Agriculture Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in Agriculture

Domain 1.   Plant and Soil Science

Candidates demonstrate a broad understanding of principles of plant and soil science. Candidates apply this knowledge to plan and implement programs. Candidates are able to demonstrate an understanding of a range of topics in plant and soil science, including soil science; plant nutrition and soil treatments; plant classification, anatomy, and physiology; plant genetics, reproduction, and propagation; crop production practices; and emerging technologies in plant and soil science.

1.1   Characteristics, Components, and Properties of Soil
   a. Demonstrate knowledge of soil biology (e.g., soil food chains) and soil components (e.g., humus, sand, clay, silt) and their relevance for supporting plant growth.
   b. Demonstrate knowledge of properties of soil (e.g., texture, particle size, structure, pore space) and characteristics of different types of soil.
   c. Analyze the relationship of soil type and composition to crop selection and production.

1.2   Plant Nutrition and Soil Treatments
   a. Demonstrate an understanding of plant nutrition and the role of various nutrients (e.g., nitrogen, phosphorus, potassium) in plant growth.
   b. Demonstrate knowledge of how to conduct and interpret basic soil tests (e.g., fertility, texture, pH).
   c. Demonstrate knowledge of different types (e.g., organic, inorganic, slow release), forms (e.g., liquid, granule), uses, and formulations of fertilizer and other soil amendments.

1.3   Plant Classification, Anatomy, and Physiology
   a. Demonstrate an understanding of principles of plant classification and identification (e.g., using dichotomous keys) and characteristics of major plant groups (e.g., monocots, dicots).
   b. Demonstrate knowledge of types (e.g., forage, grain, tree, vine, vegetable), varieties, characteristics, and uses of agriculturally important crops grown in California.
   c. Demonstrate knowledge of the nature and functions of plant cells, structures, organs, and systems.
   d. Demonstrate an understanding of physiological processes in plants (e.g., photosynthesis, respiration, transpiration, transport of nutrients and water).
   e. Demonstrate knowledge of processes of plant growth and analyze factors that influence plant growth (e.g., water, light, temperature, pruning).

1.4   Plant Genetics, Reproduction, and Propagation
   a. Demonstrate an understanding of processes and structures involved in asexual and sexual reproduction in plants.
   b. Demonstrate knowledge of plant genetics, selective breeding, and hybridization.
   c. Demonstrate knowledge of methods and techniques of plant propagation (e.g., seeds, budding, grafting, division).

1.5   Crop Management and Production

   a.   Demonstrate knowledge of characteristics and uses of tillage, seedbed preparation, planting layout (e.g., raised bed, strip cropping), and planting methods.

   b.   Demonstrate knowledge of crop management methods and practices (e.g., drainage, irrigation, mulching, crop rotation, land classification) in the production of various crops.

   c.   Demonstrate knowledge of characteristics of plant pests, diseases, and weeds and methods for their control (e.g., chemical pest control, biological pest control, integrated pest management, cultivation).

   d.   Demonstrate knowledge of procedures for the safe handling, application, and disposal of agricultural chemicals.

   e.   Demonstrate knowledge of methods of harvesting common California crops and principles and procedures for post-harvest handling, processing, and storing of these crops.

   f.   Demonstrate an understanding of food safety issues and societal concerns regarding crop production (e.g., pesticide residues, contamination during picking and handling, irradiated food, transgenic crops) and alternative methods of crop production (e.g., organic farming).

1.6   Emerging Technologies in Plant Production

   a.   Demonstrate an understanding of new technologies in plant propagation (e.g., micro-propagation).

   b.   Demonstrate an understanding of new technologies for crop improvement (e.g., biotechnology, genetic engineering).

   c.   Demonstrate knowledge of new technologies used for crop management and production (e.g., remote sensing, precision farming, Variable Rate Technology [VRT], Geographic Information Systems [GIS], Global Positioning Systems [GPS]).

   (Draft Curriculum Standards for Agriculture [2004]: Standards 1.10–1.12, 3. California Agricultural Education Career Preparation Standards: Grades 11–12 [1995]: Plant and Soil Science Career Path Standards 1–7. Agriculture Teacher Preparation in California: Standards of Quality and Effectiveness [1999]: Standard 3.)

Domain 2.   Ornamental Horticulture

Candidates demonstrate a broad understanding of principles of ornamental horticulture. Candidates apply this knowledge to plan and implement programs. Candidates are able to demonstrate an understanding of a range of topics in ornamental horticulture, including greenhouse and nursery management, landscape design and management, and floriculture and floral design.

2.1   Greenhouse and Nursery Management

   a.   Demonstrate knowledge of types, varieties, characteristics, and uses of greenhouse and nursery crops (e.g., shrubs, flowers, bedding plants, potted plants) grown in California.

   b.   Demonstrate an understanding of the types, characteristics, uses, and care of greenhouse and nursery facilities, tools, and equipment, as well as methods for managing the greenhouse and nursery environments (e.g., water management; scheduling production; controlling temperature, light, and humidity).

   c.   Demonstrate knowledge of types, characteristics, uses, and preparation of growing media in greenhouses and nurseries.

   d.   Demonstrate knowledge of characteristics of pests, diseases, and weeds in greenhouses and nurseries, as well as methods for their identification and control (e.g., integrated pest management).

e. Demonstrate knowledge of production of greenhouse and nursery crops (e.g., propagating, transplanting, hardening off, pruning, forcing, controlling day length, fertilizing, watering).

2.2   Landscape Design, Construction, and Management
    a. Demonstrate knowledge of types, varieties, characteristics, and uses of plants (e.g., turfgrasses, annuals, perennials, shrubs, trees) and materials used in landscaping in California.
    b. Demonstrate knowledge of principles of landscape design, planning, and construction.
    c. Demonstrate knowledge of methods for selecting, planting, irrigating, caring for, pruning, and maintaining landscape plants and turfgrass.
    d. Demonstrate knowledge of types, characteristics, uses, and care of tools and equipment used in landscaping and turfgrass maintenance and installation.

2.3   Floral Design
    a. Demonstrate knowledge of varieties, characteristics, and uses (e.g., line, mass, filler, form) of flowers and foliage in floral design.
    b. Demonstrate knowledge of procedures for harvesting, handling, storing, and preparing cut flowers.
    c. Demonstrate an understanding of the basic elements (e.g., form, line, texture, space, color) and principles (e.g., balance, scale, proportion, rhythm, focal point, contrast, harmony) of floral design.
    d. Demonstrate knowledge of types, characteristics, uses, and care of facilities, tools, equipment, and materials used in floral design.

      (Draft Curriculum Standards for Agriculture [2004]: Standard 5. California Agricultural Education Career Preparation Standards: Grades 11–12 [1995]: Ornamental Horticulture Career Path Standards 1–6. Agriculture Teacher Preparation in California: Standards of Quality and Effectiveness [1999]: Standard 4.)

Domain 3.   Animal Science
Candidates demonstrate a broad understanding of principles of animal science. Candidates apply this knowledge to plan and implement programs. Candidates are to be able to demonstrate an understanding of a range of topics in animal science, including anatomy and physiology of livestock, animal production practices, animal nutrition, animal genetics and reproduction, and animal facilities management.

3.1   Anatomy and Physiology of Livestock
    a. Demonstrate knowledge of and compare the structure, function, and interrelationships of cells, organs, and organ systems in livestock (e.g., beef and dairy cattle, swine, sheep, horses, rabbits, poultry).
    b. Demonstrate an understanding of physiological processes (e.g., digestion, respiration) of organs and organ systems in livestock.
    c. Analyze the relationship between animal anatomy and physiology and the care of livestock (e.g., the relationship of the digestive system to nutrition and feeding practices, the relationship of the reproductive system to practices during parturition).
    d. Demonstrate knowledge of principles and procedures for evaluating livestock and carcasses.

3.2 Management and Veterinary Practices in Animal Production

a. Demonstrate knowledge of products derived from livestock and characteristics and uses of various species and breeds of livestock.

b. Demonstrate an understanding of safe, humane, and ethical management and veterinary practices and procedures in animal production (e.g., handling, castrating, dehorning, medicating) and of the public perception of animal welfare in animal production systems.

c. Demonstrate an understanding of characteristics of healthy and unhealthy animals, as well as types, causes, symptoms, preventive actions, and treatments of common infectious and noninfectious diseases in livestock.

d. Demonstrate knowledge of types, symptoms, effects, and life cycles of common internal and external pests and parasites and methods for preventing and treating pest and parasite infestations.

e. Demonstrate knowledge of harvesting and inspecting meat and other animal products.

3.3 Nutritional Requirements of Livestock

a. Demonstrate an understanding of the processes and stages of growth and development of livestock.

b. Demonstrate knowledge of sources and functions of animal nutrients and symptoms of nutrient deficiencies.

c. Demonstrate an understanding of the composition, classification, and nutritional value of various types of feed.

d. Analyze factors (e.g., species, age, pregnancy, lactation, optimal weight gain) influencing nutritional requirements and feeding options.

e. Demonstrate an understanding of types, functions, and effects of various feed additives (e.g., minerals, vitamins, antibiotics).

3.4 Animal Genetics and Reproduction

a. Demonstrate an understanding of basic principles of inheritance and genetics (e.g., Mendelian genetics; the genetic basis of animal selection; function of genes, chromosomes, and DNA; biotechnology and cloning).

b. Demonstrate an understanding of the processes of meiosis and fertilization.

c. Demonstrate knowledge of animal breeding systems, methods, and procedures (e.g., crossbreeding, artificial insemination, embryo transfer).

d. Demonstrate knowledge of the care of animals during gestation and parturition.

e. Demonstrate knowledge of factors that influence breeding decisions (e.g., phenotype, performance records).

3.5 Environmental and Facilities Management in Animal Production Systems

a. Demonstrate an understanding of environmental needs (e.g., range requirements, temperature control, appropriate housing) of livestock.

b. Demonstrate knowledge of different types, characteristics, and purposes of animal facilities, tools, technology, and equipment used in various animal production systems.

c. Demonstrate an understanding of procedures for managing waste (e.g., manure, carcasses) and maintaining sanitation in various animal production systems.

(Draft Curriculum Standards for Agriculture [2004]: Standards 1.4–1.9, 2. California Agricultural Education Career Preparation Standards: Grades 11–12 [1995]: Animal Science Career Path Standards 1–6. Agriculture Teacher Preparation in California: Standards of Quality and Effectiveness [1999]: Standard 2.)

Domain 4.   Environmental Science and Natural Resource Management

Candidates demonstrate a broad understanding of principles of environmental science and natural resource management. Candidates apply this knowledge to plan and implement programs. Candidates are able to demonstrate an understanding of a range of topics in environmental science and natural resource management, including basic ecological principles and natural resources; relationships between agriculture, the environment, and society; ecosystem and resource management; and forestry.

4.1   Basic Ecological Principles and Natural Resources
   a. Demonstrate an understanding of energy, water, and nutrient cycles and the concepts of niche, community, and ecosystem.
   b. Demonstrate knowledge of the interrelationship between environmental factors (e.g., climate, weather, habitat) and plant and animal communities.
   c. Demonstrate knowledge of types and characteristics of renewable energy and natural resources (e.g., wind power, forests, wildlife) and nonrenewable energy and natural resources (e.g., fossil fuels, minerals).
   d. Demonstrate an understanding of human and agricultural dependence on natural resources and principles and methods for the sustainable use of resources.

4.2   Relationships Between Agriculture, the Environment, and Society
   a. Demonstrate knowledge of impacts of agricultural production systems on the environment (e.g., runoff of fertilizers, water table depletion, salinization) and principles and methods for minimizing and mitigating environmental degradation.
   b. Demonstrate knowledge of the advantages and disadvantages of different production systems (e.g., monoculture, sustainable agriculture, organic agriculture).
   c. Demonstrate knowledge of the effects of environmental degradation on agricultural production (e.g., decreased productivity, loss of farmland, depletion of aquifers).
   d. Demonstrate basic knowledge of social, ethical, and legal issues (e.g., stewardship, use restrictions, landowner property rights) and the role of government agencies and private organizations (e.g., Environmental Protection Agency, land trusts, Sierra Club) relating to the use and management of ecosystems and natural resources.

4.3   Ecosystem and Resource Management
   a. Demonstrate knowledge of principles and methods of soil and water conservation and management (e.g., erosion control, water reclamation).
   b. Demonstrate knowledge of types (e.g., rangelands, forests, wetlands), characteristics (e.g., stability), and uses (e.g., grazing, mining, logging, recreation) of important California ecosystems, as well as principles and methods for their successful management.
   c. Demonstrate knowledge of principles and methods for wildlife management (e.g., identification of major wildlife species, habitat conservation and renewal).
   d. Demonstrate knowledge of principles and methods for the management of outdoor recreation areas.

4.4   Forestry
   a. Demonstrate knowledge of major types of forests in the United States, their characteristics (e.g., dominant tree species), uses (e.g., recreation, timber, watershed), and products (e.g., softwoods, hardwoods).
   b. Demonstrate knowledge of principles and methods of forest management (e.g., timber management, multiple-use management, urban forest management).

c. Demonstrate knowledge of the effects of social, economic, and political factors on forests.
d. Demonstrate an understanding of the causes, control, and importance of fire in the forest and wildland ecosystems (e.g., fire chemistry and behavior, fire control methods, the fire triangle, prescribed burning).
e. Demonstrate knowledge of tools and equipment used in forest and wildland management (e.g., compass, Global Positioning Systems [GPS], maps, surveying equipment, timber measurement tools).

(Draft Curriculum Standards for Agriculture [2004]: Standards 1.2, 7. California Agricultural Education Career Preparation Standards: Grades 11–12 [1995]: Forestry and Natural Resources Career Path Standards 1–7. Agriculture Teacher Preparation in California: Standards of Quality and Effectiveness [1999]: Standard 6.)

Domain 5.   Agricultural Business and Economics
Candidates demonstrate a broad understanding of principles of agricultural business and economics. Candidates apply this knowledge to plan and implement programs. Candidates are able to demonstrate an understanding of a range of topics in agricultural business and economics, including agricultural economics, marketing, and trade; agricultural entrepreneurship and management functions; agricultural business management; and government policies that affect agricultural businesses.

5.1   Agricultural Economics
a. Demonstrate an understanding of basic economic principles (e.g., supply, demand, elasticity, equilibrium) and their application to agricultural business.
b. Demonstrate an understanding of how government policies (e.g., tax policies, subsidies, tariffs) affect national and international agricultural businesses.
c. Demonstrate an understanding of how private and public organizations impact agricultural businesses.

5.2   Agricultural Marketing and Trade
a. Demonstrate an understanding of basic principles and strategies for marketing agricultural products (e.g., identifying target markets and market outlets, developing marketing plans).
b. Analyze factors affecting the purchase and sale of agricultural products and services (e.g., customer relations; merchandising; pricing, labeling, and displaying products).
c. Demonstrate knowledge of factors (e.g., governmental, economic, political, cultural) that affect international trade in agricultural products.

5.3   Agricultural Entrepreneurship and Leadership
a. Demonstrate an understanding of the role of entrepreneurship in agriculture and factors that are important for successful entrepreneurship.
b. Demonstrate knowledge of steps for establishing a successful business and the components of a business plan.
c. Demonstrate knowledge of business management functions (e.g., planning, organizing, directing, controlling, staffing) and types of business organizations and structures (e.g., sole proprietorship, partnership, corporation, cooperative).
d. Demonstrate knowledge of effective leadership styles, key concepts of group dynamics, team and individual decision making, and conflict resolution.
e. Demonstrate knowledge of work-related and business-related ethics.

f. Demonstrate knowledge of federal, state, and local agencies, laws, and regulations (e.g., environmental, liability, workplace safety, antidiscrimination, child labor, food safety and security) affecting agricultural businesses.

5.4   Agricultural Business Management, Record Keeping, and Accounting
a. Demonstrate an understanding of principles and procedures used for budgeting, analysis of cash flow, record keeping, and accounting in agricultural businesses.
b. Demonstrate an understanding of basic banking procedures and the types, sources, and costs of credit.
c. Demonstrate an understanding of types and benefits of insurance and other forms of risk management (e.g., hedging, forward contracting, diversification).
d. Demonstrate an understanding of basic principles and procedures of production management (e.g., scheduling, market forecasting, calculating production costs).
e. Demonstrate knowledge of human resources management (e.g., identifying sources and availability of labor, setting wages, fostering teamwork, valuing diversity).
f. Demonstrate knowledge of computer technology as a tool for decision making and office management in agricultural businesses.

(Draft Curriculum Standards for Agriculture [2004]: Standards 1.3, 4. California Agricultural Education Career Preparation Standards: Grades 11–12 [1995]: Agricultural Business Management Career Path Standards 1–9. Agriculture Teacher Preparation in California: Standards of Quality and Effectiveness [1999]: Standard 5.)

Domain 6.   Agricultural Systems Technology
Candidates demonstrate a broad understanding of principles of agricultural systems technology. Candidates apply this knowledge to plan and implement programs. Candidates are able to demonstrate an understanding of a range of topics in agricultural systems technology, including safety principles and practices, shop fabrication, construction, maintenance and operation of power equipment, and land measurement and irrigation systems.

6.1   Safety Principles and Practices
a. Demonstrate an understanding of principles and practices for the safe use, care, and maintenance of hand and power tools, machinery, and equipment used in agriculture.
b. Demonstrate an understanding of principles and practices for safely securing and hauling loads.
c. Demonstrate an understanding of principles and practices for the safe use, storage, and disposal of materials (e.g., solvents, fuels, paints) used in agriculture.

6.2   Shop Fabrication
a. Demonstrate knowledge of basic drafting principles and techniques, measurement methods, and layout techniques used in shop fabrication.
b. Demonstrate knowledge of types, properties, and uses of materials (e.g., metals, wood) used in shop fabrication.
c. Demonstrate knowledge of techniques and equipment for performing basic metalworking procedures (e.g., oxyacetylene cutting and welding, electric welding, plasma cutting).

6.3   Construction

   a. Demonstrate knowledge of procedures for designing and planning agricultural structures (e.g., siting, estimating, drawing plans) and measurement methods and techniques used in agricultural construction.

   b. Demonstrate knowledge of carpentry and concrete/masonry skills, principles, tools, methods, and materials.

   c. Demonstrate knowledge of electrical and plumbing skills, principles, tools, methods, and materials.

6.4   Maintenance and Operation of Power Equipment

   a. Demonstrate knowledge of the types (e.g., tractors, combines, discs, balers), characteristics, components, operation, and uses of various types of power equipment and implements used in agriculture.

   b. Demonstrate knowledge of the types (e.g., diesel, two- and four-stroke cycle), characteristics, components, uses, operation, and maintenance of internal combustion engines used in agricultural power equipment.

   c. Demonstrate basic knowledge of characteristics, components, and uses of power transmission systems used in agricultural power equipment.

   d. Demonstrate basic knowledge of characteristics and components of electrical/electronic systems used in agricultural power equipment.

   e. Demonstrate knowledge of basic principles of hydraulic systems used in agricultural power equipment.

6.5   Land Measurement and Irrigation Systems

   a. Demonstrate knowledge of basic principles, methods, tools, and equipment for surveying, mapping, land measurement, and land leveling.

   b. Demonstrate knowledge of types (e.g., sprinkler, drip, furrow), components (e.g., pumps, controllers, pipes), design, uses, installation, and maintenance of irrigation systems.

(Draft Curriculum Standards for Agriculture [2004]: Standard 6. California Agricultural Education Career Preparation Standards: Grades 11–12 [1995]: Agricultural Mechanics Career Path Standards 1–6, 8–9. Agriculture Teacher Preparation in California: Standards of Quality and Effectiveness [1999]: Standard 7.)

Part II: Subject Matter Skills and Abilities Applicable to the Content Domains in Agriculture

Candidates apply knowledge of scientific principles and methods, experimental design, measurement, and data analysis to investigate and understand agriculture-related problems and issues. Candidates understand and apply safety rules and practices in the classroom, laboratory, field, and Supervised Agricultural Experience (SAE) settings.

Candidates understand the integral relationships among classroom activities, FFA programs, and SAEs in the context of the local community. Candidates apply organizational, leadership, and communication skills to work effectively with groups and individuals (e.g., advisory committees, industry representatives, community organizations, student organizations, school leaders, elected officials). They understand the goals and purposes of SAE programs and the characteristics of different types of SAEs. They understand strategies for coordinating student SAEs and for supervising, advising, and supporting students during their experiences. Candidates understand the characteristics, functions, and organizational structures of student leadership development organizations (e.g., FFA) and their roles and responsibilities as advisors to these organizations. Candidates are able to effectively represent the agricultural program in individual and group settings in the school, community, and industry. Candidates are able to understand and respond to issues related to diversity, equity, and ethics in the agriculture program.

Candidates understand historical events, current research, and recent developments in agriculture. They are familiar with social, economic, legal, and ethical issues in the field. They apply strategies (e.g., accessing Internet resources, joining professional organizations) for staying abreast of current issues and developments in agriculture. They are able to identify industry trends and job opportunities, employers' expectations, and the personal characteristics (e.g., appropriate work habits, social and communication skills) necessary for a successful career in agriculture. They apply their knowledge to assist students in academic and career planning and development and in applying for, obtaining, and maintaining employment in agriculture and related fields.

Candidates understand the interrelationships and connections among the various subdisciplines of agriculture and between agriculture and other disciplines commonly taught in public schools. Candidates can identify and integrate themes and concepts among these disciplines and subdisciplines.