Advanced Plant and Soil Science (IMRA26)

Subject: Career Development and Career and Technical Education
Grade: 12
Expectations: 88
Breakouts: 302

(a) Introduction.

(1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Advanced Plant and Soil Science provides a way of learning about the natural world. In this course, students learn how plant and soil science has influenced a vast body of knowledge, that there are still applications to be discovered, and that plant and soil science is the basis for many other fields of science. To prepare for careers in plant and soil science, students must attain academic knowledge and skills, acquire technical knowledge and skills related to plant and soil science and the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills and technologies in a variety of settings.

(4) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(5) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.

(6) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(7) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(8) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide tools for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(9) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(10) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and Skills Statements

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of plant science and develop a plan for obtaining the education, training, and certifications required;

(i) identify career opportunities for a chosen occupation in the field of plant science

(ii) identify entrepreneurship opportunities for a chosen occupation in the field of plant science

(iii) develop a plan for obtaining the education required [for a chosen occupation in the field of plant science]

(iv) develop a plan for obtaining the training required [for a chosen occupation in the field of plant science]

(v) develop a plan for obtaining the certifications required [for a chosen occupation in the field of plant science]

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(i) model professionalism by continuously exhibiting appropriate work habits

(ii) model professionalism by continuously solving problems

(iii) model professionalism by continuously taking initiative

(iv) model professionalism by continuously communicating effectively

(v) model professionalism by continuously listening actively

(vi) model professionalism by continuously thinking critically

(C) model appropriate personal and occupational safety practices and explain the importance of established safety and health protocols for the workplace;

(i) model appropriate personal safety practices

(ii) model appropriate occupational safety practices

(iii) explain the importance of established safety protocols for the workplace

(iv) explain the importance of established health protocols for the workplace

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(i) analyze the rights of employers

(ii) analyze the rights of employees

(iii) analyze the responsibilities of employers, including ethical conduct

(iv) analyze the responsibilities of employers, including legal responsibilities

(v) analyze the responsibilities of employees, including ethical conduct

(vi) analyze the responsibilities of employees, including legal responsibilities

(vii) interpret the rights of employers

(viii) interpret the rights of employees

(ix) interpret the responsibilities of employers, including ethical conduct

(x) interpret the responsibilities of employers, including legal responsibilities

(xi) interpret the responsibilities of employees, including ethical conduct

(xii) interpret the responsibilities of employees, including legal responsibilities

(E) describe and demonstrate characteristics of good citizenship in the agricultural workplace, including promoting stewardship, community leadership, civic engagement, and agricultural awareness and literacy.

(i) describe characteristics of good citizenship in the agricultural workplace, including promoting stewardship

(ii) describe characteristics of good citizenship in the agricultural workplace, including promoting community leadership

(iii) describe characteristics of good citizenship in the agricultural workplace, including promoting civic engagement

(iv) describe characteristics of good citizenship in the agricultural workplace, including promoting agricultural awareness

(v) describe characteristics of good citizenship in the agricultural workplace, including promoting agricultural literacy

(vi) demonstrate characteristics of good citizenship in the agricultural workplace, including promoting stewardship

(vii) demonstrate characteristics of good citizenship in the agricultural workplace, including promoting community leadership

(viii) demonstrate characteristics of good citizenship in the agricultural workplace, including promoting civic engagement

(ix) demonstrate characteristics of good citizenship in the agricultural workplace, including promoting agricultural awareness

(x) demonstrate characteristics of good citizenship in the agricultural workplace, including promoting agricultural literacy

(2) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(i) ask questions based on observations or information from text, phenomena, models, or investigations

(ii) define problems based on observations or information from text, phenomena, models, or investigations

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(i) apply scientific practices to plan descriptive investigations

(ii) apply scientific practices to plan comparative investigations

(iii) apply scientific practices to plan experimental investigations

(iv) apply scientific practices to conduct descriptive investigations

(v) apply scientific practices to conduct comparative investigations

(vi) apply scientific practices to conduct experimental investigations

(vii) use engineering practices to design solutions to problems

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(i) use appropriate safety equipment during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(ii) use appropriate safety equipment during classroom investigations as outlined in Texas Education Agency-approved safety standards

(iii) use appropriate safety equipment during field investigations as outlined in Texas Education Agency-approved safety standards

(iv) use appropriate safety practices during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(v) use appropriate safety practices during classroom investigations as outlined in Texas Education Agency-approved safety standards

(vi) use appropriate safety practices during field investigations as outlined in Texas Education Agency-approved safety standards

(D) use appropriate tools such as microscopes, measuring equipment, sensors, plant propagation tools, soil testing kits, and calculators;

(i) use appropriate tools

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(i) collect quantitative data using the International Systems of Units (SI)

(ii) collect quantitative data using qualitative data as evidence

(F) organize quantitative and qualitative data using graphs and charts;

(i) organize quantitative data using graphs

(ii) organize quantitative data using charts

(iii) organize qualitative data using graphs

(iv) organize qualitative data using charts

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(i) develop models to represent phenomena, systems, processes, or solutions to engineering problems

(ii) use models to represent phenomena, systems, processes, or solutions to engineering problems

(H) distinguish between scientific hypotheses, theories, and laws.

(i) distinguish between scientific hypotheses, theories, and laws

(3) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(i) identify advantages of models

(ii) identify limitations of models

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(i) analyze data by identifying significant statistical features

(ii) analyze data by identifying significant patterns

(iii) analyze data by identifying significant sources of error

(iv) analyze data by identifying significant limitations

(C) use mathematical calculations to assess quantitative relationships in data; and

(i) use mathematical calculations to assess quantitative relationships in data

(D) evaluate experimental and engineering designs.

(i) evaluate experimental designs

(ii) evaluate engineering design

(4) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(i) develop explanations supported by data

(ii) develop explanations supported by models

(iii) develop explanations consistent with scientific ideas

(iv) develop explanations consistent with scientific principles

(v) develop explanations consistent with scientific theories

(vi) propose solutions supported by data

(vii) propose solutions supported by models

(viii) propose solutions consistent with scientific ideas

(ix) propose solutions consistent with scientific principles

(x) propose solutions consistent with scientific theories

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(i) communicate explanations individually in a variety of settings

(ii) communicate explanations individually in a variety of formats

(iii) communicate explanations collaboratively in a variety of settings

(iv) communicate explanations collaboratively in a variety of formats

(v) communicate solutions individually in a variety of settings

(vi) communicate solutions individually in a variety of formats

(vii) communicate solutions collaboratively in a variety of settings

(viii) communicate solutions collaboratively in a variety of formats

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(i) engage respectfully in scientific argumentation using applied scientific explanations

(ii) engage respectfully in scientific argumentation using applied empirical evidence

(5) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student;

(i) analyze scientific explanations by using empirical evidence so as to encourage critical thinking by the student

(ii) analyze scientific explanations by using logical reasoning so as to encourage critical thinking by the student

(iii) analyze scientific explanations by using experimental testing so as to encourage critical thinking by the student

(iv) analyze scientific explanations by using observational testing so as to encourage critical thinking by the student

(v) analyze scientific solutions by using empirical evidence so as to encourage critical thinking by the student

(vi) analyze scientific solutions by using logical reasoning so as to encourage critical thinking by the student

(vii) analyze scientific solutions by using experimental testing so as to encourage critical thinking by the student

(viii) analyze scientific solutions by using observational testing so as to encourage critical thinking by the student

(ix) evaluate scientific explanations by using empirical evidence so as to encourage critical thinking by the student

(x) evaluate scientific explanations by using logical reasoning so as to encourage critical thinking by the student

(xi) evaluate scientific explanations by using experimental testing so as to encourage critical thinking by the student

(xii) evaluate scientific explanations by using observational testing so as to encourage critical thinking by the student

(xiii) evaluate scientific solutions by using empirical evidence so as to encourage critical thinking by the student

(xiv) evaluate scientific solutions by using logical reasoning so as to encourage critical thinking by the student

(xv) evaluate scientific solutions by using experimental testing so as to encourage critical thinking by the student

(xvi) evaluate scientific solutions by using observational testing so as to encourage critical thinking by the student

(xvii) critique scientific explanations by using empirical evidence so as to encourage critical thinking by the student

(xviii) critique scientific explanations by using logical reasoning so as to encourage critical thinking by the student

(xix) critique scientific explanations by using experimental testing so as to encourage critical thinking by the student

(xx) critique scientific explanations by using observational testing so as to encourage critical thinking by the student

(xxi) critique scientific solutions by using empirical evidence so as to encourage critical thinking by the student

(xxii) critique scientific solutions by using logical reasoning so as to encourage critical thinking by the student

(xxiii) critique scientific solutions by using experimental testing so as to encourage critical thinking by the student

(xxiv) critique scientific solutions by using observational testing so as to encourage critical thinking by the student

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

(i) relate the impact of past research on scientific thought, including research methodology as related to the content

(ii) relate the impact of past research on scientific thought, including cost-benefit analysis as related to the content

(iii) relate the impact of past research on scientific thought, including contributions of diverse scientists as related to the content

(iv) relate the impact of past research on society, including research methodology as related to the content

(v) relate the impact of past research on society, including cost-benefit analysis as related to the content

(vi) relate the impact of past research on society, including contributions of diverse scientists as related to the content

(vii) relate the impact of current research on scientific thought, including research methodology as related to the content

(viii) relate the impact of current research on scientific thought, including cost-benefit analysis as related to the content

(ix) relate the impact of current research on scientific thought, including contributions of diverse scientists as related to the content

(x) relate the impact of current research on society, including research methodology as related to the content

(xi) relate the impact of current research on society, including cost-benefit analysis as related to the content

(xii) relate the impact of current research on society, including contributions of diverse scientists as related to the content

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.

(i) research resources in order to investigate STEM careers

(ii) explore resources in order to investigate STEM careers

(6) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity; and

(i) plan a supervised agricultural experience program as an experiential learning activity

(ii) propose a supervised agricultural experience program as an experiential learning activity

(iii) conduct a supervised agricultural experience program as an experiential learning activity

(iv) document a supervised agricultural experience program as an experiential learning activity

(v) evaluate a supervised agricultural experience program as an experiential learning activity

(B) use appropriate record-keeping skills in a supervised agricultural experience program.

(i) use appropriate record-keeping skills in a supervised agricultural experience program

(7) The student develops leadership skills through participation in an agricultural youth organization. The student is expected to:

(A) participate in youth agricultural leadership opportunities;

(i) participate in youth agricultural leadership opportunities [in an agricultural youth organization]

(B) review and participate in a local program of activities; and

(i) review a local program of activities [in an agricultural youth organization]

(ii) participate in a local program of activities [in an agricultural youth organization]

(C) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(i) create documentation of relevant agricultural experience

(ii) update documentation of relevant agricultural experience

(8) The student understands interrelationships between plants, soil, and people in historical and current contexts. The student is expected to:

(A) research and document major historical milestones related to plant and soil science in human civilization;

(i) research major historical milestones related to plant science in human civilization

(ii) research major historical milestones related to soil science in human civilization

(iii) document major historical milestones related to plant science in human civilization

(iv) document major historical milestones related to soil science in human civilization

(B) explain how humans have influenced plant selection and how plant selection has influenced civilization's development;

(i) explain how humans have influenced plant selection

(ii) explain how plant selection has influenced civilization's development

(C) analyze the effect of soil properties on settlement of civilizations and migration; and

(i) analyze the effect of soil properties on settlement of civilizations

(ii) analyze the effect of soil properties on migration

(D) investigate and explain how plants have shaped major world economies.

(i) investigate how plants have shaped major world economies

(ii) explain how plants have shaped major world economies

(9) The student identifies how plants grow and how specialized cells, tissues, and organs develop. The student is expected to:

(A) describe the unique structure and function of organelles in plant cells;

(i) describe the unique structure of organelles in plant cells

(ii) describe the unique function of organelles in plant cells

(B) explain the growth and division of plant cells;

(i) explain the growth of plant cells

(ii) explain the division of plant cells

(C) compare cells from different parts of the plant, including roots, stems, flowers, and leaves, to show specialization of structures and functions; and

(i) compare cells from different parts of the plant, including roots to show specialization of structures

(ii) compare cells from different parts of the plant, including roots to show specialization of functions

(iii) compare cells from different parts of the plant, including stems to show specialization of structures

(iv) compare cells from different parts of the plant, including stems to show specialization of functions

(v) compare cells from different parts of the plant, including flowers to show specialization of structures

(vi) compare cells from different parts of the plant, including flowers to show specialization of functions

(vii) compare cells from different parts of the plant, including leaves to show specialization of structures

(viii) compare cells from different parts of the plant, including leaves to show specialization of functions

(D) illustrate the levels of cellular organization in plants.

(i) illustrate the levels of cellular organization in plants

(10) The student develops a knowledge of plant anatomy and functions. The student is expected to:

(A) describe the structure and function of plant parts, including roots, stems, leaves, flowers, fruits, and seeds;

(i) describe the structure of plant parts, including roots

(ii) describe the structure of plant parts, including stems

(iii) describe the structure of plant parts, including leaves

(iv) describe the structure of plant parts, including flowers

(v) describe the structure of plant parts, including fruits

(vi) describe the structure of plant parts, including seeds

(vii) describe the function of plant parts, including roots

(viii) describe the function of plant parts, including stems

(ix) describe the function of plant parts, including leaves

(x) describe the function of plant parts, including flowers

(xi) describe the function of plant parts, including fruits

(xii) describe the function of plant parts, including seeds

(B) compare the anatomy of monocots and dicots;

(i) compare the anatomy of monocots and dicots

(C) compare the various propagation methods for plants; and

(i) compare the various propagation methods for plants

(D) identify the functions of modified plant structures such as tubers, rhizomes, pseudo stems, and pitchers.

(i) identify the functions of modified plant structures

(11) The student develops an understanding of plant physiology and nutrition. The student is expected to:

(A) explain the metabolic process of photosynthesis and cellular respiration;

(i) explain the metabolic process of photosynthesis

(ii) explain the metabolic process of cellular respiration

(B) describe the role of mineral nutrition in the soil for plant development;

(i) describe the role of mineral nutrition in the soil for plant development

(C) identify the essential nutrients in soil; and

(i) identify the essential nutrients in soil

(D) describe the role of macronutrients and micronutrients in plants.

(i) describe the role of macronutrients in plants

(ii) describe the role of micronutrients in plants

(12) The student analyzes soil science as it relates to plant and human activity. The student is expected to:

(A) explain soil formation;

(i) explain soil formation

(B) investigate and document the properties of soils, including texture, horizons, structure, color, parent materials, and fertility;

(i) investigate the properties of soils, including texture

(ii) investigate the properties of soils, including horizons

(iii) investigate the properties of soils, including structure

(iv) investigate the properties of soils, including color

(v) investigate the properties of soils, including parent materials

(vi) investigate the properties of soils, including fertility

(vii) document the properties of soils, including texture

(viii) document the properties of soils, including horizons

(ix) document the properties of soils, including structure

(x) document the properties of soils, including color

(xi) document the properties of soils, including parent materials

(xii) document the properties of soils, including fertility

(C) identify and classify soil orders;

(i) identify soil orders

(ii) classify soil orders

(D) explain methods of soil conservation such as crop rotation, mulching, terracing, cover cropping, and contour plowing;

(i) explain methods of soil conservation

(E) describe the application of soil mechanics to buildings, landscapes, and crop production;

(i) describe the application of soil mechanics to buildings

(ii) describe the application of soil mechanics to landscapes

(iii) describe the application of soil mechanics to crop production

(F) research and explain soil management practices such as tillage trials and sustainable soil management practices;

(i) research soil management practices

(ii) explain soil management practices

(G) practice and explain soil evaluations related to experiential activities such as land judging;

(i) practice soil evaluations related to experiential activities

(ii) explain soil evaluations related to experiential activities

(H) evaluate and determine soil health through soil testing; and

(i) evaluate soil health through soil testing

(ii) determine soil health through soil testing

(I) analyze concepts of soil ecology.

(i) analyze concepts of soil ecology

(13) The student maps the process of soil formation influenced by weathering, including erosion processes due to water, wind, and mechanical factors influenced by climate. The student is expected to:

(A) illustrate the role of weathering in soil formations;

(i) illustrate the role of weathering in soil formations

(B) distinguish between chemical weathering and mechanical weathering;

(i) distinguish between chemical weathering and mechanical weathering

(C) identify geological formations that result from differing weathering processes; and

(i) identify geological formations that result from differing weathering processes

(D) describe the role of biotic factors in soil formation.

(i) describe the role of biotic factors in soil formation

(14) The student explains the relationship of biotic and abiotic factors within habitats and ecosystems and their effects on plant ecology. The student is expected to:

(A) identify and define plant populations, ecosystems, communities, and biomes;

(i) identify plant populations

(ii) identify plant ecosystems

(iii) identify plant communities

(iv) identify plant biomes

(v) define plant populations

(vi) define plant ecosystems

(vii) define plant communities

(viii) define plant biomes

(B) distinguish between native and introduced plants in an ecosystem;

(i) distinguish between native and introduced plants in an ecosystem

(C) investigate and describe characteristics of native and introduced plants;

(i) investigate characteristics of native plants

(ii) investigate characteristics of introduced plants

(iii) describe characteristics of native plants

(iv) describe characteristics of introduced plants

(D) make observations and compile data about fluctuations in abiotic cycles;

(i) make observations about fluctuations in abiotic cycles

(ii) compile data about fluctuations in abiotic cycles

(E) describe the effects of fluctuations in abiotic cycles on local ecosystems; and

(i) describe the effects of fluctuations in abiotic cycles on local ecosystems

(F) describe potential positive and negative impacts of human activity such as pest control, hydroponics, monoculture planting, and sustainable agriculture on ecosystems.

(i) describe potential positive impacts of human activity on ecosystems

(ii) describe potential negative impacts of human activity on ecosystems

(15) The student evaluates components of plant science as they relate to crop production and advancements. The student is expected to:

(A) analyze the genetics and evolution of various crops;

(i) analyze the genetics of various crops

(ii) analyze the evolution of various crops

(B) identify and classify plants according to taxonomy;

(i) identify plants according to taxonomy

(ii) classify plants according to taxonomy

(C) identify characteristics related to seed quality, including mechanical damage, viability, and grade;

(i) identify characteristics related to seed quality, including mechanical damage

(ii) identify characteristics related to seed quality, including viability

(iii) identify characteristics related to seed quality, including grade

(D) identify plant pests and diseases using laboratory equipment such as microscopes, test kits, and technology;

(i) identify plant pests using laboratory equipment

(ii) identify plant diseases using laboratory equipment

(E) evaluate the effectiveness of plant management practices, including germination tests, plant spacing trials, and fertilizer tests;

(i) evaluate the effectiveness of plant management practices, including germination test

(ii) evaluate the effectiveness of plant management practices, including plant spacing trials

(iii) evaluate the effectiveness of plant management practices, including fertilizer test

(F) analyze trends in crop species and varieties grown locally in Texas and the United States and how trends affect producers and consumers; and

(i) analyze trends in crop species grown locally in Texas

(ii) analyze trends in crop varieties grown locally in Texas

(iii) analyze trends in crop species grown in the United States

(iv) analyze trends in crop varieties grown in the United States

(v) analyze how trends affect producers

(vi) analyze how trends affect consumers

(G) investigate and identify recent advancements in plant and soil science such as biotechnology, artificial intelligence, and drone, infrared, and sensor technologies.

(i) investigate recent advancements in plant science

(ii) investigate recent advancements in soil science

(iii) identify recent advancements in plant science

(iv) identify recent advancements in soil science

(16) The student describes the relationship between resources within environmental systems. The student is expected to:

(A) summarize and evaluate methods of land use and management;

(i) summarize methods of land use

(ii) summarize methods of land management

(iii) evaluate methods of land use

(iv) evaluate methods of land management

(B) identify sources, quality, and conservation of water in plant production;

(i) identify sources of water in plant production

(ii) identify quality of water in plant production

(iii) identify conservation of water in plant production

(C) explore and describe conservation practices such as rainwater collection, water-conserving irrigation systems, and use of biofuels;

(i) explore conservation practices

(ii) describe conservation practices

(iii) explore use of biofuels

(iv) describe use of biofuels

(D) analyze and evaluate the economic significance and interdependence of components of the environment;

(i) analyze the economic significance of components of the environment

(ii) analyze the economic interdependence of components of the environment

(iii) evaluate the economic significance of components of the environment

(iv) evaluate the economic interdependence of components of the environment

(E) debate the impact of human activity and technology on soil health and plant productivity;

(i) debate the impact of human activity on soil health

(ii) debate the impact of human activity on plant productivity

(iii) debate the impact of technology on soil health

(iv) debate the impact of technology on plant productivity

(F) research and summarize the impact of natural disasters on soil health and plant productivity; and

(i) research the impact of natural disasters on soil health

(ii) research the impact of natural disasters on plant productivity

(iii) summarize the impact of natural disasters on soil health

(iv) summarize the impact of natural disasters on plant productivity

(G) explain how regional changes in the environment may have a global effect.

(i) explain how regional changes in the environment may have a global effect

(17) The student describes the dynamics of soil on watersheds and its effects on plant growth and production. The student is expected to:

(A) identify and record the characteristics of a local watershed such as average annual rainfall, runoff patterns, aquifers, location of water basins, and surface reservoirs; and

(i) identify the characteristics of a local watershed

(ii) record the characteristics of a local watershed

(B) analyze the impact of floods, drought, irrigation, urbanization, and industrialization in a watershed.

(i) analyze the impact of floods in a watershed

(ii) analyze the impact of drought in a watershed

(iii) analyze the impact of irrigation in a watershed

(iv) analyze the impact of urbanization in a watershed

(v) analyze the impact of industrialization in a watershed

(18) The student analyzes plant and soil science as it relates to plant and soil relationships affecting the production of food, fiber, and other economic crops. The student is expected to:

(A) explain the importance and interrelationship of soil and plants;

(i) explain the importance of soil

(ii) explain the importance of plants

(iii) explain the interrelationship of soil and plants

(B) compare soil and plants in agricultural and urban settings;

(i) compare soil in agricultural and urban settings

(ii) compare plants in agricultural and urban settings

(C) explain growing plants without soil (hydroponic techniques); and

(i) explain growing plants without soil (hydroponic techniques)

(D) evaluate advantages and disadvantages of hydroponics.

(i) evaluate advantages of hydroponics

(ii) evaluate disadvantages of hydroponics

(19) The student demonstrates skills related to the human, scientific, and technological dimensions of crop production and the resources necessary for producing domesticated plants. The student is expected to:

(A) describe the growth and development of major agricultural crops in Texas such as cotton, corn, sorghum, sugarcane, wheat, and rice;

(i) describe the growth of major agricultural crops in Texas

(ii) describe the development of major agricultural crops in Texas

(B) apply principles of genetics and plant breeding to plant production;

(i) apply principles of genetics to plant production

(ii) apply principles of plant breeding to plant production

(C) illustrate the development of new crop varieties that are developed over time;

(i) illustrate the development of new crop varieties that are developed over time

(D) design and conduct investigations to test principles of genetics; and

(i) design investigations to test principles of genetics

(ii) conduct investigations to test principles of genetics

(E) identify and test alternative growing methods such as hydroponics and aquaponics used in plant production.

(i) identify alternative growing methods used in plant production

(ii) test alternative growing methods used in plant production