

Foundation of Energy

Subject: Career Development and Career and Technical Education

Grade: 09

Expectations: 62

Breakouts: 224

(a) Introduction.

1. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and success in current or emerging energy professions.
2. The Energy Career Cluster focuses on Texas's diverse economic landscape, geography and natural resources, including renewable energy potential, transportation system, labor force, and leadership in environmental research.
3. In Foundations of Energy, students will conduct laboratory and field investigations, use scientific practices during investigations, and make informed decisions using critical thinking and scientific problem solving. Various systems will be described in terms of energy. Students will study a variety of topics that include energy transformation, the law of conservation of energy, energy efficiency, interrelationships among energy resources and society, and sources and flow of energy through the production, transmission, processing, and use of energy. Students will apply these concepts and perform investigations and experiments at least 40% of the time using safe practices.
4. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
5. Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and Skills Statements

- (1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
 - (A) evaluate the importance of dressing appropriately, speaking politely, and conducting oneself in a manner appropriate for the profession;
 - (i) evaluate the importance of dressing appropriately
 - (ii) evaluate the importance of speaking politely
 - (iii) evaluate the importance of conducting oneself in a manner appropriate for the profession
 - (B) cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome;
 - (i) cooperate as a member of a group in an effort to achieve a positive collective outcome
 - (ii) contribute as a member of a group in an effort to achieve a positive collective outcome
 - (iii) collaborate as a member of a group in an effort to achieve a positive collective outcome

- (C) present written and oral communication in a clear, concise, and effective manner;
 - (i) present written communication in a clear manner
 - (ii) present written communication in a concise manner
 - (iii) present written communication in an effective manner
 - (iv) present oral communication in a clear manner
 - (v) present oral communication in a concise manner
 - (vi) present oral communication in an effective manner
 - (D) demonstrate time-management skills by prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results;
 - (i) demonstrate time-management skills by prioritizing tasks in a way that produces efficient results
 - (ii) demonstrate time-management skills by following schedules in a way that produces efficient results
 - (iii) demonstrate time-management skills by performing goal-relevant activities in a way that produces efficient results
 - (E) demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed;
 - (i) demonstrate punctuality in performing assigned tasks as directed
 - (ii) demonstrate dependability in performing assigned tasks as directed
 - (iii) demonstrate reliability in performing assigned tasks as directed
 - (iv) demonstrate responsibility in performing assigned tasks as directed
 - (F) discuss and exhibit teamwork and leadership skills necessary for the workplace;
 - (i) discuss teamwork skills necessary for the workplace
 - (ii) discuss leadership skills necessary for the workplace
 - (iii) exhibit teamwork skills necessary for the workplace
 - (iv) exhibit leadership skills necessary for the workplace
 - (G) define and demonstrate effective problem-solving skills; and
 - (i) define effective problem-solving skills
 - (ii) demonstrate effective problem-solving skills
 - (H) apply computer-based skills and other technologies relevant to the energy industry.
 - (i) apply computer-based skills relevant to the energy industry
 - (ii) apply other technologies relevant to the energy industry
- (2) The student analyzes current and future career opportunities in the energy sector, including oil and gas exploration and production, refining and chemical processing, and renewable energy. The student is expected to:
- (A) evaluate energy systems and identify careers within those systems;
 - (i) evaluate energy systems
 - (ii) identify careers within [energy] systems

- (B) examine past market and employment trends in the energy sector;
 - (i) examine past market trends in the energy sector
 - (ii) examine employment trends in the energy sector
 - (C) discuss current issues in energy production and predict future needs and employment opportunities in this field;
 - (i) discuss current issues in energy production
 - (ii) predict future needs [in energy production]
 - (iii) predict employment opportunities in [the] field [of energy production]
 - (D) identify career development, education, credentialing, and entrepreneurship opportunities in the energy sector; and
 - (i) identify career development opportunities in the energy sector
 - (ii) identify education opportunities in the energy sector
 - (iii) identify credentialing opportunities in the energy sector
 - (iv) identify entrepreneurship opportunities in the energy sector
 - (E) apply competencies related to resources, information, and systems of operation in the energy sector.
 - (i) apply competencies related to resources in the energy sector
 - (ii) apply competencies related to information in the energy sector
 - (iii) apply competencies related to systems of operation in the energy sector
- (3) The student conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
- (A) demonstrate safe practices during laboratory and field investigations;
 - (i) demonstrate safe practices during laboratory investigations
 - (ii) demonstrate safe practices during field investigations
 - (B) use a wide variety of additional course apparatuses, equipment, techniques, and procedures as appropriate such as satellite imagery and other remote sensing data, Geographic Information Systems (GIS), Global Positioning System (GPS), scientific probes, microscopes, telescopes, modern video and image libraries, weather stations, fossil and rock kits, tectonic plate models, and planetary globes;
 - (i) use a wide variety of additional course apparatuses as appropriate
 - (ii) use a wide variety of additional course equipment as appropriate
 - (iii) use a wide variety of additional course techniques as appropriate
 - (iv) use a wide variety of additional course procedures as appropriate
 - (C) engage in meaningful hands-on, minds-on conceptual activities in the areas of energy; and
 - (i) engage in meaningful hands-on conceptual activities in the areas of energy
 - (ii) engage in meaningful minds-on conceptual activities in the areas of energy

- (D) demonstrate an understanding of the use and conservation of resources and proper disposal or recycling of materials.
 - (i) demonstrate an understanding of the use of resources
 - (ii) demonstrate an understanding of conservation of resources
 - (iii) demonstrate an understanding of proper disposal or recycling of materials

- (4) The student uses critical thinking and problem solving to make informed decisions within and outside the classroom. The student is expected to:
 - (A) communicate and present valid conclusions from energy information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;
 - (i) communicate valid conclusions from energy information extracted from various sources
 - (ii) present valid conclusions from energy information extracted from various sources
 - (B) explain the impacts of energy discoveries by a variety of historical and contemporary scientists and entrepreneurs on current societal attitudes;
 - (i) explain the impacts of energy discoveries by a variety of historical scientists on current societal attitudes
 - (ii) explain the impacts of energy discoveries by a variety of contemporary scientists on current societal attitudes
 - (iii) explain the impacts of energy discoveries by a variety of entrepreneurs on current societal attitudes
 - (C) compare advantages and disadvantages in the use of the various energy sources; and
 - (i) compare advantages and disadvantages in the use of the various energy sources
 - (D) distinguish between scientific decision making (scientific methods) and ethical and social decisions that involve science (the application of scientific information).
 - (i) distinguish between scientific decision making (scientific methods) and ethical decisions that involve science (the application of scientific information)
 - (ii) distinguish between scientific decision making (scientific methods) and social decisions that involve science (the application of scientific information)

- (5) The student presents conclusions, research findings, and designs using a variety of media throughout the course. The student is expected to:
 - (A) develop written and oral presentation skills related to energy issues and solutions by researching and describing the history of energy production in Texas and contributions of scientists and entrepreneurs; and
 - (i) develop written presentation skills related to energy issues by researching the history of energy production in Texas
 - (ii) develop written presentation skills related to energy issues by researching the contributions of scientists
 - (iii) develop written presentation skills related to energy issues by researching the contributions of entrepreneurs
 - (iv) develop written presentation skills related to energy solutions by researching the history of energy production in Texas
 - (v) develop written presentation skills related to energy solutions by researching the contributions of scientists

- (vi) develop written presentation skills related to energy solutions by researching the contributions of entrepreneurs
 - (vii) develop written presentation skills related to energy issues by describing the history of energy production in Texas
 - (viii) develop written presentation skills related to energy issues by describing the contributions of scientists
 - (ix) develop written presentation skills related to energy issues by describing the contributions of entrepreneurs
 - (x) develop written presentation skills related to energy solutions by describing the history of energy production in Texas
 - (xi) develop written presentation skills related to energy solutions by describing the contributions of scientists
 - (xii) develop written presentation skills related to energy solutions by describing the contributions of entrepreneurs
 - (xiii) develop oral presentation skills related to energy issues by researching the history of energy production in Texas
 - (xiv) develop oral presentation skills related to energy issues by researching the contributions of scientists
 - (xv) develop oral presentation skills related to energy issues by researching the contributions of entrepreneurs
 - (xvi) develop oral presentation skills related to energy solutions by researching the history of energy production in Texas
 - (xvii) develop oral presentation skills related to energy solutions by researching the contributions of scientists
 - (xviii) develop oral presentation skills related to energy solutions by researching the contributions of entrepreneurs
 - (xix) develop oral presentation skills related to energy issues by describing the history of energy production in Texas
 - (xx) develop oral presentation skills related to energy issues by describing the contributions of scientists
 - (xxi) develop oral presentation skills related to energy issues by describing the contributions of entrepreneurs
 - (xxii) develop oral presentation skills related to energy solutions by describing the history of energy production in Texas
 - (xxiii) develop oral presentation skills related to energy solutions by describing the contributions of scientists
 - (xxiv) develop oral presentation skills related to energy solutions by describing the contributions of entrepreneurs
- (B) develop data retrieval and analysis skills related to energy production and use by researching information about energy sources, including renewable and non-renewable sources, and energy efficiency and how each source is used to produce electrical energy.
- (i) develop data retrieval skills related to energy production by researching information about energy sources, including renewable sources
 - (ii) develop data retrieval skills related to energy production by researching information about energy sources, including non-renewable sources
 - (iii) develop data retrieval related to energy production by researching information about energy efficiency

- (iv) develop data retrieval skills related to energy production by researching information about how each [energy] source is used to produce electrical energy
- (v) develop data retrieval skills related to energy use by researching information about energy sources, including renewable sources
- (vi) develop data retrieval skills related to energy use by researching information about energy sources, including non-renewable sources
- (vii) develop data retrieval skills related to energy use by researching information about energy efficiency
- (viii) develop data retrieval skills related to energy use by researching information about how each [energy] source is used to produce electrical energy
- (ix) develop data analysis skills related to energy production by researching information about energy sources, including renewable sources
- (x) develop data analysis skills related to energy production by researching information about energy sources, including non-renewable sources
- (xi) develop data analysis related to energy production by researching information about energy efficiency
- (xii) develop data analysis skills related to energy production by researching information about how each [energy] source is used to produce electrical energy
- (xiii) develop data analysis skills related to energy use by researching information about energy sources, including renewable sources
- (xiv) develop data analysis skills related to energy use by researching information about energy sources, including non-renewable sources
- (xv) develop data analysis skills related to energy use by researching information about energy efficiency
- (xvi) develop data analysis skills related to energy use by researching information about how each [energy] source is used to produce electrical energy

(6) The student examines and explains concepts and procedures related to energy. The student is expected to:

- (A) identify general purposes for energy, including transportation, light, cooking, heating or cooling, entertainment, and cleaning;
 - (i) identify general purposes for energy, including transportation
 - (ii) identify general purposes for energy, including light
 - (iii) identify general purposes for energy, including cooking
 - (iv) identify general purposes for energy, including heating or cooling
 - (v) identify general purposes for energy, including entertainment
 - (vi) identify general purposes for energy, including cleaning
- (B) explain and demonstrate transformations among various energy forms, including potential, kinetic, chemical, mechanical, electrical, and light energy;
 - (i) explain transformations among various energy forms, including potential energy
 - (ii) explain transformations among various energy forms, including kinetic energy
 - (iii) explain transformations among various energy forms, including chemical energy

- (iv) explain transformations among various energy forms, including mechanical energy
 - (v) explain transformations among various energy forms, including electrical energy
 - (vi) explain transformations among various energy forms, including light energy
 - (vii) demonstrate transformations among various energy forms, including potential energy
 - (viii) demonstrate transformations among various energy forms, including kinetic energy
 - (ix) demonstrate transformations among various energy forms, including chemical energy
 - (x) demonstrate transformations among various energy forms, including mechanical energy
 - (xi) demonstrate transformations among various energy forms, including electrical energy
 - (xii) demonstrate transformations among various energy forms, including light energy
- (C) analyze the role of gravity in transforming energy;
- (i) analyze the role of gravity in transforming energy
- (D) investigate and calculate the relationship between work, potential energy, and kinetic energy;
- (i) investigate the relationship between work, potential energy, and kinetic energy
 - (ii) calculate the relationship between work, potential energy, and kinetic energy
- (E) examine various types of energy transfer mechanisms, determine the original form of energy and what form that energy is being transformed into, and use examples to analyze and calculate the relationships among work, kinetic energy, and potential energy;
- (i) examine various types of energy transfer mechanisms
 - (ii) determine the original form of energy and what form that energy is being transformed into
 - (iii) use examples to analyze the relationships among work, kinetic energy, and potential energy
 - (iv) use examples to calculate the relationships among work, kinetic energy, and potential energy
- (F) describe and apply the law of conservation of energy; and
- (i) describe the law of conservation of energy
 - (ii) apply the law of conservation of energy
- (G) use basic calorimetry to determine the amount of energy stored in substances such as coal.
- (i) use basic calorimetry to determine the amount of energy stored in substances
- (7) The student understands the basics of fluid mechanics related to energy discovery, production, and transportation. The student is expected to:
- (A) identify fluids used as fuels, including liquids and gases;
 - (i) identify fluids used as fuels, including liquids
 - (ii) identify fluids used as fuels, including gases

- (B) identify fluids used in the discovery, production, and transportation of energy sources;
 - (i) identify fluids used in the discovery of energy sources
 - (ii) identify fluids used in the production of energy sources
 - (iii) identify fluids used in the transportation of energy sources
 - (C) explain capillary action and relate it to energy production; and
 - (i) explain capillary action
 - (ii) relate [capillary action] to energy production
 - (D) explain, using formulas, how pressure and temperature affect the behavior of fluids.
 - (i) explain, using formulas, how pressure affects the behavior of fluids
 - (ii) explain, using formulas, how temperature affects the behavior of fluids
- (8) The student understands how and where energy is produced and identifies Texas energy resources. The student is expected to:
- (A) research the location of energy resources and power production plants in Texas;
 - (i) research the location of energy resources in Texas
 - (ii) research the location of power production plants in Texas
 - (B) compile information on the history of energy production in Texas and describe its past and current importance to the U.S. economy;
 - (i) compile information on the history of energy production in Texas
 - (ii) describe [the] past importance [of the history of energy production] to the U.S. economy
 - (iii) describe [the] current importance [of the history of energy production] to the U.S. economy
 - (C) investigate the role of technology in the future development of energy usage;
 - (i) investigate the role of technology in the future development of energy usage
 - (D) identify ways to conserve energy;
 - (i) identify ways to conserve energy
 - (E) map the major sources of energy used in Texas;
 - (i) map the major sources of energy used in Texas
 - (F) assess the impact of the various energy sources on the economy in Texas;
 - (i) assess the impact of the various energy sources on the economy in Texas
 - (G) analyze how supply and demand impacts Texas's economy in relation to energy; and
 - (i) analyze how supply impacts Texas's economy in relation to energy
 - (ii) analyze how demand impacts Texas's economy in relation to energy
 - (H) compare and contrast the impact of energy sources and supply and demand in Texas with national and global data.
 - (i) compare and contrast the impact of energy sources and supply and demand in Texas with national data
 - (ii) compare and contrast the impact of energy sources and supply and demand in Texas with global data

- (9) The student investigates how energy resources such as water, oil, and natural gas are stored underground in rock formations. The student is expected to:
- (A) assess the properties and geological histories of rocks and rock formations that enable energy storage;
 - (i) assess the properties of rocks that enable energy storage
 - (ii) assess the properties of rock formations that enable energy storage
 - (iii) assess the geological histories of rocks that enable energy storage
 - (iv) assess the geological histories of rock formations that enable energy storage
 - (B) determine the physical properties of permeability and porosity of rock formations and relate these properties to the amount of water, oil, and natural gas held in these formations;
 - (i) determine the physical properties of permeability of rock formations
 - (ii) determine the physical properties of porosity of rock formations
 - (iii) relate [the] properties [of permeability] to the amount of water held in [rock] formations
 - (iv) relate [the] properties [of permeability] to the amount of oil held in [rock] formations
 - (v) relate [the] properties [of permeability] to the amount of natural gas held in [rock] formations
 - (vi) relate [the] properties [of porosity] to the amount of water held in [rock] formations
 - (vii) relate [the] properties [of porosity] to the amount of oil held in [rock] formations
 - (viii) relate [the] properties [of porosity] to the amount of natural gas held in [rock] formations
 - (C) explain how aquifers function and locate major aquifers in Texas; and
 - (i) explain how aquifers function in Texas
 - (ii) locate major aquifers in Texas
 - (D) investigate how innovations such as hydraulic fracturing and high-power transmission lines have made massive energy resources such as oil, gas, wind, and electricity available in Texas.
 - (i) investigate how innovations have made massive energy resources available in Texas
- (10) The student knows differences between renewable and non-renewable resources. The student is expected to:
- (A) identify and describe various renewable and non-renewable resources;
 - (i) identify various renewable resources
 - (ii) identify various non-renewable resources
 - (iii) describe various renewable resources
 - (iv) describe various non-renewable resources

- (B) describe and compare the energy efficiency of renewable and non-renewable energy derived from natural and alternative sources such as oil, natural gas, coal, nuclear, solar, geothermal, hydroelectric, and wind;
 - (i) describe the energy efficiency of renewable energy derived from natural sources
 - (ii) describe energy efficiency of non-renewable energy derived from natural sources
 - (iii) describe the energy efficiency of renewable energy derived from alternative sources
 - (iv) describe the energy efficiency of non-renewable energy derived from alternative sources
 - (v) compare the energy efficiency of renewable and non-renewable energy derived from natural and alternative sources
- (C) examine the benefits and hazards of using renewable and non-renewable energy sources;
 - (i) examine the benefits of using renewable energy sources
 - (ii) examine the benefits of using non-renewable energy sources
 - (iii) examine the hazards of using renewable energy sources
 - (iv) examine the hazards of using non-renewable energy sources
- (D) research methods by which benefits can be increased and hazards reduced in the use of renewable and non-renewable energy sources;
 - (i) research methods by which benefits can be increased in the use of renewable energy sources
 - (ii) research methods by which benefits can be increased in the use of non-renewable energy sources
 - (iii) research methods by which hazards [can be] reduced in the use of renewable energy sources
 - (iv) research methods by which hazards [can be] reduced in the use of non-renewable energy sources
- (E) examine different viewpoints of an energy source regarding availability, cost, potential pollution, impact to plant and animal habitat, and sustainability;
 - (i) examine different viewpoints of an energy source regarding availability
 - (ii) examine different viewpoints of an energy source regarding cost
 - (iii) examine different viewpoints of an energy source regarding potential pollution
 - (iv) examine different viewpoints of an energy source regarding impact to plant habitat
 - (v) examine different viewpoints of an energy source regarding impact to animal habitat
 - (vi) examine different viewpoints of an energy source regarding sustainability
- (F) analyze an energy source's relative availability and renewability and discuss how these factors inform decision making regarding a source's use; and
 - (i) analyze an energy source's relative availability
 - (ii) analyze an energy source's relative renewability
 - (iii) discuss how [the] factors [of an energy source's relative availability] inform decision making regarding a source's use
 - (iv) discuss how [the] factors [of an energy source's relative availability] inform decision making regarding a source's use

(G) analyze changing social perspectives and how they can influence scientific practices.

(i) analyze changing social perspectives

(ii) analyze how [changing social perspectives] can influence scientific practices

(11) The student knows how energy impacts the student's life and the role energy plays in international relations, the environment, standards of living, and the economy. The student is expected to:

(A) analyze the impact energy has on the environment;

(i) analyze the impact energy has on the environment

(B) research and discuss the ethical and social issues surrounding Earth's energy resources;

(i) research the ethical issues surrounding Earth's energy resources

(ii) research the social issues surrounding Earth's energy resources

(iii) discuss the ethical issues surrounding Earth's energy resources

(iv) discuss the social issues surrounding Earth's energy resources

(C) analyze the advantages and disadvantages of an energy source's long-term use;

(i) analyze the advantages of an energy source's long-term use

(ii) analyze the disadvantages of an energy source's long-term use

(D) explain the relationship between energy and quality of life;

(i) explain the relationship between energy and quality of life

(E) research and describe the connection between energy production, transmission, processing, and marketing; and

(i) research the connection between energy production, transmission, processing, and marketing

(ii) describe the connection between energy production, transmission, processing, and marketing

(F) analyze the impact and effectiveness of the measures taken by the United States and other countries to use energy to reduce greenhouse gases, improve water and air quality, and extend life expectancy.

(i) analyze the impact of the measures taken by the United States to use energy to reduce greenhouse gases

(ii) analyze the impact of the measures taken by the United States to use energy to improve water quality

(iii) analyze the impact of the measures taken by the United States to use energy to improve air quality

(iv) analyze the impact of the measures taken by the United States to use energy to extend life expectancy

(v) analyze the effectiveness of the measures taken by the United States to use energy to reduce greenhouse gases

(vi) analyze the effectiveness of the measures taken by the United States to use energy to improve water quality

(vii) analyze the effectiveness of the measures taken by the United States to use energy to improve air quality

(viii) analyze the effectiveness of the measures taken by the United States to use energy to extend life expectancy

(ix) analyze the impact of the measures taken by other countries to use energy to reduce greenhouse gases

(x) analyze the impact of the measures taken by other countries to use energy to improve water quality

- (xi) analyze the impact of the measures taken by other countries to use energy to improve air quality
- (xii) analyze the impact of the measures taken by other countries to use energy to extend life expectancy
- (xiii) analyze the effectiveness of the measures taken by other countries to use energy to reduce greenhouse gases
- (xiv) analyze the effectiveness of the measures taken by other countries to use energy to improve water quality
- (xv) analyze the effectiveness of the measures taken by other countries to use energy to improve air quality
- (xvi) analyze the effectiveness of the measures taken by other countries to use energy to extend life expectancy

(12) The student investigates extended learning experiences such as career and technical student organizations and area energy museums and displays. The student is expected to:

- (A) identify a minimum of three energy professionals for potential speaking invitations either in person or via the Internet;
 - (i) identify a minimum of three energy professionals for potential speaking invitations either in person or via the Internet
- (B) research and describe an energy-related organization such as a museum or local business; and
 - (i) research an energy-related organization
 - (ii) describe an energy-related organization
- (C) compare educational requirements for different energy industry jobs in Texas.
 - (i) compare educational requirements for different energy industry jobs in Texas