

A Framework for the AgSTEM Pathways

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## INTRODUCTION

The four pathways included in the Region 12 AgSTEM program provide a framework for the content, experiences and knowledge students will gain. Throughout the program, students will EVALUATE, CREATE, CALCULATE, RESEARCH, EXAMINE, ANALYZE, DESIGN, DISTINGUISH, DEFINE, SELECT, ASSESS, DEFEND, UTILIZE, CORRELATE, DIFFERENTIATE, PERFORM, COMPARE & CONTRAST, DEMONSTRATE, IDENTIFY,...

- Samples:
- DEMONSTRATE how to determine probability trait inheritance in animals.
  - ANALYZE how DNA characteristics can detect genetic effects in breeding stock.
  - DEVISE a strategy to communicate to different audiences, preventative maintenance and service schedule for equipment, machinery and power units.
  - CONSTRUCT and REPAIR metal structures and equipment using oxy acetylene welding equipment.
  - ANALYZE and INTERPRET hydraulic and pneumatic system symbols and diagrams...
  - PROPOSE and IMPLEMENT...food processing and distribution practices.
  - OUTLINE procedures to assign quality and yield grades to food products according to industry standards.
  - EXAMINE and RESPOND to consumer concerns about the inspection and harvesting techniques of animals using accurate information from regulatory agency approved techniques.
  - CALCULATE the amount of fertilizer to be applied based on nutrient recommendation and fertilizer analysis.
  - INTERPRET laboratory analyses of soil and tissue samples.
  - CONTRAST pH and cation exchange capacity between mineral soil and soilless growing media.
  - ANALYZE the factors that affect cellular respiration processes and rate in a crop production setting.
  - DEVISE plans for plant management that applies knowledge of transpiration, translocation and assimilation on plant growth.

CONDUCT tests associated with seed germination rates, viability, and vigor.

#### AGRISCIENCE PATHWAY 1:

##### **Plant Systems – The Study of Plant Life**

- Life cycles, classifications, functions, structures, reproduction, media and nutrients, as well as growth and cultural practices
- The study of crops, turf grass, trees, shrubs, and ornamental plants; including physiology, genetics, ecology, distribution, classification and economic importance
  - Soil and other plant growing media, identify and propagate horticultural plants: basics of growing horticultural plants in the greenhouse design landscape plans, hardscape construction techniques, install landscape plans, a basic understanding of building and managing a working hydroponics system
  - Life cycles of annuals, biennials, perennial plants; Propagation techniques; cutting, division, grafting and tissue culture; process of plant pollination and fertilization; conditions for germination
  - The science of managing soil and crop production, cultivation and breeding of crops, and conservation of resources
  - The science of plant physiology and energy conversion; cellular respiration; crop management
  - Environmental factors that impact healthy plant growth; soil structure; pH; measurement of light, effects of air, temperature, water and soil quality
  - Propagate, culture and harvest plants and plant products; develop and implement a management plan for plant production, including pest management; sustainable agriculture
  - Manage/calculate/plan for fertilization needs for healthy plants and crops
  - Greenhouse environmental controls/conditions – study of light, air movement, temperature, and humidity control in promoting plant growth; greenhouse business practices; preventative maintenance, monitoring, troubleshooting, repair associated with mechanical components
  - Plant anatomy
  - Principles of design; floral, forest, landscape and farm; importance of focal point, balance, proportion, scale, and appropriate conditions/storage of cut flowers; install plants according to a design plan; apply green technologies
  - Safety and appropriate handling of hand-tools and equipment in the landscape industry
  - Safety with agricultural chemicals and interpret container labels; maintain safety data sheets; Food Safety Modernization Act; distribution safety
- Tier 3 Vocabulary/Terminology: Plant metabolism, biometeorology, pH, N, P, K, hydraulic conductivity, irrigation, fertilizer, vegetative growth, root development, seed production, plant stress, mineral soil, scouting, taxonomic systems, hierarchical classification,

morphological characteristics, monocotyledons, dicotyledons, woody, herbaceous, annual, biennial, perennial, life cycle, growing zones, monocot, dicot, root system, nutrition, seeds, inflorescence, vascular tissue, photosynthesis, anatomy, leaf, blade, petiole, flower, stamen, pistil, stem, nodes, roots, root hair, meiosis, meiosis, xylem, phloem, cambium tissues, active and passive transports, cells, organelles, propagate, cuttings, division, separation, layering, budding, grafting, micropropagation, hybrid plants, genetically modified plants, seeding rate, disease-free, organic production, hydroponic, aquaponic, by-products, cellular respiration, transpiration, translocation, assimilation, self-pollination, sowing techniques, germination, pests, pesticides, USDA, sustainable, harvesting, crop maturity, marketability, grading, landscape ecology, profit margin, pricing guides, garden rake, leaf rake, shovel, spade, hand shears, loppers, rotary spreader, drop spreader, turf, nutrients, mow, thatch, aerate,

- Career Areas: Farm management, agricultural economics, agricultural engineering, botany, conservation of resources, land management, greenhouse management, forestry, crop farming, plant pathology, floriculture, agronomy, horticulture

## AGRISCIENCE PATHWAY 2:

### **Animal Systems – The Study of Animal Life**

- Animal life processes, health, nutrition, genetics, management, and processing
- The study of small animals, wildlife, exotic animals, livestock, dairy, horses, and poultry
  - Historic and current trends impacting animal science industry; animal origin, domestication, production practices and the environment
  - Breeds of dogs, pocket pets, sheep, goats, swine, domestic livestock, equine
  - Scientific developments of animal industries; major components of animal systems
  - Production methods; record management; marketing plans
  - Wildlife populations; ecological health; wildlife management methods
  - Laws impacting animal systems; sustainable practices; international trade; production policies
  - Animal husbandry and welfare programs
  - Animal behaviors; domestic livestock; companion animals
  - Animal housing; optimal environmental conditions
  - Safety procedures; bio-security
  - Feed rations; nutritional needs; optimal economic production
  - Ethics of feed additives; growth promotants
  - Production methods; organic; conventional
  - Breeding readiness and soundness; reproductive organs; age, size, life cycle, maturity, and health impacts; genetic inheritance; trait inheritance; artificial and natural methods; reproduction management systems; breeding values
  - Anatomy and physiology characteristics/functions
  - Animal health care; diseases; parasites; disorders; surgical, non-surgical veterinary treatments and procedures; wound management; antibiotic use
  - Zoonotic disease prevention
  - Safety with agricultural chemicals
  - Effects of animal agriculture on the environment
  - Management practices for non-livestock animal production
  - Animal system business; record management systems; marketing plans
  - Laws governing animal industries

- Tier 3 Vocabulary/Terminology: livestock, poultry, companion animal, adaptations, sustainable, conventional, humane, organic, animal welfare, systems: respiratory, circulatory, reproductive, endocrine, urinary, digestive, bio-security, zoonotic disease, wildlife, husbandry, trace-back, nutrients, feedstuffs, species, reproductive organs, reproduction, newborn, parturition, gestation, lactation, additives, promotants, genetic defects, DNA, natural breeding, artificial insemination, estrous synchronization, flushing, cloning, preventive measures, parasites, vaccination, binomial nomenclature system, taxonomic classification system, anatomical and physiological characteristics, aseptic techniques, wound management, carbon footprint
  
- Career Areas: Veterinary science, animal nutrition, animal management, livestock producer, livestock genetics, USDA inspector, meat science research, feedlot specialty, agricultural tourism, animal behavior, agricultural journalism, animal pathology

## AGRISCIENCE PATHWAY 3:

### **Food Products and Processing Systems – The Study of Food Safety & Sanitation**

- Food safety, sanitation, nutrition, biology, microbiology, chemistry and human behavior
- The study of food selection, processing for storage, distribution, consumption, and historical and current development of the food industry
  - Safety programs; Sanitation Standard Operating Procedures
  - Equipment used in food products and processing systems
  - Contamination hazards; quality assurance tests; food-borne pathogens; microbiological tests
  - Storage of food; documentation
  - Principles of nutrition; taste; appearance; value
  - Chemical and physical properties; biochemistry
  - Wholesome, nutritious food supply
  - Food label requirements
  - Food storage, distribution; inspection techniques
  - Grades of food products
  - Food Safety Inspection Service guidelines
  - Quality control inspection
  - Food processing, preservation, packaging and presentation
  - Measurement of weights; conversions
  - Distribution plans; environmental impacts; market demands
  - Food industry; scope – historical; current
  - Legislation; regulatory agencies; labeling; GMOs; biosecurity; irradiation; microorganisms
  - Culturally sensitive food
  - Consumer concerns
- Tier 3 Vocabulary/Terminology: Sanitation Standard Operating Procedures (SSOP), Good Manufacturing Practices (GMP), contamination, quality assurance tests, food-borne pathogens, microbiological tests, food constituents, proteins, carbohydrates, fats, vitamins, minerals, additives, regulation, economics, biochemistry, double-blind testing, consumer preferences, yield grades, quality grades, pre-mortem, post-mortem inspections, English and metric measurements, automation, biotechnology, Genetically Modified Organisms, irradiation, microorganisms

- Career Areas: Food Science, Meat Processing, Food Inspection, Biochemistry, Meat Grading, Microbiology, Quality Control

AGRISCIENCE PATHWAY 4:

**Power, Structural and Technical Systems – The Study of Agricultural Equipment & Power Systems**

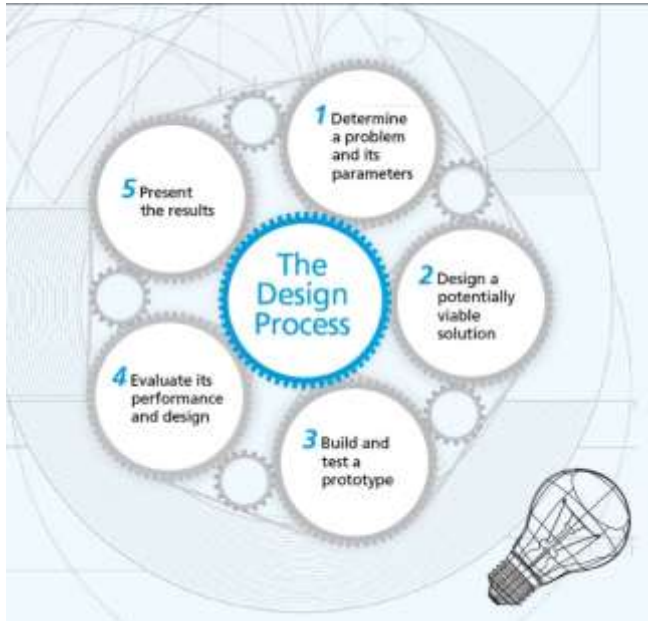
- Agricultural equipment, power systems, alternate fuel sources and precision technology
- The study of woodworking, metalworking, welding and project planning for agricultural structures
  - Physical science; engineering principles
  - Energy sources
  - Energy benchmarking; energy conservation
  - Efficiency of renewable/non-renewable energy sources
  - Environmental impacts
  - Conversions; CCF, KWH, Btu
  - Safe and efficient mechanical systems
  - Uses of woodworking tools
  - Business aspects; cost analysis
  - Safe uses of tools, machinery and equipment
  - Metal fabrication; SMAW, GMAW, GTAW, fuel-oxygen, plasma arc torch
  - Preventative maintenance
  - Engine specifications; service and repair
  - Combustion engines
  - Units of electricity
  - Ohm's Law; Power Law
  - Electrical control circuit
  - Power; structural; technical systems
  - Symbols; Sketches; Structures
  - Drafting software; computer-aided design; robotics; CNC; UAS; programmable logic controllers
  - Construction; materials; concrete; brick; stone; masonry
  - Fencing; wood, static, wire, electrical wire
  - Plumbing; pipes; equipment
  - Measurement; amps, volts, watts
  - Geospatial technologies; precision technology



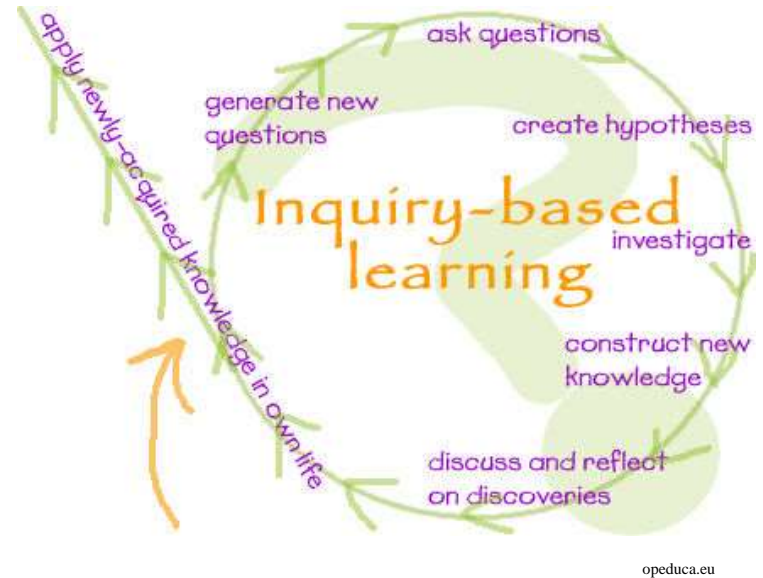
- Tier 3 Vocabulary/Terminology: circular saw, belt sander, router, portable drill, miter saw, rafters, trusses, scale drawing, square feet, forms, finishing, curing, amps, volts, watts, ohms, CCF, Btu, EUIs, electrical circuits, electrodes, duplex receptacle, single pole switch, three-way switch, soldering, sweating, copper, PVC, PEX, gas metal arc welding, shielded metal arc welding, current, arc length, travel speed, renewable energy, nonrenewable energy, oxy acetylene welding equipment, belts, drives, hoses, lines, nozzles, chains, sprockets skid steers, computer-based diagnostics, manuals, combustion engines, two-stroke, four-stroke, spark-and-compression, battery, resistor, diode, transistor, capacitor, hydraulic, pneumatic, transmission, steering, suspension; computer-aided design; robotics; unmanned automated systems; programmable logic controllers; global positioning systems
  
- Career Areas: Diesel mechanics, machine operations, agricultural and civil engineering, heavy equipment maintenance technicians, equipment and parts management, welding, machine maintenance, GPS technicians, remote sensing specialists

## **A Commitment to STEM (Science, Technology, Engineering, and Mathematics)**

- In addition to the pathway standards, AgSTEM curriculum will also include Next Generation Science Standards (NGSS), Engineering by Design, and Engineering Habits of Mind.
  
- Curriculum will address the following Essential Understandings:
  - Engineering is used as a context for exploring science, technology, and mathematics.
  - Engineering drives invention and innovation.
  - The Design Process illustrates how engineering improves life.
  - Technologies cannot exist without engineering.
  - Engineering is collaborative.
  - Scientific investigation and engineering design are closely related and mutually reinforcing.
  
- Curriculum will also include the following Engineering Habits of Mind:
  - Systems thinking, modeling, and analysis
  - Creativity
  - Optimism
  - Collaboration
  - Communication
  - Ethical Considerations



Alison Mackey/Discover; Thinkstock



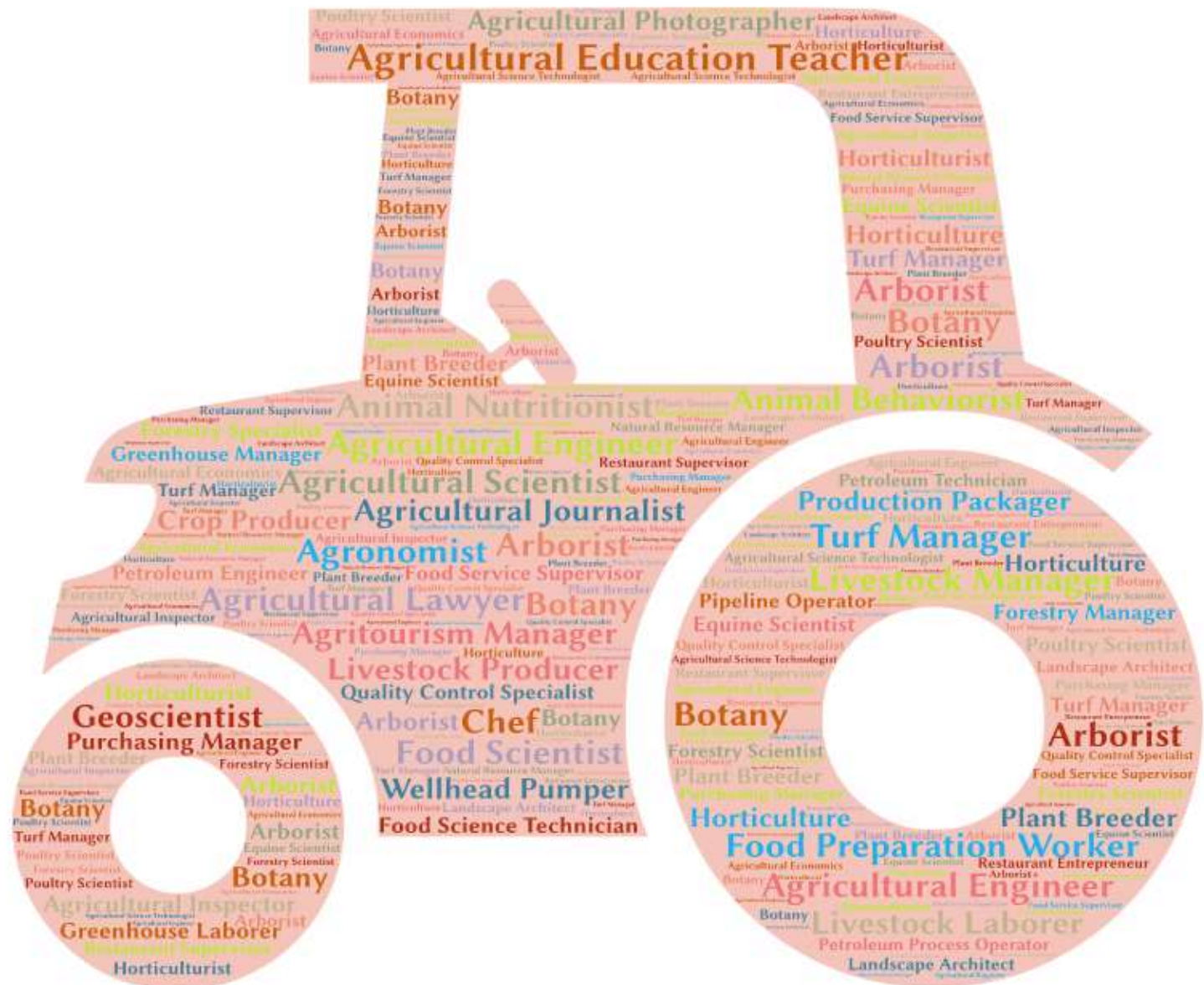
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## MAXIMIZING DESIGN & INQUIRY IN THE INTEGRATIVE STEM CLASSROOM

- Engage** – experience, question, stimulate
- Explore** - predict, experiment, observe, discover, record, retest, discuss
- Explain** - develop, progress, grow
- eNGINEER** - **apply, conceptualize, informed design, modeling, create**
- Enrich** – interact, question, hypothesize, experiments, record observations, draw conclusions
- Evaluate** – analysis, synthesis, re-visit

➤ Linked to Next Generation Science Standards:

- High School Life Science 1.1: Structure & Function: *Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.*
- High School Life Science 1.5: Energy & Matter: *Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants. Examples of models include diagrams, chemical equations and conceptual models.*
- High School Life Science 2.2: Scale, Proportion, and Quantity: *Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.*
- High School Life Science 3.1: Cause & Effect: *Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.*
- High School Life Science 3.3: Scale, Proportion, and Quantity: *Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.*
- High School Physical Science 3.5: Cause & Effect: *Develop and two objects interacting through electric fields to illustrate forces between objects and changes in energy of the objects. Determine what happens when two charges of opposite polarity are near each other.*
- High School Engineering, Technology and Applications of Science 1.3: *Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including costs, safety, reliability, and aesthetics as well as possible social, cultural and environmental impacts.*
- High School Engineering, Technology and Applications of Science 1.4: Systems & Systems Models: *Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.*



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