Ohio CTE

Grades 7-12

Business Operations/21st Century Skills: Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field. 1

1 **Employability Skills: Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.** 1.1

1 Identify the knowledge, skills and abilities necessary to succeed in careers. 1.1.1

2 Identify the scope of career opportunities and the requirements for education, training, certification, licensure and experience. 1.1.2

3 Develop a career plan that reflects career interests, pathways and secondary and postsecondary options. 1.1.3

4 Describe the role and function of professional organizations, industry associations and organized labor and use networking techniques to develop and maintain professional relationships. 1.1.4

6 Explain the importance of work ethic, accountability and responsibility and demonstrate associated behaviors in fulfilling personal, community and workplace roles. 1.1.6

5 Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, resumé writing, interviewing skills, portfolio development). 1.1.5

8 Identify the correlation between emotions, behavior and appearance and manage those to establish and maintain professionalism. 1.1.8

7 Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions. 1.1.7

9 Give and receive constructive feedback to improve work habits. 1.1.9

10 Adapt personal coping skills to adjust to taxing workplace demands. 1.1.10

11 Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them. 1.1.11

12 Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits and abusive behavior. 1.1.12

2 **Leadership and Communications: Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.** 1.2

1 Extract relevant, valid information from materials and cite sources of information. 1.2.1

Deliver formal and informal presentations. 1.2.2

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3 Identify and use verbal, nonverbal and active listening skills to communicate effectively. 1.2.3

4 Use negotiation and conflict-resolution skills to reach solutions. 1.2.4

5 Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose. 1.2.5

6 Use proper grammar and expression in all aspects of communication. 1.2.6

7 Use problem-solving and consensus-building techniques to draw conclusions and determine next steps. 1.2.7

8 Identify the strengths, weaknesses and characteristics of leadership styles that influence internal and external workplace relationships. 1.2.8

9 Identify advantages and disadvantages involving digital and/or electronic communications (e.g., common content for large audience, control of tone, speed, cost, lack of non-verbal cues, potential for forwarding information, longevity). 1.2.9

10 Use interpersonal skills to provide group leadership, promote collaboration and work in a team. 1.2.10

11 Write professional correspondence, documents, job applications and resumés. 1.2.11

12 Use technical writing skills to complete forms and create reports. 1.2.12

13 Identify stakeholders and solicit their opinions. 1.2.13

14 Use motivational strategies to accomplish goals. 1.2.14

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3 **Business Ethics and Law: Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.** 1.3

1 Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance. 1.3.1

2 Follow protocols and practices necessary to maintain a clean, safe and healthy work environment. 1.3.2

3 Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice). 1.3.3

4 Identify how federal and state consumer protection laws affect products and services. 1.3.4

5 Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization. 1.3.5

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6 Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance. 1.3.6

7 Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission [EEOC]). 1.3.7

8 Verify compliance with computer and intellectual property laws and regulations. 1.3.8

9 Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational and professional ethical standards. 1.3.9

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4 Knowledge Management and Information Technology: Demonstrate current and emerging strategies and technologies used to collect, analyze, record and share information in business operations. 1.4

2 Select and use software applications to locate, record, analyze and present information (e.g., word processing, e-mail, spreadsheet, databases, presentation, Internet search engines). 1.4.2

1 Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems 1.4.1

3 Verify compliance with security rules, regulations and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to the industry pathway. 1.4.3

4 Use system hardware to support software applications. 1.4.4

5 Use information technology tools to maintain, secure and monitor business records. 1.4.5

6 Use an electronic database to access and create business and technical information. 1.4.6

7 Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books). 1.4.7

8 Use electronic media to communicate and follow network etiquette guidelines. 1.4.8

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5 Global Environment: Evaluate how beliefs, values, attitudes and behaviors influence organizational strategies and goals. 1.5

1 Describe how cultural understanding, cultural intelligence skills and continual awareness are interdependent. 1.5.1

2 Describe how cultural intelligence skills influence the overall success and survival of an organization. 1.5.2

3 Use cultural intelligence to interact with individuals from diverse cultural settings. 1.5.3

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4 Recognize barriers in cross-cultural relationships and implement behavioral adjustments. 1.5.4

5 Recognize the ways in which bias and discrimination may influence productivity and profitability. 1.5.5

6 Analyze work tasks for understanding and interpretation from a different cultural perspective. 1.5.6

7 Use intercultural communication skills to exchange ideas and create meaning. 1.5.7

8 Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities. 1.5.8

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6 **Business Literacy: Develop foundational skills and knowledge in entrepreneurship, financial literacy and business operations.** 1.6

1 Identify business opportunities. 1.6.1

2 Assess the reality of becoming an entrepreneur, including advantages and disadvantages (e.g., risk versus reward, reasons for success and failure). 1.6.2

3 Explain the importance of planning your business. 1.6.3

4 Identify types of businesses, ownership and entities (i.e., individual proprietorships, partnerships, corporations, cooperatives, public, private, profit, not-for-profit). 1.6.4

5 Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments and interdepartmental interactions. 1.6.5

6 Identify the target market served by the organization, the niche that the organization fills and an outlook of the industry. 1.6.6

7 Identify the effect of supply and demand on products and services. 1.6.7

8 Identify the features and benefits that make an organization's product or service competitive. 1.6.8

9 Explain how the performance of an employee, a department and an organization is assessed. 1.6.9

10 Describe the impact of globalization on an enterprise or organization. 1.6.10

11 Describe how all business activities of an organization work within the parameters of a budget. 1.6.11

12 Describe classifications of employee benefits, rights, deductions and compensations. 1.6.12

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7 **Entrepreneurship/Entrepreneurs: Analyze the environment in which a business operates and the economic factors and opportunities associated with self-employment.** 1.7

1 Compare and contrast the four types of business ownership (i.e., individual proprietorships, partnerships, corporations, cooperatives). 1.7.1

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2 Explain the role of profit as the incentive to entrepreneurs in a market economy. 1.7.2

3 Identify the factors that contribute to the success and failure of entrepreneurial ventures. 1.7.3

4 Assess the roles of nonprofit and for-profit businesses. 1.7.4

5 Develop a business plan. 1.7.5

6 Describe life cycles of an entrepreneurial business and an entrepreneur. 1.7.6

7 Create a list of personal strengths, weaknesses, skills and abilities needed to be successful as an entrepreneur. 1.7.7

8 Explain pathways used to become an entrepreneur. 1.7.8

9 Conduct a self-assessment to determine entrepreneurial potential. 1.7.9

10 Describe techniques for obtaining experience (e.g., apprenticeship, co-operative [co-op] education, work placement, internship, job shadowing) related to an entrepreneurial objective. 1.7.10

11 Identify initial steps in establishing a business (e.g., limited liability company [LLC], tax ID, permits, insurance, licensing). 1.7.11

12 Identify resources available to entrepreneurs (e.g., Small Business Administration, mentors, information resources, educational opportunities). 1.7.12

13 Protect intellectual property and knowledge (e.g., copyright, patent, trademark, trade secrets, processes). 1.7.13

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8 **Operations Management: Plan, organize and monitor an organization or department to maximize contribution to organizational goals and objectives.** 1.8

1 Forecast future resources and budgetary needs using financial documents (e.g., balance sheet, demand forecasting, financial ratios). 1.8.1

2 Select and organize resources to develop a product or a service. 1.8.2

3 Analyze the performance of organizational activities and reallocate resources to achieve established goals. 1.8.3

4 Identify alternative actions to take when goals are not met (e.g., changing goals, changing strategies, efficiencies). 1.8.4

5 Use inventory and control systems to purchase materials, supplies and equipment (e.g., Last In, First Out [LIFO]; First In, First Out [FIFO]; Just in Time [JIT]; LEAN). 1.8.5

6 Identify the advantages and disadvantages of carrying cost and Just-in-Time (JIT) production systems and the effects of maintaining inventory (e.g., perishable, shrinkage, insurance) on profitability. 1.8.6

7 Collect information and feedback to help assess the organization's strategic planning and policymaking processes. 1.8.7

8 Identify routine activities for maintaining business facilities and equipment. 1.8.8

9 Develop a budget that reflects the strategies and goals of the organization. 1.8.9

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10 Analyze how business management and environmental management systems (e.g., health, safety) contribute to continuous improvement and sustainability. 1.8.10

9 **Financial Management: Use financial tools, strategies and systems to develop, monitor and control the use of financial resources to ensure personal and business financial well-being.** 1.9

1 Create, analyze and interpret financial documents (e.g., budgets, income statements). 1.9.1

2 Identify tax obligations. 1.9.2

3 Review and summarize savings, investment strategies and purchasing options (e.g., cash, lease, finance, stocks, bonds). 1.9.3

4 Identify credit types and their uses in order to establish credit. 1.9.4

5 Identify ways to avoid or correct debt problems. 1.9.5

6 Explain how credit ratings and the criteria lenders use to evaluate repayment capacity affect access to loans. 1.9.6

7 Review and summarize categories (types) of insurance and identify how insurances can reduce financial risk. 1.9.7

8 Identify income sources and expenditures. 1.9.8

9 Compare and contrast different banking services available through financial institutions. 1.9.9

10 Identify the role of depreciation in tax planning and liability. 1.9.10

10 **Sales and Marketing: Manage pricing, place, promotion, packaging, positioning and public relations to improve quality customer service.** 1.10

1 Identify how the roles of sales, advertising and public relations contribute to a company's brand. 1.10.1

2 Determine the customer's needs and identify solutions. 1.10.2

3 Communicate features, benefits and warranties of a product or service to the customer. 1.10.3

4 Identify the company policies and procedures for initiating product and service improvements. 1.10.4

5 Monitor customer expectations and determine product/service satisfaction by using measurement tools. 1.10.5

6 Discuss the importance of correct pricing to support a product's or service's positioning in the marketing mix. 1.10.6

7 Describe the importance and diversity of distribution channels (i.e., direct, indirect) to sell a product. 1.10.7

8 Use promotional techniques to maximize sales revenues (e.g., advertising, sales promotions, publicity, public relations). 1.10.8

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9 Describe how product mix (e.g., product line, product items) maximizes sales revenues, market, share and profit margin. 1.10.9

10 Demonstrate sales techniques. 1.10.10

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11 Principles of Business Economics: Examine and employ economic principles, concepts and policies to accomplish organizational goals and objectives. . 1.11

1 Identify the economic principles that guide geographic location of an industry's facilities (e.g., relative scarcity, price, quantity of products and services). 1.11.1

2 Identify the difference between monetary and nonmonetary incentives and explain how changes in incentives cause changes in behavior. 1.11.2

3 Use economic indicators to identify economic trends and conditions (e.g., inflation, interest rate fluctuations, unemployment rates). 1.11.3

4 Determine how the quality, quantity and pricing of goods and services are affected by domestic and international competition in a market economy. 1.11.4

5 Analyze factors that affect currency and exchange rates. 1.11.5

6 Explain how financial markets and government policies influence interest rates (credit ratings/debt ceiling), trade deficits and unemployment. 1.11.6

7 Describe how economic performance and culture are interdependent. 1.11.7

9 Describe how laws and regulations influence domestic and international trade. 1.11.9

8 Identify the relationships between economy, society and environment that lead to sustainability. 1.11.8

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12 Site and Personal Safety Procedures: Follow site and personal safety procedures in specific situations with specialized tools and equipment, evaluate the situation and take corrective action. 1.12

1 Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling. 1.12.1

2 Interpret safety signs and symbols. 1.12.2

3 Interpret personal safety rights according to the employee Right to Know plan. 1.12.3

4 Describe how working under the influence of drugs and alcohol increases the risk of accident, lowers productivity, raises insurance costs and reduces profits. 1.12.4

5 Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms and exits. 1.12.5

6 Identify procedures for the handling, storage and disposal of hazardous materials. 1.12.6

7 Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials. 1.12.7

8 Identify safety hazards and take corrective measures. 1.12.8

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9 Identify, inspect and use safety equipment appropriate for the task. 1.12.9

10 Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary. 1.12.10

11 Set up for ergonomic workflow. 1.12.11

12 Apply inspection, rejection criteria, hitch configurations and load handling practices to slings and rigging hardware. 1.12.12

13 Demonstrate the proper use of American National Standards Institute (ANSI) hand signals. 1.12.13

14 Identify the source of electrical hazards and use shutdown and established lock-out/tag-out procedures. 1.12.14

15 Select and operate fire extinguishers based on the class of fire. 1.12.15

16 Describe the interactions of incompatible substances when measuring and mixing chemicals. 1.12.16

17 Identify symptoms of exposure to health-threatening environments (e.g., temperature; chemical noise, vibration, harshness [NVH] hazards). 1.12.17

Animal Science: Learners apply principles of animal anatomy, physiology, genetics, behavior, nutrition and production to the research and development, selection and reproduction, health and management of animals in domestic and natural environments. 2

1 **Nutrition: Analyze, formulate, prepare and administer a ration for a population of specific animal species based on the economics, nutrition and availability of feedstuffs and evaluate the feed's effects on animals, and animal products.** 2.1

1 Identify the traditional and alternative types, compositions, quality and compatibility of feedstuff, feed additives and feed byproducts. 2.1.1

2 Describe the role of nutrients and nutritional requirements of different animal life processes and species. 2.1.2

3 Collect a feedstuff sample and interpret the data to determine the quality. 2.1.3

4 Identify and address major nutrient deficiency and toxicity symptoms. 2.1.4

5 Identify the biological and non-biological contaminants (physical, chemical, biological and radiological) found in feedstuffs and their impacts on animals. 2.1.5

6 Formulate and prepare rations and diets for different stages of an animal's life. 2.1.6

7 Calculate performance indicators (feed efficiency, average daily gain, minimum energy required) in relation to the cost, quality and availability of feeds. 2.1.7

8 Select and determine the feeding and watering practices and systems, based on the animal population, purpose and requirement. 2.1.8

2 **Body Systems: Describe the interrelationships of animal body systems with growth, development, health, maintenance, reproduction and production.** 2.2

1 Describe external anatomical parts and their functions within different species. 2.2.1

Compare and contrast the anatomical parts of the digestive system(s) and describe their physiology within different species. 2.2.2

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3 Identify anatomical components of nerve tissue and the nervous system, including regions of the brain, spinal nerves and the sympathetic and parasympathetic system, and describe their physiology. 2.2.3

4 Identify the anatomical components of the skeletal system, including the types and forms of bones, and describe their physiology. 2.2.4

5 Identify the anatomical components of the musculature systems, including, striated, cardiac and smooth muscle and describe their physology. 2.2.5

6 Compare and contrast bone growth, muscle growth, and fat deposition in relation to developmental patterns. 2.2.6

7 Describe the components of the cardiovascular system and their functions, including factors affecting blood flow. 2.2.7

8 Identify and describe the physcial chracteristics, components and functions of blood. 2.2.8

9 Identify and describe the integumentary system (e.g. skin, hair, nails, wool, feathers, scales), related structures, functions and cycles. 2.2.9

10 Identify and describe the function and components of the respitory system and pulmonary ventilation and the factors influencing respiratory rates. 2.2.10

11 Identify and describe the urinary system structure and functions, including excretion and osmoregulation. 2.2.11

12 Compare and contrast between the male and female reproductive system, structures and function. 2.2.12

13 Describe the endocrine system, its structure and the role of hormones. 2.2.13

14 Identify and describe the immune system and lymphatic system's role in immunity. 2.2.14

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3 **Care and Management: Apply animal care, management and record procedures to ensure husbandry and welfare, including managing environmental conditions to ensure health and performance.** 2.3

1 Identify species-specific terminology (gender, age, reproductive status). 2.3.1

2 Identify, classify, evaluate and select animal species or breeds for a desired outcome. 2.3.2

3 Determine the biotic and abiotic factors (e.g. air, ventelation) that impact the animal's environment. 2.3.3

4 Apply concepts of pest control and nuisance animal control, sanitation and disinfection procedures for animals' care and management. 2.3.4

5 Perform species-specific animal identification techniques for tracebility and records. 2.3.5

6 Calculate a facilty or habitat's carrying capacity and its impact on animal health. 2.3.6

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Identify and recognize predator-prey relationships and implement control measures. 2.3.7

8 Evaluate and perform animal care procedures aligned with industry standards throughout the life of the animal. 2.3.8

9 Monitor and evaluate the quality of an animal's habitat and implement corrective methods as needed. 2.3.9

10 Recognize common restraints and tack devices for handling including their use and adjustments. 2.3.10

11 Groom animals through brushing, bathing and thueraputic treatments. 2.3.11

12 Assess the nails and hooves of animals and understand the practice of trimming and treating for specific species. 2.3.12

13 Compare and contrast different standards of grooming and styling techniques for specific animal species and breeds. 2.3.13

14 Identify and recognize normal and abnormal dental structures and conditions. 2.3.14

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4 **Recognizing Diseases and Disorders: Evaluate animal conditions for species-specific diseases and disorders to assess an animal's health and welfare.** 2.4

1 Identify common infectious and noninfectious causes of diseases and disorders within different species. 2.4.1

2 Identify abnormalities in the skeleton, body form and functions and identify associated symptoms. 2.4.2

3 Describe the clinical signs that are associated with an abnormality caused by environmental factors (e.g. heat stress, standing condition, air quality). 2.4.3

4 Assess clinical signs of animals and identify diseases caused by microorganisms (e.g., parasites, viruses, bacteria, fungi, protozoa). 2.4.4

5 Describe zoonotic diseases and explain the health risk on humans and animals. 2.4.5

6 Implement disease prevention methods and procedures including the use of personal protective equipment. 2.4.6

7 Utilize voided specimens to determine animal health by performing urinalysis and fecal floatation with centrifugation. 2.4.7

8 Understand the principles of imaging and diagnostics through the use of X-ray and ultrasound equipment and techniques. 2.4.8

9 Apply principles of image physics and perform ultrasound techniques. 2.4.9

10 Differentiate between active and passive immunities and identify immunization schedule per species. 2.4.10

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5 **Animal Health: Implement preventive measures, treatment and maintenance options for species-specific diseases and disorders to improve an animal's health and welfare.** 2.5

1 Obtain and interpret an animal's vitals. 2.5.1

2 Apply concepts of body condition scoring to assess an animal's general health and nutrition status. 2.5.2

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3 Recognize the preventative measures or treatments needed to maintain animal health. 2.5.3

4 Apply basic principles of first-aid. 2.5.4

5 Inventory, store and dispose of pharmaceutical drugs by category, class and label. 2.5.5

6 Describe the routes of administration for medications (oral, IM, IV, SQ) and the process of drug absorption, distribution, metabolism, withdrawal and excretion. 2.5.6

7 Interpret and follow label directions for the dosage, route of administration and withdrawal period. 2.5.7

8 Simulate the administration of drug treatments and vaccines, following quality assurance guidelines, and monitor common adverse effects and potential problems associated with administration. 2.5.8

9 Prepare a sterile surgical environment, prepare patients for surgery and conduct post-operative procedures. 2.5.9

10 Describe advantages, disadvantages and adverse side effects of commonly used preanesthetic and anesthetic agents. 2.5.10

11 Identify and prepare sterile surgical instruments commonly used for surgery and post-operatice procedures. 2.5.11

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6 **Population Management: Manage reproduction practices in animal populations across habitats to achieve the desired outcomes and specific goals.** 2.6

1 Identify factors that lead to reproductive maturity and select animals for reproductive readiness. 2.6.1

2 Compare and select superior individuals based on phenotype. 2.6.2

3 Compare and select superior individuals based on breeding values and heritability of the desired traits. 2.6.3

4 Identify normal and abnormal signs of parturition and recommend appropriate management practices. 2.6.4

5 Understand the rationale to manipulate an animal's reproductive processes to support breeding (e.g., sex-sorted semen, heat synchronization, nutritional flushing, light cycling, natural and selected breeding). 2.6.5

6 Understand the rationale for selecting breeding methods (e.g., artificial insemination, embryo transfer, natural selection, selective breeding, invitro fertilization, cloning). 2.6.6

7 Describe requirements and environmental influences during different stages of gestation within different species. 2.6.7

8 Describe ethical and responsible animal population management practices (e.g., spaying, neutering, heat supression, relocation, reintroduction, hunting, containment, culling, euthanasia). 2.6.8

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Biotechnology: Learners engage in the scientific process, learn fundamental processes using modern tools and laboratory techniques, adhere to safety protocols, and bring a biotechnology product to the market. 3

1 **Research and Experiments: Use scientific methodology to conduct problem-based studies, develop products, and interpret results.** 3.1

1 Use scientific methodology to conduct problem-based studies, develop products, and interpret results. 3.1.1

2 Design a research plan, including the significance of the problem, purpose, hypotheses, objectives, appropriate controls, independent variables, dependent variables, methods of study and a list of materials. 3.1.2

3 Examine sources for credibility. 3.1.3

4 Apply sampling methods that appropriately represent the population, and implement procedures for systematic data collection. 3.1.4

5 Explain the importance and design of trialing, and the information gained from it. 3.1.5

6 Document results of the experiment in a laboratory notebook, including a statement of purpose, experimental design, observations, results, conclusions and next steps. 3.1.6

7 Create, interpret and use tabular and graphical displays and describe the data. 3.1.7

8 Compute measures of central tendency to interpret results and draw conclusions. 3.1.8

9 Define the concepts of confidencce intervals and significant figures. 3.1.9

10 Use t-test and p-value to determine statistical significance of results. 3.1.10

11 Describe the relationships among variables using correlations and draw conclusions. 3.1.11

12 Draw conclusions based on observations and data analyses, recognizing that experimental results must be open to the scrutiny of others. 3.1.12

13 Prepare and present findings using scientific reports. 3.1.13

14 Evaluate experimental failure and use integrity to communicate findings. 3.1.14

15 Describe how biotechnology products are produced and used in the United States. 3.1.15

16 Describe how biotechnology products are regulated in the United States. 3.1.16

17 Describe biotechnology product safety assessment. 3.1.17

18 Identify the purpose of a bioreactor and its use in the agricultural industry. 3.1.18

2 **Laboratory Standard Operational Procedures: Conduct experiments using proper industry based protocols, methods and techniques** 3.2

1 Use aseptic techniques to collect, prepare and test samples. 3.2.1

2 Prepare and dispense stock reagents, buffers, media and solutions by calculating concentrations, adjusting factors such as pH and selecting purification techniques and equipment. 3.2.2

Test and maintain the integrity of stains, regents, chemicals and mounts. 3.2.3

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4 Select and apply sterilization methods for regents, buffers, media, biological samples and solutions. 3.2.4

5 Perform laboratory measures by calculating and preparing a serial dilution, calculation quantities needed to perform a test analysis and calculating unit conversions and concentrations (graphing results). 3.2.5

6 Monitor physical properties of reagents, buffers, media and solutions for conductivity and resistivity, pH and turbidity and explain the significance of each. 3.2.6

7 Perform separation techniques, including chemical separations, chromatography, centrifugation, distillation and filtration and interpret the results. 3.2.7

8 Titrate liquids. 3.2.8

9 Create a standard operating procedure and explain its use. 3.2.9

10 Describe industry-based and required regulatory quality assurance practices for documentation. 3.2.10

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3 **Specimen, equipment and chemical handling: Handle, prepare, transport, store and dispose of specimens and chemicals. Monitor, record and maintain the integrity of equipment and instrumentation, environmental conditions of the facility and inventory.** 3.3

1 Prepare and interpret labels for chemicals, supplies, and equipment. 3.3.1

2 Use chemical references to identify hazards associated with handling and storing chemicals. 3.3.2

3 Safely transfer chemicals from storage containers to equipment used in the laboratory. 3.3.3

4 Neutralize acids, bases or caustic solutions for handling and disposal. 3.3.4

5 Sample, monitor and record the environmental conditions of a facility (e.g. air quality, HEPA, temperature, microbial contaminations). 3.3.5

6 Identify and describe the purpose of common laboratory equipment. 3.3.6

7 Select personal protective equipment for various laboratory protocols. 3.3.7

8 Identify required tools and procedures of different biosafety levels. 3.3.8

9 Adjust, calibrate and perform systems diagnostics on laboratory equipment. 3.3.9

10 Use and maintain a record keeping system for laboratory equipment, chemicals, or products. 3.3.10

11 Use and maintain an inventory management system. 3.3.11

12 Use and calibrate precision weighing and measuring techniques (e.g. analytical balance, micropipette), based on the metric system. 3.3.12

13 Use volumetric glassware to accurately measure liquids. 3.3.13

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4 **Applying Chemistry to Laboratory Practices: Using common laboratory equipment, apply general and organic chemistry concepts to examine the**

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structures, functions, binding of molecules, and methodologies for their purity and characterization. 3.4

1 Illustrate electron configurations of elements, compounds and mixtures. 3.4.1

2 Use the periodic table to describe atomic structure and to characterize molecules based on functional groups. 3.4.2

3 Differentiate between organic and inorganic compounds. 3.4.3

4 Use common and chemical nomenclature for organic and inorganic materials. 3.4.4

5 Write names and formulas for common compounds. 3.4.5

6 Prepare solutions based on molarity, percent weight per volume (w/v) and percent volume per volume (v/v). 3.4.6

7 Describe chemical bonding and bond types and the relationships that they have with the physical state of materials. 3.4.7

8 Apply the concepts of stoichiometry and the laws of thermodynamics to chemical reactions. 3.4.8

9 Balance chemical reactions. 3.4.9

10 Identify materials that can be used as a catalyst and describe their role in reactions. 3.4.10

11 Predict endothermic and exothermic characteristics of chemical reaction. 3.4.11

12 Use naming systems, including common and International Union of Pure and Applied Chemistry (IUPAC) conventions. 3.4.12

13 Calculate errors in various measurements, based on data acquired using common laboratory equipment. 3.4.13

14 Apply standard rules for determining the number of significant figures in measurements and in the answers to corresponding calculations. 3.4.14

15 Convert units of measure from English to metric, within the English system, and within the metric system. 3.4.15

16 Calculate the volume, temperature and pressure of gases using the ideal gas law, Charles's Law and Boyle's Law. 3.4.16

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5 **Microbiology Testing and Technology: Classify, differentiate between, and test for various kinds of microorganisms and microbial by-products.** 3.5

1 Explain classification, composition and preparation of culture media and prepare media for propagation. 3.5.1

2 Operate centrifuge, dissecting scope, compound microscope, spectrophotometer, incubator, colony counter, pipettes, and other basic microbiology and analytical equipment to examine biological specimens. 3.5.2

3 Explain the principles of microscopy and process a specimen for light microscopy. 3.5.3

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4 Perform Gram staining to identify morphology and gram results of bacteria. 3.5.4

5 Prepare, incubate and identify colonies microscopically and macroscopically (e.g., colonial morphology, staining procedures, biochemical analysis). 3.5.5

6 Use microbial taxonomy and classification systems to identify microbial organisms. 3.5.6

7 Compare and contrast cellular structure and functions of prokaryotic and eukaryotic cells. 3.5.7

8 Identify aerobic bacteria through morphological, physical, and biochemical properties. 3.5.8

9 Obtain specimens for microbiological testing. 3.5.9

10 Differentiate between types of viruses. 3.5.10

11 Explain virulence, pathogenicity and the factors that contribute to pathogenicity. 3.5.11

12 Explain how chemical energy operates major cell processes (e.g. biosynthesis, movement, transport, growth). 3.5.12

13 Identify bacteriologic methods necessary for the isolation and identification of organisms. 3.5.13

14 Identify factors that affect and optimize rates of enzyme assay reactions. 3.5.14

15 Describe the purpose of an enzyme-linked immunosorbent assay (ELISA) and interpret the results. 3.5.15

16 Describe types of assays and disinguish uses and limitations. 3.5.16

17 Follow complex instructions in performing an assay and explain the role of each step. 3.5.17

18 Perform biochemical assays of proteins, lipids, carbohydrates, nucleic acids and enzymes. 3.5.18

19 Identify the purpose and implementation of bioassays for pathogens. 3.5.19

20 Apply quality assurance control processes within the lab setting (e.g. pre-analytic, analytic and post-analytic sources of error). 3.5.20

21 Perform autoclave sterilization. 3.5.21

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6 **Molecular-Genetics Technology: Apply knowledge of genetic inheritance and modification to organisms, and use genetic information and bioinformatics to analyze specimens.** 3.6

1 Use a Punnett Square to predict and explain Mendel's Laws, genotype, and phenotype. 3.6.1

2 Explain epigenetics and provide examples of its effects. 3.6.2

3 Model, predict and diagram the three-dimensional shape, types of bonds (covalent and hydrogen bonds) and antiparallel nature of DNA. 3.6.3

4 Model central dogma of molecular biology (e.g. replication, transcription, translation). 3.6.4

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5 Describe post-transcriptional and post-translational modification of RNA and describe its function. 3.6.5

6 Explain gene editing including the process, possible benefits, and potential risks. 3.6.6

7 Identify, isolate and manipulate peptides and proteins (i.e. primary, secondary, tertiary, quaternary structures). 3.6.7

8 Analyze DNA using common laboratory techniques (e.g. DNA isolation, gel electrophoresis, restriction enzyme digest, Southern Blotting, Northern Blotting). 3.6.8

9 Use bioinformatics to anaylze DNA and proteins. 3.6.9

10 Explain cloning techniques including vector preparation, transformation and selection. 3.6.10

11 Preform spectroscopy of biological materials explaining the principles behind the procedures, the purpose of a blank and determine the concentration of biomolecular samples. 3.6.11

12 Evaluate genomes in relation to food, plant, animals, and natural resources. 3.6.12

13 Perform genotyping analysis for genetic diagnostics. 3.6.13

14 Transform bacteria with exogenous DNA to alter bacterial metabolism, reproduction, cell structures and their functions. 3.6.14

15 Describe types and features of passive and active transport systems. 3.6.15

16 Describe molecular behavior and structure of large molecules, including carbohydrates, lipids, proteins and nucleic acids. 3.6.16

17 Describe genome sequencing and the information gained from it. 3.6.17

18 "Describe artificial selection and how it is used in plant and animal breeding. " 3.6.18

19 Define genetically modified organisms and explain their impact on society. 3.6.19

20 Describe how vectors (e.g., plasmids, transposons, viruses) are used to transform host and microorganisms. 3.6.20

21 Explain gene by environment interactions. 3.6.21

22 Describe the difference between a quantitative and qualitiative gene trait and give examples of each. 3.6.22

Power Systems: Learners apply principles of tool use, power transmission, hydraulics, two- and four-stroke cycle co igr and charging, steering,

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1 **Tool, Stationary and Mobile Maintenance: Inspect, clean, maintain and perform preventative maintenance on equipment.** 4.1

1 Inspect, clean, maintain and perform preventative maintenance on equipment. 4.1.1

2 Identify types of hand tools, power tools and equipment and describe their functions. 4.1.2

Ensure the presence and functionality of safety equipment. 4.1.3

HVAC, and lubrication systems to operate, maintain and repair equipment. 4

4 Identify potential hazards and limitations related to the use of equipment. 4.1.4

5 Maintain organization, and cleanliness of facilites, machinery, equipment, and tools for safety and appearance. 4.1.5

6 Inspect and service electrical systems and components. 4.1.6

7 Inspect for fluid leakage, fluid levels and the condition of fluids. 4.1.7

8 Inspect, clean, lubricate, and adjust equipment for safe operation. 4.1.8

9 Select fluids, maintain fluid levels and replace system filters per OEM (original equipment manufacturer) specification. 4.1.9

10 Inspect and maintain fluid conveyance and storage components. 4.1.10

11 Identify and maintain accuracy of tooling, machinery, and equipment when performing preventive maintenance and repairs. 4.1.11

12 Compare alternative sources of power for equipment. 4.1.12

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2 Equipment Operations: Operate and maintain mechanical equipment and power systems. 4.2

1 Follow Original Equipment Manufacturer (OEM) recommended operating procedures and adjustment specifications as found in the operators manual. 4.2.1

2 Differentiate among the functions, limitations and proper use of equipment, equipment controls and instrumentation. 4.2.2

3 Perform pre- and post-operation inspections and adjustments and report malfunctions. 4.2.3

4 Perform appropriate start-up, operating and shut-down procedures. 4.2.4

5 Select and operate equipment and attachments needed to complete the task per the original equipment manufacturer (OEM) operators manual. 4.2.5

6 Identify onboard diagnostic procedures per OEM specifications to identify the causes of drivability and emissions concerns. 4.2.6

7 Identify, describe and troubleshoot module communication errors (e.g., controller area network [CAN], BUS systems). 4.2.7

8 Inspect and test computerized engine control system sensors, powertrain control modules (PCMs), actuators and circuits. 4.2.8

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3 Engines: Apply concepts to service components of both small and large internal combustion engines per the original equipment manufacturer (OEM) operators manual. 4.3

1 Assess the physical and mechanical principles of engine operation, including motion, friction and thermodynamics. 4.3.1

2 Retrieve, record, and interpret stored on-board diagnostics (OBD) trouble codes and clear codes where applicable. 4.3.2

3 Locate data plate and determine engine specifications. 4.3.3

4 Analyze, evaluate and troubleshoot an engine. 4.3.4

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5 Compare and contrast two-cycle and four-cycle engines and their operating principles. 4.3.5

6 Evaluate engine head and engine block components to determine serviceability per the original equipment manufacturer (OEM) specification. 4.3.6

7 Remove and replace components comprising the engine block and engine head. 4.3.7

8 Perform the requirements of engine servicing per original equipment manufacturer (OEM) specification to maintain emissions requirements. 4.3.8

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4 **Lubrication and Cooling System: Inspect lubrication and cooling systems operation.** 4.4

1 Explain principles of engine lubrication and cooling. 4.4.1

2 Perform pressure and sensor test on lubrication and cooling systems. 4.4.2

3 Understand the purpose fluid sampling, perform fluid sampling procedures and and interpret sample reporting. 4.4.3

4 Inspect the oil pump gears or rotors, housing, pressure relief devices and pump drive. 4.4.4

5 Inspect, test and replace the radiator, pressure cap, and coolant recovery tank. 4.4.5

6 Inspect and replace engine system hoses and belts. 4.4.6

7 Inspect and replace the thermostat per original equipment manufacturer (OEM) specification. 4.4.7

8 Test, drain, flush and refill coolant and bleed the cooling system peroriginal equipment manufacturer (OEM) specification. 4.4.8

9 Inspect, remove and replace the water pump per original equipment manufacturer (OEM) specification. 4.4.9

10 Inspect and test mechanical and electrical fans, fan clutches, fan shrouds and air dams. 4.4.10

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5 **Fuel, Air Induction and Exhaust System: Diagnose and repair fuel, air induction, exhaust systems, and aftertreatment devices (ATD).** 4.5

1 Explain principles of exhaust, intake, aftertreatment and turbocharger on designs and operations. 4.5.1

2 Identify and understand starting and drivability issues or concerns. 4.5.2

3 Understand and interpret fuel sampling report for contaminants and quality. 4.5.3

4 Inspect and test fuel pumps and pump control systems for pressure, regulation and volume. 4.5.4

5 Inspect and test the cold start system. 4.5.5

6 Inspect the air induction system, intake manifold and gaskets for vacuum leaks and unmetered air. 4.5.6

7 Inspect and service governor systems.v 4.5.7

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8 Explain fuel injection theory. 4.5.8

9 Inspect and test fuel injectors per original equipment manufacturer (OEM) specification. 4.5.9

10 Inspect the integrity of the exhaust system and aftertreatment components. 4.5.10

11 Identify, remove and replace positive crankcase ventilation system components. 4.5.11

12 Identify the parts and describe the functions of evaporative emission control systems. 4.5.12

13 Check and refill the diesel exhaust fluid and service the diesel particulate filter per original equipment manufacturer (OEM) specification. 4.5.13

14 Identify and describe alternative power systems. 4.5.14

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6 Ignition System: Perform ignition system diagnostics and repair. 4.6

1 Explain basic ignition system theory. 4.6.1

2 Use wiring diagrams and schematics to troubleshoot and repair ignition system components. 4.6.2

3 Diagnose and repair ignition system problems for drivability. 4.6.3

4 Inspect, test, and replace ignition system circuit wiring and components. 4.6.4

5 Identify, describe, adjust ignition system timing, timing advance and retard. 4.6.5

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7 Transmission of Power: Diagnose and service power train components. 4.7

1 Identify and describe the features, benefits, and applications of power transmission components. 4.7.1

2 Identify and describe the physical and mechanical principles of mechanical, hydraulic, pneumatic and electrical power transfer. 4.7.2

3 Perform calculations involving speed, torque and power. 4.7.3

4 Remove, replace, and adjust hydrostatic transmissions 4.7.4

5 Remove, replace, and adjust clutches and brakes 4.7.5

6 Test, diagnose, remove, and replace electronic power train control systems components. 4.7.6

7 Test, remove and replace pneumatic components. 4.7.7

8 Remove, replace, and adjust damaged and non-functioning power train components. 4.7.8

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8 Starting and Charging Systems: Identify, inspect and repair starting and charging system components. 4.8

1 Identify and differentiate between electrical and engine problems that cause a slow crank or no crank condition. 4.8.1

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2 Use wiring diagrams and schematics to troubleshoot starting and charging system components. 4.8.2

3 Inspect, test, and replace fuses, relays, circuit breakers, and solenoids. 4.8.3

4 Perform charging system output tests. 4.8.4

5 Inspect, remove, replace and adjust alternator drive belts, pulleys, tensioners and check pulley and belt alignment. 4.8.5

6 Remove, inspect and install an alternator and starter per original equipment manufacturer (OEM) specification. 4.8.6

7 Measure and diagnose the causes of excessive key-off battery drain (parasitic draw). 4.8.7

8 Identify the high voltage circuit of electric or hybrid electric vehicles and related safety precautions. 4.8.8

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9 Steering, Suspension and Traction: Diagnose and repair steering, suspension and traction systems. 4.9

1 Evaluate traction, ballasting and weight transfer of equipment, including towing and trailering systems per gross vehicle weight rating (GVWR). 4.9.1

2 Evaluate and formulate solutions for vehicle stability to include automatic leveling devices, center of gravity, roll-over potential and wheel base dimensions. 4.9.2

3 Remove, inspect, repair or replace steering system components. 4.9.3

4 Align steering components, including tires and tracks. 4.9.4

5 Interpret tire and track wear patterns and evaluate replacement needs per original equipment manufacturer (OEM) specification. 4.9.5

6 Identify and differentiate bearing noise, vehicle pull and wheel vibration, shimmy and noise. 4.9.6

7 Measure wheel, tire, axle and hub runout to evaluate replacement needs. 4.9.7

8 Remove, inspect, repair/replace and reinstall the tire and wheel or track assembly per original equipment manufacturer (OEM) specification. 4.9.8

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10 Drive Axle Universal and Differential: Identify, inspect and replace drive axle and differential components. 4.10

1 Identify and inspect drive axle and differential assemblies. 4.10.1

2 Service and replace the shaft, yokes, boots and joints per original equipment manufacturer (OEM) specification. 4.10.2

3 Replace drive axle seals, bearings and retainers per original equipment manufacturer (OEM) specification. 4.10.3

4 Inspect, adjust and replace drive belts and chains per original equipment manufacturer (OEM) specification. 4.10.4

5 Inspect and replace drive axle housing cover plates, gaskets, sealants, vents, plugs and seals per original equipment manufacturer (OEM) specification. 4.10.5

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11 **Hydraulic Systems: Diagnose, repair and rebuild hydraulic systems.** 4.11

1 Interpret symbols and schematic drawings related to hydraulic system design. 4.11.1

2 Describe the physical and mechanical principles of hydraulics. 4.11.2

3 Identify and describe the features, benefits and applications of the different types of hydraulic and hydrostatic systems. 4.11.3

4 Identify and describe the applications and operations of major hydraulic system components. 4.11.4

5 Inspect, test, diagnose, repair, or replace hydraulic systems and components. 4.11.5

6 Test and diagnose electronic controls for hydraulic systems. 4.11.6

7 Identify and describe the purpose fluid sampling, perform fluid sampling procedures and and interpret sample reporting. 4.11.7

8 Identify and describe hydraulic fitting types and sizes per international standard organization (ISO). 4.11.8

9 Measure flow rate, pressure and temperature. 4.11.9

12 **Brakes: Identify, inspect and replace components of braking systems.** 4.12

2 Identify and describe pressure concerns in the brake systems. 4.12.2

1 Identify and locate components of braking systems. 4.12.1

3 Identify poor stopping, pulling, noise, vibration, premature wear or dragging. 4.12.3

4 Remove and replace a master cylinder per original equipment manufacturer (OEM) specification. 4.12.4

5 Inspect and install lines and fittings per original equipment manufacturer (OEM) specification. 4.12.5

6 Remove, inspect and replace brake components and inspect for leaks. 4.12.6

7 Inspect the condition of the parking brake, and service or replace as needed. 4.12.7

13 **Heating and Air Conditioning Systems: Diagnose and repair heating, ventilating and air conditioning systems (HVAC).** 4.13

1 Identify and describe the physical and mechanical principles of heating ventilating and air conditioning (HVAC) systems. 4.13.1

2 Use schematics and diagrams to troubleshoot heating, ventilating, and air conditioning (HVAC) systems. 4.13.2

3 Identify and describe refrigerant types, major components and function and in the overall operation of the heating, ventilating, and air conditioning (HVAC) system. 4.13.3

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4 Diagnose heating and air conditioning systems by performing pressure and leak testing. 4.13.4

5 Identify, evacuate/recover, recycle/charge the air conditioning system per EPA standards. 4.13.5

14 Pneumatic Systems: Diagnose, repair and rebuild Pneumatic systems. 4.14

1 Interpret symbols and schematic drawings related to pneumatic system design. 4.14.1

2 Describe the physical and mechanical principles of pneumatics. 4.14.2

3 Identify and describe the features, benefits and applications of the different types of pneumatic systems. 4.14.3

4 Identify and describe the applications and operations of major pneumatic system components. 4.14.4

5 Inspect, test, diagnose, repair, or replace pneumatic systems and components to maintain system integrity. 4.14.5

6 Test and diagnose electronic controls for pneumatic systems. 4.14.6

7 Identify and describe the pneumatic system contaminates and methods of testing and control. 4.14.7

8 Identify and describe pneumatic fittings and hose by types and sizes per international standard organization (ISO). 4.14.8

9 Measure system flow , pressure, temperature, and dew point. 4.14.9

Elements of Production: Learners apply principles of practice related to the management and maintenance of food, agriculture and natural resources systems. 5

1 Electrical Theory: Interpret and apply electrical and electronic principles and theories. 5.1

1 Read and interpret wiring diagrams and symbols. 5.1.1

2 Describe the features, benefits and applications of electrical and electronic systems. 5.1.2

3 Describe the relationship between electrical effect and electromagnetic effect. 5.1.3

4 Explain methods of producing electrical current. 5.1.4

5 Describe the differences between alternating current (AC) and direct current (DC). 5.1.5

6 Compare and contrast conductors and insulators. 5.1.6

7 Differentiate the relationships among voltage, current, resistance and power in circuits and understand the basics of transformers. 5.1.7

8 Measure the amperage of AC and DC electrical systems and system components. 5.1.8

9 Calculate voltage, current, resistance, impedance and power in circuits using Ohm's Law, Kirchhoff's Law and Watt's Law. 5.1.9

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10 Describe the purpose of grounding and common methods used for grounding. 5.1.10

11 Describe the uses of series, parallel, and series-parallel circuits. 5.1.11

12 Use a digital multimeter to determine voltage, current, frequency and phase. 5.1.12

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2 **Structural Electrical Circuits: Describe features of an electrical schematic that illustrates a wiring system and interpret and install the design.** 5.2

1 Describe over-current protective devices and their functions. 5.2.1

2 Identify key information and follow manufacturer's recommendation to repair or replace motors per manufactuer specifications. 5.2.2

3 Map circuits and label the service panel directory to reflect devices installed on each circuit. 5.2.3

4 Calculate service requirements for an electrical installation and evaluate for safe capacity. 5.2.4

5 Identify types of cable, conduit, boxes, switches, outlets and other common wiring devices. 5.2.5

6 Identify fasteners, anchors and fire stop systems. 5.2.6

7 Select materials and lay out rough-in wiring runs according to specifications, drawings and code requirements. 5.2.7

8 Select and install lighting technologies and systems. 5.2.8

9 Make conductor terminations and connect appliances to circuits. 5.2.9

10 Identify and apply basic troubleshooting with electrical systems and circuits. 5.2.10

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3 **Design and Estimate: Interpret basic site plan for a desired outcome or company specification.** 5.3

1 Identify and interpret symbols, drawings, prints, and blueprints. 5.3.1

2 Apply proportional measurement and scale techniques. 5.3.2

3 Complete a site inventory and analysis, including physical conditions, code and utilities requirements and the environmental impact. 5.3.3

4 Develop a program list, including intended use, budget, economics, customer wants and needs and maintenance. 5.3.4

5 Identify and apply the principles of balance, proportion, scale, focal point, emphasis, rhythm, harmony and unity to create a design. 5.3.5

6 Identify and apply the elements of line, function, form, texture and color to create a design. 5.3.6

7 Identify and apply design, organizational, and spatial principles into a design. 5.3.7

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Calculate the space requirements and compute various attributes, including length, angle measurement, surface area and volume. 5.3.8

9 Identify construction documents, common scales, specifications and materials used in construction or fabrication. 5.3.9

10 Identify material, inputs and equipment needs based on availability to calculate costs in production or application. 5.3.10

11 Establish the sequential steps of construction and installation. 5.3.11

4 **Surveying and Mapping: Perform surveying procedures to construct a site plan.** 5.4

1 Identify civil drafting symbols and abbreviations. 5.4.1

2 Interpret maps, topographic site plans, deeds and aerial or satellite imagery for site planning. 5.4.2

3 Perform site measurements. 5.4.3

4 Integrate map and surveying data into geographic information system (GIS) or computer aided design (CAD) software. 5.4.4

5 Identify topographical and existing features of areas, including property lines, benchmarks, utilities, streets and setbacks, on survey maps, parcel maps and plats. 5.4.5

5 **Geographic Information Systems (GIS): Employ GIS computer applications to interpret data, maps and land use.** 5.5

1 Interpret and evaluate the accuracy of digital imagery and aerial photography. 5.5.1

2 Explain map projections and the use of scales. 5.5.2

3 Describe GIS data structures (e.g., vector, grid, triangulated irregular network [TIN]). 5.5.3

4 Explain digital elevation methods (e.g., digital elevation model [DEM], global positioning system [GPS]). 5.5.4

5 Interpret spatial interpolation and two- and three-dimensional functional spatial analyses. 5.5.5

6 Demonstrate ranging methods. 5.5.6

7 Identify sources of errors in GIS and formulate corrections and solutions. 5.5.7

8 Determine one's position on the earth using GPS. 5.5.8

9 Integrate GPS data into GIS applications. 5.5.9

10 Identify desired user outcomes and create suitable instruction sheets and check sheets. 5.5.10

11 Assess soil compaction and analyze the correlation between soil compaction data and pixel value. 5.5.11

12 Identify suitability of given area for agricultural applications. 5.5.12

3 Analyze zonal statistics and perform raster manipulation. 5.5.13

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14 Interpret results to create crop reports, prescriptions and application maps. 5.5.14

15 Conduct a temporal analysis to prepare recommendations. 5.5.15

16 Use geospatial technology to develop soil sampling grids or identify sampling sites for testing characteristics such as nitrogen, phosphorus, or potassium content, pH, or micronutrients. 5.5.16

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6. Construction: Follow architectural plans to construct and repair agricultural structures and hardscapes. 5.6

1 Compare and contrast the structural properties, grades and types of construction materials. 5.6.1

2 Lay out, cut, smooth, shape and bore construction materials. 5.6.2

3 Lay out, cut and install decks and floors. 5.6.3

4 Lay out, cut, assemble and brace framing components. 5.6.4

5 Lay out, cut and install stairs and steps. 5.6.5

6 Lay out, cut and install roof framing, roof trim accessories and roofing materials. 5.6.6

7 Install exterior doors and window units with hardware. 5.6.7

8 Install exterior sheathing and siding with trim accessories. 5.6.8

9 Install and repair glass, rigid plastic panels or film plastic. 5.6.9

10 Install and repair draft stops, weather stripping, thermal insulation and vapor barriers. 5.6.10

11 Analyze a surface's condition and select and apply abrasives and fillers. 5.6.11

12 Contrast surface coatings and apply under appropriate environmental conditions. 5.6.12

13 Review and apply facility and fencing options in a production setting. 5.6.14

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7 Brick, Block, Concrete: Follow a design layout to install a structure using bricks, pavers, blocks, stone or concrete. 5.7

1 Describe the physical properties of bricks, pavers, mortar, blocks and concrete. 5.7.1

2 Explain the chemical reactions within and between materials. 5.7.2

3 Describe air ratio and slump. 5.7.3

4 Perform layout and elevations using measurements to scale. 5.7.4

5 Mix, place and finish bricks, pavers, blocks, stone or concrete. 5.7.5

6 Install cut bricks, pavers, blocks, stone or concrete with or without adhesives. 5.7.6

7 Install footers, lintels, sills, poured walls, floors and accessories per manufacturer's specifications. 5.7.7

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Install gravel and sand pads. 5.7.8

9 Layout and construct forms and reinforce them using steel, wire and other materials. 5.7.9

10 Layout and install anchor bolts in concrete. 5.7.10

11 Install joints in concreate (e.g. expansion, saw cut vs tooled joint). 5.7.11

12 Select curing, coloring and texturing additives or specialty finishes and apply to concrete for a specific purpose. 5.7.12

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8 **Water Distribution Systems: Calculate the demand for specific water applications and design and install water supply and drainage components.** 5.8

1 Calculate water demand for specific applications. 5.8.1

2 Compare the types, applications and operating principles of pumps and controls. 5.8.2

3 Locate water system entry points, walls and chases. 5.8.3

4 Identify components of supply and drainage systems and describe their functions. 5.8.4

5 Describe how waste moves from a fixture through the drain system to the environment. 5.8.5

6 Describe factors that are considered when planning and installing a supply and drainage system. 5.8.6

7 Estimate and compute length, angle of measurement, area, surface area and volume to calculate pipe legs and pipe sizes. 5.8.7

8 Calculate the slope required for drainage components. 5.8.8

9 Select supply and drainage components based on their application for a given purpose. 5.8.9

10 Explain the impact of modifying structural members to accommodate supply and drainage lines. 5.8.10

11 Join pipe, pipefittings and valves of similar and dissimilar materials using solder, brazing, solvents and mechanical means of joining. 5.8.11

12 Connect plumbing fixtures and appliances to a supply and drainage system. 5.8.12

13 Compare and contrast sources of contamination in water supplies and methods of filtering and disinfecting water. 5.8.13

14 Prevent freezing and mechanical damage to pipes. 5.8.14

15 Describe how water moves from the source through the water distribution system to the fixture. 5.8.15

16 Test a water supply and drainage system for leaks and pressure using soap, inert gas, electronic sensors and fluorescent dye. 5.8.16

17 Maintain plumbing fixtures. 5.8.17

18 Identify, describe and install cross connection and backflow prevention devices. 5.8.18

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9 **Physics and Metallurgy of Welding: Apply the physics and metallurgy of welding in joining materials.** 5.9

1 Assess how the welding arc produces a weld. 5.9.1

2 Identify the factors that affect the deposit of weld metal and melting (e.g. speed, metal type, travel speed, amps, voltage, angles of electrode). 5.9.2

3 Describe the effects of arc length and shielding gases on the arc. 5.9.3

4 Identify key variables that determine the type of metal transfers. 5.9.4

5 Analyze the relationship between wire feed speed and welding current. 5.9.5

6 Describe pulsed arc transfer mode. 5.9.6

7 Compare and contrast the relationship of wire size to deposition rate and current ranges. 5.9.7

8 Compare constant current and constant voltage power sources and how they relate to the self regulation of arcs. 5.9.8

9 Explain conditions when arc blow occurs and how to reduce arc blow. 5.9.9

10 Identify and describe the changes during solidification. 5.9.10

11 Identify and describe concepts of common crystal structures in metallic materials. 5.9.11

12 Identify and describe the types of weld imperfections and indicate their effects on material properties. 5.9.12

10 **Joining and cutting ferrous and non-ferrous materials with heat: Join and cut ferrous and non-ferrous materials using heat in horizontal and vertical positions.** 5.10

1 Classify, select, handle and store electrodes and match them to the job requirements based on the desired level of penetration and heat range. 5.10.1

2 Determine the correct welder type, wire diameter and gas to be used in a specific welding situation. 5.10.2

3 Compare and contrast ferrous and non-ferrous material welding operating characteristics and performance. 5.10.3

4 Identify and select the appropriate joint design, weld type and welding position. 5.10.4

5 Set up and adjust the welder according to the material being welded and influencing conditions. 5.10.5

6 Store, handle and install high pressure gas cylinders. 5.10.6

7 Clean, prepare, align, and secure post-weld material. 5.10.7

8 Compensate for the effects of expansion and contraction forces when joining ferrous and non-ferrous materials. 5.10.8

9 Employ protective methods for surrounding equipment and materials during welding and cutting operations. 5.10.9

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10 Perform continuous, stitch, tack, plug and butt welds with and without backing and fillet welds. 5.10.10

11 Cut ferrous and non-ferrous materials using oxy fuel and plasma equipment based on the various applications. 5.10.11

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11 Fabricating with cold ferrous and non-ferrous material: Repair ferrous and non-ferrous material structures and equipment through cutting, shaping, forming and joining stock. 5.11

1 Evaluate ferrous and non-ferrous structures and equipment and plan the method of repair. 5.11.1

2 Lay out and cut ferrous and non-ferrous material. 5.11.2

3 Shape stock through bending, cutting, drilling and filing. 5.11.3

4 Form and assemble metal through cutting and bending. 5.11.4

5 Edge metal through wiring, turning, beading and crimping. 5.11.5

6 Identify various methods of fastening ferrous and non-ferrous material. 5.11.6

7 Fasten ferrous and non-ferrous material using a range of hardware. 5.11.7

8 Process ferrous and non-ferrous material through tapping, threading, torquing and smoothing. 5.11.8

9 Analyze the surface condition and select and apply abrasives and fillers for ferrous and non-ferrous material. 5.11.9

10 Contrast surface coatings and apply them under appropriate environmental conditions. 5.11.10

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12 Precision Agriculture: Analyze data from precision agriculture platforms and prepare recommendations 5.12

1 Identify a list of agricultural enterprises that can benefit from precision agriculture. 5.12.1

2 Identify and explain precision agriculture platforms and differentiate uses and benefits for specific platforms. 5.12.2

3 List specific precision agriculture techniques for pesticide application, yield mapping, soil analysis, tillage and planting operations, animal feed and water systems, temperature controled housing and specific machine functions. 5.12.3

4 Explain steps involved in procuring required equipment based on the desired outcome to meet a production goal. 5.12.4

5 Demonstrate proficiency using a multi-meter on precison components to determine reading from manufacture's specifications. 5.12.5

6 Determine the correct course of action based on preliminary troubleshooting findings. 5.12.6

7 Analyze each component in relation to the system and determine the suitabilty of a given component for different agriculture applications. 5.12.7

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8 Apply precision agriculture information to specifically reduce the negative environmental impacts of production practices. 5.12.8

9 Explain how programable logic control (PLC) works and determine equipment malfunctions related to plc failure. 5.12.9

10 Interpret results and prepare recommendations to present findings to stakeholders. 5.12.10

11 Determine precision system based on cost and recommendation for an operation. 5.12.11

12 Explain and figure vairable rate for production goal. 5.12.12

13 Identify and troubleshoot problems that arise with computer/network/hardware and software compatibility problems. 5.12.13

14 Calibrate, repair and maintain electronic equipment per manufacturer's specifications. 5.12.14

15 Identify and describe functions of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming. 5.12.15

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13 Electronic Systems: Learners apply principles of electronics related to electronic theory, alternating and direct current, electronic components, electronic circuits, digital electronics and power supp 5.13

1 Describe static (open circuit) and dynamic (closed circuit) testing principles. 5.13.1

2 Measure the source voltage and perform voltage drop and current draw tests in electronic circuits. 5.13.2

3 Identify and describe the principles of capacitance and inductance. 5.13.3

4 Identify and describe the functions of non-suppressed, suppressed, and bistable relays. 5.13.4

5 Inspect and test switches, connectors, relays, solenoid and wires of electronic circuits. 5.13.5

6 Identify manufacture, and repair or replace terminal connectors per OEM specifications. 5.13.6

7 Perform solder repair of electrical wiring. 5.13.7

8 Locate shorts, grounds, opens and resistance problems in electronic circuits. 5.13.8

9 Inspect, test, and reset or replace or reset fusible links, circuit breakers and fuses per OEM specifications. 5.13.9

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14 Motors and Programmable Logic Controllers: Learns will apply the principles of installing motors, variable-frequency drives (VFD) and power wiring; as well as program, install and monitor digital computers used for automation of electronic mechanical processes to perform tasks. 5.14

Skip to main content

1 Identify types and components of single phase and three phase motors. 5.14.1

2 Interpret motor nameplate information and motor specifications. 5.14.2

3 Calculate motor loads. 5.14.3

4 Determine motor rotation needed for the installed load and explain the process for reversing rotation (i.e. three phase and single phase). 5.14.4

5 Interpret schematics and control diagrams for building a motor circuit. 5.14.5

6 Wire single phase and three phase circuits and install motor control devices (e.g. contactors, starters, variable-frequency drive (VFD) and motor speed controls). 5.14.6

7 Explain the starting sequence of motor components within a given circuit. 5.14.7

8 Troubleshoot and repair motor starting systems to verify operation according to schematics and control diagrams. 5.14.8

9 Describe the use of Programmable Logic Circuits (PLC) in manufacturing automation. 5.14.9

10 Identify programmable logic controller (PLC) components. 5.14.10

11 Design a motor control program using manual and automatic modes. 5.14.11

12 Monitor and troubleshoot a network and hardwired system with a programmable logic controller (PLC). 5.14.12

13 Monitor and troubleshoot programmable logic controller (PLC) operation. 5.14.13

14 Install and maintain programmable logic controllers (PLCs). 5.14.14

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15 Animal Behavior: Apply management practices to assure animal welfare considering species-specific behaviors, human safety, social influences, public perception and regulations associated with animal welfare. 5.15

1 Understand social influences, public perception and regulations that are associated with animal welfare. 5.15.1

2 Describe the adaptations and special senses (e.g., sight, hearing, smell, touch) of animals and how they contribute to animal behavior. 5.15.2

3 Identify and describe the innate behavioral patterns of animals. 5.15.3

4 Describe social relationships involved in behavioral adjustment and adaptation (e.g., animal-to-animal and human-to-animal interaction). 5.15.4

5 Interpret an animal's intent based on its vocalization, body posture and chemical means of communication. 5.15.5

6 Recognize behavior abnormalities and recommend corrective action. 5.15.6

7 Humanely handle, restrain and move animals. 5.15.7

8 Identity and describe the life expectancy and use of animals. 5.15.8

9 Identify and describe the impacts of animal welfare and handling on meat quality and food safety. 5.15.9

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10 Compare and contrast proper and improper handling, equipment use, and strategies that impact food quality. 5.15.10

11 Identify methods to minimize animal stress and safety (physiology, psychological and nutritional). 5.15.11

12 Examine an animal to evaluate its general condition. 5.15.12

16 Biosecurity: Connect the sources and causes of contamination and develop the protocols to implement biosecurity procedures. 5.16

1 Investigate sources and origins of agents that can contaminate processed and unprocessed food products. 5.16.1

2 Identify activities and biological agents that contribute to the risk of acquiring or preventing a specific disease. 5.16.2

3 Identify sources of biological and chemical tampering points. 5.16.3

4 Assess a facility's biosecurity, classify the level of risk and recommend improvements. 5.16.4

5 Implement biosecurity procedures to prevent cross-site contamination (e.g., proper use and disposal of personal protective equipment [PPE] from site to site, vehicle cleaning between farm and processing site). 5.16.5

6 Screen and test animals and plant products for infectious agents or contamination. 5.16.6

7 Select bio-containment practices (e.g., quarantine, eradicate, showering into facilities) to manage pests and diseases. 5.16.7

8 Manage the biosecurity of raw materials and finished products during transportation (e.g., security seals, chain of custody). 5.16.8

Environmental Science: Learners apply earth, life and physical sciences to the production, extraction, processing, protection, use and renewal of both renewable and non-renewable resources. 6

1 Soils: Apply knowledge of soil characteristics and soil information resources to overcome any existing soil use limitations while maintaining or improving soil quality. 6.1

1 Identify soil forming factors and explain how they produce variability in soils. 6.1.1

2 Describe the relationship among physical properties of soils. 6.1.2

3 Collect, test and analyze soil samples for physical and chemical properties. 6.1.3

4 Identify and describe factors (e.g., climate, soil texture, mineralogy, soil organisms, drainage co-efficient, land use, vegetation types, management practices) affecting organic matter and its function in soil quality. 6.1.4

5 Determine land use and identify land capabilities classes. 6.1.5

6 Identify and describe soil conservation practices to reduce soil erosion and compaction. 6.1.6

7 Compare and contrast the causes and effects of soil erosion. 6.1.7

8 Describe soil limitations in agronomic, urban and natural resource practices. 6.1.8

9 Evaluate soil survey data and implement management decisions. 6.1.9

0 Assess basic processes(e.g., slope stability, water control, earth material control, vegetative treatment, soil amdments) of soil reclamation. 6.1.10

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2 **Water Quality: Analyze, interpret and manage the biological, chemical and physical properties of water quality.** 6.2

1 Assess and explain the interactions between human activities and the Earth's hydrosphere (e.g., septic systems, desalinization, point and non-point source pollution). 6.2.1

2 Measure pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), nitrogen and phosphores in lentic and lotic waters to determine water quality. 6.2.2

3 Measure vegetation, temperature, turbidity, macroinvertebrate populations, and bacterial quality in lentic and lotic waters to determine water quality. 6.2.3

4 Explain the hydrological cycle and how human and animal activity impacts the cycle. 6.2.4

5 Explain the biotic and abiotic factors affecting water quality. 6.2.5

6 Monitor and analyze water quality and quantity. 6.2.6

7 Identify and describe best management and industry (e.g., agriculture, timber production, construction) production practices that maintain or improve water quality. 6.2.7

3 **Air Quality: Analyze, interpret and manage the biological, chemical and physical properties of air quality.** 6.3

1 Determine the chemical and physical properties of air (e.g., composition, density, pressure). 6.3.1

2 Explain biogeochemical cycles (e.g., nitrogen, oxygen, sulfur) and how they relate to the biosphere, geosphere and atmosphere. 6.3.2

3 Explain the effects of carbon dioxide sequestration on air quality. 6.3.3

4 Analyze the importance of air quality to humans and other living organisms. 6.3.4

5 Explain human and natural factors (e.g., transportation, farming practices, greenhouse gases, forest fires, volcanic eruptions) affecting air quality. 6.3.5

6 Monitor and evaluate air composition, quality and quantity with direct reading instruments (e.g., combustible gases, oxygen, ammonia). 6.3.6

7 Assess the potential for air contamination at a specific site. 6.3.7

8 Identify and describe best management and industry (e.g., agriculture, timber production, construction) production practices that maintain or improve air quality. 6.3.8

4 **Water Use and Management: Collect, analyze and interpret data for a localized water use and management plan.** 6.4

1 Explain the domains of hydrology. 6.4.1

2 Describe the geological and meteorological principles affecting water supplies. 6.4.2

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Identify and describe types of tests (e.g., Well Yield Test, Pumping Test) used to determin groudwater potential and discharge rates. 6.4.3

4 Identify and describe uses of suface water flow measurments (e.g., stage, stage-discharge curve, peak stage, instantaneous flow, estimation of annual dischare). 6.4.4

5 Interpret surface water flow measurments (e.g., stage, stage-discharge curve, peak stage, instantaneous flow, estimation of annual dischare). 6.4.5

6 Evaluate water collection, storage and distribution systems (e.g., wells, ponds, runoff, waterways, irrigation). 6.4.6

7 Identify and describe watersheds and their structures (e.g., flowing waters, still water, and upland areas.) 6.4.7

8 Identify and describe risk factors for potential surface water and groundwater contamination. 6.4.8

9 Identify and describe best management practices that conserve and sustain water. 6.4.9

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5 Potable Water Treatment: Monitor the water treatment processes for potable water at a specific site. 6.5

1 Identify and assess the characteristics of potable water treatment and the sources of water. 6.5.1

2 Collect and analyze water samples to determine potability. 6.5.2

3 Describe components of a water treatment facility. 6.5.3

4 Monitor the water treatment process (e.g., aeration, flocculation, sedimentation, filtration, disinfection). 6.5.4

5 Monitor the control and treatment of chemical and biological contaminants (e.g., trihalomethanes, lead, bacteria, nitrates) in water. 6.5.5

6 Describe taste and odor control in water treatment. 6.5.6

7 Identify methods for backflow prevention. 6.5.7

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6 Wastewater Operations: Monitor the wastewater collection and treatment methods for a specific site. 6.6

1 Identify the components of a wastewater treatment system. 6.6.1

2 Collect wastewater samples using industry approved standard operating procedures. 6.6.2

3 Identify, analyze and reconcile the components of wastewater samples using industry approved standard operating procedures. 6.6.3

4 Identify normal and abnormal conditions in wastewater collection and treatment systems. 6.6.4

5 Describe the processes of wastewater treatment (e.g., mixing, coagulation, flocculation, disinfection, treatment system, effluent disposal, solids management). 6.6.5

Identify and describe methods for cross-connection and backflow prevention. 6.6.6

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7 Locate, identify and inventory wastewater assessts. 6.6.7

7 Solid Waste and Renewable Resource Management: Control and process solid waste using current and alternative technologies. 6.7

1 Collect, analyze and treat solid waste materials (e.g., livestock mortalities, manure, garbage, food waste). 6.7.1

2 Distinguish the risks associated with solid waste accumulation, utilization and disposal. 6.7.2

3 Determine an acceptable site for solid waste disposal. 6.7.3

4 Compare the processes of aerobic and anaerobic waste decomposition. 6.7.4

5 Describe and monitor solid waste disposal procedures (e.g., landfill, compost). 6.7.5

6 Describe and monitor solid waste disposal procedures and management procedures (e.g., composting, incineration, recycling, burial, bio digester). 6.7.6

7 Explain the control processes and potential uses for solid waste byproducts (e.g., leachate, ash, landfill gas, biosolids, methane, manure). 6.7.7

8 Describe standard operating procedures and identify design requirements for specific purposes (e.g., landfill, lagoon, leachate treatment). 6.7.8

9 Evaluate site closure methods and post-closure monitoring. 6.7.9

10 Determine type and volume of solid waste generated by an operation or facility. 6.7.10

8 Contaminants and Pollution Control: Assess an affected area, determine the source and type of contaminant and respond. 6.8

1 Collect, record and analyze environmental samples and interpret the results. 6.8.1

2 Determine the types, sources and impact of natural, human-made contaminants, and high-risk contaminants 6.8.2

3 Monitor, analyze and quantify levels of contaminants from point and non-point sources. 6.8.3

4 Monitor noise and light pollution and recommend abatement measures. 6.8.4

5 Describe the environmental impact from both industrial and nonindustrial processes. 6.8.5

6 Identify, comply with, and implement best management practices for contaminant control, remediation and prevention (e.g., biological, sanitation, buffer strips). 6.8.6

7 Identify, describe, and recommend remediation strategies for a release of contaminant to soil, surface water or groundwater. 6.8.7

8 Monitor and conduct remediation activities. 6.8.8

9 Identify and describe requierments to develop and implement various emergency response plans. 6.8.9

10 Identify and contact local emergency response teams. 6.8.10

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11 Analyze environmental conditions that influence environmental response. 6.8.11

9 **Hazardous Materials and Waste Management: Follow and apply handling, storage and recording procedures for hazardous materials and waste.** 6.9

1 Identify and differentiate solid waste, hazardous waste, toxic waste and radioactive waste streams. 6.9.1

2 Describe health and safety practices for reducing risks from hazardous materials (e.g., safety data sheet [SDS], employer notification forms, personal protective equipment [PPE]). 6.9.2

3 Demonstrate appropriate responses for major types of hazardous materials disasters. 6.9.3

4 Locate and use information addressing hazardous substance discharge. 6.9.4

5 Demonstrate safe management, handling, disposal and recycling procedures for hazardous materials and waste. 6.9.5

6 Perform site assessments to detect and identify the presence and storage of hazardous materials. 6.9.6

7 Identify and describe collection procedures for hazardous materials and waste and interpret results. 6.9.7

8 Identify and describe procedures to transport and store hazardous materials in accordance with regulations. 6.9.8

9 Prepare and maintain hazardous material handling documentation. 6.9.9

10 Identify hazardous materials that can be recycled. 6.9.10

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10 **Ecosystems: Evaluate biotic and abiotic components and relationships in ecosystems to apply restoration and conservation practices that maintain functionality.** 6.10

1 Describe ecological levels, including population, community, ecosystem, biome and biosphere. 6.10.1

2 Distinguish the flow of energy through ecosystems. 6.10.2

3 Identify and classify interactions among organisms, including predation, symbiosis and competition, to determine species interdependent relationships. 6.10.3

4 Describe the process of succession and its impact on ecosystems. 6.10.4

5 Connect biotic interactions with the abiotic environment. 6.10.5

6 Describe biogeochemical cycles (e.g., carbon, nitrogen, phosphorous, hydrological) and their roles in maintaining equilibrium in an ecosystem. 6.10.6

7 Identify interactions of ecosystems to differentiate biomes. 6.10.7

8 Select and implement restoration ecology practices to repair damaged ecosystems. 6.10.8

9 Identify and describe impacts of native and non-native invasive species on an ecosystem. 6.10.9

10 Describe the relationship between evolution and ecosystems. 6.10.10

11 **Habitat Management and Restoration: Develop a plan for the management and restoration of a specific habitat.** 6.11

1 Differentiate the properties and characteristics of habitats. 6.11.1

2 Examine sites and place them into ecological classifications. 6.11.2

3 Evaluate the current and historical (e.g., industrialism, agriculture, climent change) imapcts of human interactions on ecosystems and habitats. 6.11.3

4 Identify and differentiate extinct, endangered, extirpated, threatened, and species of concern. 6.11.4

5 Survey and monitor species within a habitat. 6.11.5

6 Explain the role of various stakeholders, including individuals, non-governmental organizations (NGOs), corporations and governments in habitat restoration and conservation. 6.11.6

7 Implement techniques used in habitat management, mitigation, enhancement and restoration. 6.11.7

8 Develop a management plan for the restoration and sustainability of a specific habitat using environmental practices that enhance biological diversity. 6.11.8

9 Implement habitat restoration and sustainability management plan environmental practices 6.11.9

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Parks and Recreational Management: Demonstrate a basic understanding of the foundation of the park and recreation profession and their associate industries in history, theory, science, and philosophy. 6.12

1 Identify and describe the principal concepts of leisure (Time, Activity, and State of Mind). 6.12.1

2 Identify and describe flow theory (Mihaly Csikszentmihalyi) and how it may be applied to leisure, play, and recreation. 6.12.2

3 Identify and describe legislative and historical events that have significantly impacted leisure, play, and recreation in the United States. 6.12.3

4 Identify and describe the nature and scope of park, recreation, tourism or related professions and their associated industries. 6.12.4

5 Identify the relationship between culture, values and recreation/leisure participation in the U.S. through the process of conducting cultural interviews. 6.12.5

6 Identify and describe the leisure needs and opportunities of community that can be facilitated through parks and recreation management. 6.12.6

7 Identify and describe individual and community barriers that can impede engagement in leisure, play, and recreation. 6.12.7

Food Science: Learners apply principles of biology, chemistry and physics to the research, development, production, processing and distribution of food products meeting food safety and quality assurance standards in a secure system. 7

1 **The Science of Food: Differentiate the structures, functions and sources of ingredients and the roles they play in food product development for human nutrition.** 7.1

1 Classify components of foods into nutrient categories. 7.1.1

2 Identify sources and forms of energy in foods. 7.1.2

3 Measure and describe the role of pH in food processing and storage. 7.1.3

4 Measure and describe water activity and differentiate how water activity affects food functionality and storage. 7.1.4

5 Describe the composition and structure of sugars, complex carbohydrates, lipids, vitamins, minerals and proteins. 7.1.5

6 Identify sources of sugars, complex carbohydrates, lipids, vitamins, minerals and proteins, and their nutritional contributions to dietary needs. 7.1.6

7 Relate the functions and physical properties of simple and complex carbohydrates, lipids, vitamins, minerals and proteins (i.e., functional ingredients) to the manufacturing of food products. 7.1.7

8 Describe the roles of enzymes as catalysts and the factors that affect enzyme activity. 7.1.8

9 Differentiate the metabolic processes and the factors that affect metabolic changes in the human body, including anabolism, catabolism and basal metabolism. 7.1.9

10 Identify and describe the functions of food additives in food products. 7.1.10

11 Identify and describe regulations regarding food additives. 7.1.11

12 Identify the characteristics and properties of mixtures and select and apply appropriate chemical or biological separation techniques. 7.1.12

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2 **Quality Assurance: Inspect the food production process, and locate potential sources of food quality and safety deviations in facilities.** 7.2

1 Describe the types of spoilage (e.g., oxidation, microbial), their sources and impact. 7.2.1

2 Describe the quality attributes (e.g. color, flavor, texture) that a food product possesses. 7.2.2

3 Identify molds, bacteria, virtuses, prions and yeast and describe their roles in food production. 7.2.3

4 Identify molds, bacteria, virtuses, prions and yeast and describe how they reproduce and factors that affect their growth. 7.2.4

5 Test food quality through chemical, microbiological, sensory and physical methods. 7.2.5

6 Evaluate, inspect and select raw food products for manufacturing, based on raw ingredient specifications. 7.2.6

7 Develop a quality check list, based on finished food product attributes, specifications and regulations. 7.2.7

8 Identify elements commonly included on the principal display and information panels on a food product. 7.2.8

9 Compare and contrast food safety, food fraud, and food defense. 7.2.9

10 Describe the relationship between timeliness of processing or production to product quality. 7.2.10

11 Identify the importance of data collection and management and its relationship to a quality assurance program. 7.2.11

12 Record and manage data relevant to a quality assurance program. 7.2.12

3 **Meat Science: Identify the role of inspection, sanitation, food safety, and proper harvesting practices; the role of carcass evaluation and grading on meat quality and percent saleable products and cutting guidelines from primal to retail meat cuts.** 7.3

1 Identify the benefits and roles of antemortum inspection in relation to food safety. 7.3.1

2 Identify the benefits and roles of postmortum inspection in relation to food safety. 7.3.2

3 Describe humane harvesting techniques and their impact on meat quality. 7.3.3

4 Remove and inspect offal postmortem for signs of disease or contamination. 7.3.4

5 Prepare a carcass through species-specific techniques for postmortum inspection. 7.3.5

6 Describe the role and impacts of the conversion of muscle to meat on meat quality. 7.3.6

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Evaluate and describe the role of marbling on overall quality grade. 7.3.7

8 Evaluate retail cuts of meat to determine both quality and economic value. 7.3.8

9 Determine the maturity of an animal using skeletal ossification and lean maturity ratings, and determine those impacts on the overall quality grade per USDA grading. 7.3.9

10 Calculate percentage saleable product from yield grades utilizing the USDA formula in estimating percent boneless closely trimmed retail cuts. 7.3.10

11 Calculate beef carcass value using a grid-based marketing system. 7.3.11

12 Fabricate carcasses into species-specific wholesale and retail cuts. 7.3.12

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4 **Food Production and Processing: Process a safe shelf stable food product for distribution and consumption.** 7.4

1 Describe the processes used in food preservation, control the variables, and apply biological processing methods. 7.4.1

2 Describe the process of dehydration and concentration, control the variables that affect the quality of dried foods and apply the methods. 7.4.2

3 Describe the functions and types of packaging operations, equipment and materials and use them to manufacture food products (e.g., metal, glass, paper, plastic, film, laminates, edible coatings, biodegradable). 7.4.3

4 Process food through mixing, grinding, pumping and washing and describe the physical change in the food product. 7.4.4

5 Identify and apply food grading systems and standards of identity. 7.4.5

6 Compare and contrast storage and distribution methods for shelf-stable and non-shelf-stable products. 7.4.6

7 Differentiate among beneficial microorganisms (e.g., bacteria, mold, yeast) and their uses in food production. 7.4.7

8 Process food products through biological processing. 7.4.8

9 Describe the role of enzymes as catalysts and factors that affect enzyme activity in the fermentation process. 7.4.9

10 Determine the environmental impacts and manage the wastes of processing a food product. 7.4.10

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5 **Food Product Development: Apply principles of nutrition and human behavior to create a new food prototype.** 7.5

1 Conduct a sensory evaluation of food products. 7.5.1

2 Identify consumer preferences, trends and opportunities affecting food product development. 7.5.2

3 Manipulate ingredients to meet a desired product goal. 7.5.3

4 Identify nutrient values, serving sizes, and nutrient variability for a food product. 7.5.4

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Calculate the amounts of restricted ingredients in food products. 7.5.5

6 Develop a food product package and label according to industry standards. 7.5.6

7 Estimate the shelf life and potential changes in attributes over time. 7.5.7

8 Create a new product roll out plan (e.g., concept, bench trial, market assessment, industrial trial, consumer acceptance). 7.5.8

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6 Food Safety and Sanitation: Describe a food safety and sanitation plan, addressing processing facility needs and contamination points. 7.6

1 Identify and control food product allergens. 7.6.1

2 Establish and implement procedures for preoperational inspection and cleaning. 7.6.2

3 Identify the sources and most prevalent types of food borne bacteria and pathogens to account for the potential of their entrance into the food supply. 7.6.3

4 Describe good manufacturing practices and the corrrelating corrective actions. 7.6.4

5 Identify and describe food-bourne hazards. 7.6.5

6 Identify and describe points in production where food safety hazards can be controlled. 7.6.6

7 Identify and describe critical limits. 7.6.7

8 Identify and describe a corrective active plan. 7.6.8

9 Identify the key activities (e.g., recall exercise, regulatory notification) of a recall program. 7.6.9

10 Identify the government agencies involved in the regulation and governance of food production. 7.6.10

11 Compare and contrast food security and food defense. 7.6.11

12 Identify sources of physical, biological, radiological, and chemical tampering points. 7.6.12

13 Manage the biosecurity of raw materials and finished products during transportation. 7.6.13

Plant Science: Learners apply principles of plant anatomy, physiology, nutrition and genetics to the research and development, selection and reproduction, planting, fertilization, health, harvesting and management of plants in a domestic and/or natural environment. 8

1 Plant Nutrition: Select and apply macronutrients and micronutrients based on deficiencies identified from the use of industry-driven testing, application, methods and optimum management strategies that account for environmental factors. 8.1

1 Compare and contrast organic and inorganic sources of macronutrients and micronutrients. 8.1.1

2 Describe the functions of macronutrients and micronutrients in plants and the role that microorganisms play in plant nutrition. 8.1.2

3 Identify and describe the nutrient recommendations of a plant for a desired production setting. 8.1.3

Identify symptoms and causes of plant nutrient deficiencies and toxicities. 8.1.4

Collect soil and plant tissue for testing and analysis using standard industry practice. 8.1.5

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6 Analyze and draw conclusions from soil and plant tissue test data and determine management recommendations for increase production, increase profitability, enhance environmental protection and improved suitability 8.1.6

7 Distinguish between biotic and abiotic factors (e.g., soil type, minerals, pH, microorganisms) that influence and optimize the availability of nutrients for plants. 8.1.7

8 Calculate nutrient requirements and select nutrient sources and additives for the highest potential yield. 8.1.8

9 Calculate nutrient requirements and select nutrient sources and additives for highest return on investment. 8.1.9

10 Determine the nutrient content of organic and inorganic fertilizers. 8.1.10

11 Select the methods and time of nutrient application and apply nutrients. 8.1.11

12 Describe and apply the 5 R's of nutrient management: (1)right source of fertilizer at the (2) right rate at the (3) right time in the (4) right place with the (5) right irrigation method . 8.1.12

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2 **Plant Reproduction: Propagate plants and cultivars for specific performance characteristics under a variety of production systems.** 8.2

1 Identify the reproductive anatomy of plants and describe their physiological functions. 8.2.1

2 Describe how biotic and abiotic factors(e.g., insects, light, temperature, microorganisms, moisture, location) influence plant reproduction. 8.2.2

3 Compare and contrast variations of plant reproductive systems among plant species. 8.2.3

4 Describe how artificial selection methods are used in plant breeding to improve plant traits. 8.2.4

5 Select and apply methods of asexual plant propagation. 8.2.5

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3 **Pest Management: Develop and implement an integrated pest management (IPM) plan by scouting and identifying specific plant pests and the damage they cause and apply specialized control methods.** 8.3

1 Identify and classify insects, weeds, pathogen, animal pests, and describe the damages they cause. 8.3.1

2 Examine the interrelationships of the disease triangle among host, pathogen and environment. 8.3.2

3 Analyze and calculate the economic threshold of pest damage. 8.3.3

4 Determine the compenents of an intergated pest management plans and related safety practices. 8.3.4

5 Describe native and transgenic adaptions and modifications that have led to plant tolerance or resistance to fungal, bacteria and insect pests. 8.3.5

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Describe the types and functions of biological, mechanical, and chemical control methods. 8.3.6

7 Develop an IPM plan, based on pest life cycles, available treatments, application methods and evaluate it's impact on the environment (e.g. drift, application rate and long term soil health). 8.3.7

4 **Growth and Management: Explain, manage and manipulate plants through all stages of growth and development.** 8.4

1 Identify and classify plants using taxonomy. 8.4.1

2 Identify plant anatomical structures and their functions. 8.4.2

3 Identify and classify seeds. 8.4.3

4 Identify and classify plants and describe management decisions at all stages. 8.4.4

5 Explain the requirements of photosynthesis and identify the products and byproducts. 8.4.5

6 Explain the process and importance of transpiration in plant growth and development. 8.4.6

7 Understand aerobic respiration and its relationship to plant growth and management. 8.4.7

8 Explain primary and secondary plant growth. 8.4.8

9 Identify plant responses to plant growth regulators and different forms of tropism. 8.4.9

10 Understand the environmental and artificial factors that influence plant germination, growth and development. 8.4.10

11 Select, evaluate and prepare soil or media for planting. 8.4.11

12 Understand and evaluate the process by which plants are selected in relation to production use. 8.4.12

13 Evaluate and implement planting practices. 8.4.13

14 Describe factors related to seed quality, treatment, and density that affect emergence, stand uniformity and seedling health. 8.4.14

15 Evaluate and implement transplanting practices. 8.4.15

16 Control plant growth through mechanical and chemical means. 8.4.16

17 Analyze plant water requirements and describe methods of irrigation. 8.4.17

18 Compare and contrast inorganic and organic production practices. 8.4.18

19 Identify and describe production practices that lead to plant resistance and tolerance. 8.4.19

20 Compare and contrast management practices in controlled and natural growing environments. 8.4.20

21 Distinguish between biotic and abiotic factors that influence plant stress. 8.4.21

5 **Harvesting: Describe and implement harvesting methods.** 8.5

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Determine crop readiness for saleability and environmental conditions that can impact crop quality at harvest. 8.5.1

2 Describe safety precautions to take when harvesting. 8.5.2

3 Evaluate techniques to maximize yield through mechanical or hand harvesting methods. 8.5.3

4 Calculate and evaluate potential yield and loss due to harvesting. 8.5.4

5 Evaluate the impact of harvest techniques on the quality of plants and plant products. 8.5.5

6 Identify and implement harvesting methods and equipment. 8.5.6

7 Implement management practices to reduce loss. 8.5.7

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6 Handling and Storage: Handle and store plants and plant products to maximize quality and longevity. 8.6

1 Describe safety precautions in handling and storage practices. 8.6.1

2 Explain, monitor, and manipulate conditions for optimal handling and storage of plants and plant products. 8.6.2

3 Calculate potential yield and loss due to processing and storage. 8.6.3

4 Prepare products for sale, transportation and storage. 8.6.4

5 Identify storage methods and storage capacity for plants and plant products. 8.6.5

6 Explain the reasons for preparing plants and plant products for distribution. 8.6.6

7 Implement and evaluate techniques for grading, handling, blending, segerating, packaging and loading plants and plant products for distribution or transportation. 8.6.7

Energy: Learners apply principles of physics, chemistry, earth sciences and mathematics to energy sources, transformations, acquisitions, applications and their impacts. 9

1 Energy Sources: Identify energy sources according to their economic viability, sustainability and environmental impact. 9.1

1 Identify, compare and contrast fossil fuel sources (e.g., oil, natural gas, and coal) and the technology used to generate energy. 9.1.1

2 Identify, compare and contrast renewable energy sources and the technology used to generate energy. 9.1.2

3 Identify, compare and contrast alternative and emerging energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear). 9.1.3

4 Identify the social, economic and environmental drivers and barriers that influence the development and use of energy sources. 9.1.4

5 Identify and describe energy density properties of different types of fuel sources according to industry standards. 9.1.5

6 Trace the transformations of energy within a system (e.g., mechanical to electrical, chemical to mechanical). 9.1.6

7 Identify and describe best management practices (e.g., carbon sequestration, conservation, animal safety, efficiency) that lessen environmental impact. 9.1.7

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:rude Oil and Natural Gas: Describe the processes for exploring, drilling, producing, transporting, refining and marketing products of cruel oil and natural

gas. 9.2

1. Describe the role of geology in the formation, migration and trapping of crude oil and natural gas. 9.2.1
2. Assess how crude oil and natural gas wells are placed, designed and installed. 9.2.2
3. Identify and explain the processes associated with drilling (e.g., rig types, blowout prevention, drilling fluids, casing, cementing). 9.2.3
4. Evaluate different environmental and safety procedures for the storage, containment, transporting, recycling, processing and disposing of drilling liquids (e.g., drilling fluids, brine, flow-back). 9.2.4
5. Identify and apply the appropriate permits and governance associated with crude oil and natural gas production. 9.2.5
6. Identify the different processes for producing, treating, transporting, processing crude oil and natural gas byproducts. 9.2.6
7. Identify and describe equipment used in the extraction and processing of crude oil and natural gas for up, mid, and down streams process. 9.2.7
8. Identify the products and byproducts of crude oil and natural gas. 9.2.8

3. **Biomass: Describe and manage processes required to extract energy from biomass.** 9.3

1. Identify applications for biomass energy production. 9.3.1
2. Describe the thermal, chemical and biochemical methods of converting biomass into energy. 9.3.2
3. Identify feedstock materials used to produce biofuels and compare the energy potential of each material. 9.3.3
4. Identify and differentiate the aerobic and anaerobic digestion of biomass. 9.3.4
5. Test source materials and final products and compare the results to industry standards. 9.3.5
6. Process source materials for energy conversion. 9.3.6
7. Identify and describe technical standards and governance for on placing agricultural, commercial, and industrial biomass operations. 9.3.7
8. Identify the byproducts generated in the production of biofuels and their use and disposal according to industry standards. 9.3.8
9. Identify and describe storage and distribution systems for biofuels. 9.3.9

4. **Solar Energy: Plan, install and maintain a solar array that can collect, store and distribute solar energy.** 9.4

1. Identify the different types of solar energy devices (e.g., photovoltaic [PV], solar thermal, concentrating solar power [CSP]) and how they produce energy. 9.4.1
2. Conduct a site evaluation to identify an appropriate solar panel installation. 9.4.2

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3 Select the appropriate solar energy application for commercial and residential use. 9.4.3

4 Identify the basic design and components of a solar installation. 9.4.4

5 Identify and describe technical standards and governance for a residential, community, utility solar energy installation. 9.4.5

6 Review and interpret an electric schematic and site plan for a solar energy installation. 9.4.6

7 Install, test and maintain a solar energy installation. 9.4.7

8 Identify and describe project decommissioning recycling and disposal methods for a solar energy installation. 9.4.8

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5 **Wind Energy: Plan and maintain a wind energy installation that captures, stores and distributes electrical energy.** 9.5

1 Describe the internal and external components of wind energy technologies and installations. 9.5.1

2 Conduct a site evaluation to identify an appropriate wind turbine installation. 9.5.2

3 Identify and describe technical standards and governance for wind energy technologies and installations. 9.5.3

4 Identify, describe and differentiate wind technologies used for wind energy production. 9.5.4

5 Select and design an appropriate wind energy installation for commercial and residential applications. 9.5.5

6 Review and interpret an electric schematic and site plan for a wind energy installation. 9.5.6

7 Install, test and maintain components of a wind energy installation. 9.5.7

8 Identify and describe project decommissioning recycling and disposal methods for a wind energy installation. 9.5.8