciences – ESS</b>			
ESS2: Earth's Systems ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology	A2.0, A11.0 A2.0, A3.0		C3.0, C4.0
ESS3: Earth and Human Activity ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	A8.0 A1.0, A6.0, A7.0 A6.0 A2.0	B1.0	C2.0, C3.0, C4.0
<b>Engineering, Technology, and the Applications of Science – ETS</b>			
ETS1: Engineering Design ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution	A5.0, A10.0, A11.0	B5.0, B7.0	C2.0, C3.0, C4.0, C5.0, C6.0
ETS2: Links Among Engineering, Technology, Science, and Society ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World	A2.0	B1.0	C2.0, C3.0, C4.0, C5.0, C6.0, C7.0

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<b>ENERGY, ENVIRONMENT, AND UTILITIES</b>	<b>PATHWAYS</b>		
	<b>A. Environmental Resources</b>	<b>B. Energy and Power Technology</b>	<b>C. Telecommunications</b>
<b>HISTORY/SOCIAL SCIENCE</b>			
<b>Principles of American Democracy and Economics (government) – AD</b>			
12.7 Students analyze and compare the powers and procedures of the national, state, tribal, and local governments.			
12.7.1. Explain how conflicts between levels of government and branches of government are resolved			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
12.7.2. Identify the major responsibilities and sources of revenue for state and local governments.			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
12.7.3. Discuss reserved powers and concurrent powers of state governments.			
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.			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
12.7.6. Compare the processes of lawmaking at each of the three levels of government, including the role of lobbying and the media.			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
<b>Principles of Economics – PE</b>			
12.1 Students understand common economic terms and concepts and economic reasoning.			
12.1.2. Explain opportunity cost and marginal benefit and marginal cost.			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
12.2 Students analyze the elements of America's market economy in a global setting.			
12.2.3. Explain the roles of property rights, competition, and profit in a market economy.			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
12.3 Students analyze the influence of the federal government on the American economy.			
12.3.1. Understand how the role of government in a market economy often includes providing for national defense, addressing environmental concerns, defining and enforcing property rights, attempting to make markets more competitive, and protecting consumers' rights.			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0





## Academic Alignment Matrix

ENERGY, ENVIRONMENT, AND UTILITIES	PATHWAYS		
	A. Environmental Resources	B. Energy and Power Technology	C. Telecommunications
<b>U.S. History and Geography – US</b>			
11.5 Students analyze the major political, social, economic, technological, and cultural developments of the 1920s.			
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.		B1.0	
11.6 Students analyze the different explanations for the Great Depression and how the New Deal fundamentally changed the role of the federal government.			
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).			C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
11.6.5. Trace the advances and retreats of organized labor, from the creation of the American Federation of Labor and the Congress of Industrial Organizations to current issues of a postindustrial, multinational economy, including the United Farm Workers in California.			C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
11.8 Students analyze the economic boom and social transformation of post-World War II America.			
11.8.7. Describe the effects on society and the economy of technological developments since 1945, including the computer revolution, changes in communication, advances in medicine, and improvements in agricultural technology.			C2.0, C3.0, C4.0, C5.0, C6.0, C7.0
11.11 Students analyze the major social problems and domestic policy issues in contemporary American society.			
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.			C2.0, C3.0, C4.0, C5.0, C6.0, C7.0

## Academic Alignment Matrix

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<b>World History, Culture, and Geography – WH</b>			
10.3 Students analyze the effects of the Industrial Revolution in England, France, Germany, Japan, and the United States.			
10.3.2. Examine how scientific and technological changes and new forms of energy brought about massive social, economic, and cultural change (e.g., the inventions and discoveries of James Watt, Eli Whitney, Henry Bessemer, Louis Pasteur, Thomas Edison).		B1.0	
10.11 Students analyze the integration of countries into the world economy and the information, technological, and communications revolutions (e.g., television, satellites, computers).			C1.0, C2.0, C3.0, C4.0, C5.0, C6.0, C7.0





## Appendix: CTE Model Curriculum Standards Contributors

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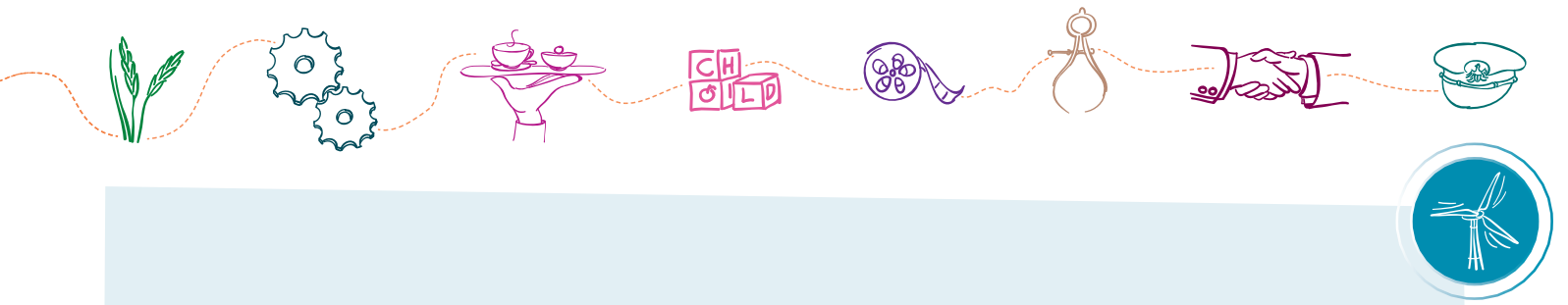
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