CHAPTER 3

NATIONAL FFA

AGRICULTURAL MECHANICS

CAREER DEVELOPMENT EVENT

A Special Project of the National FFA Foundation

IMPORTANT NOTE

Please thoroughly read the Introduction Section at the beginning of this handbook for complete rules and procedures that are relevant to all National FFA Career Development Events.

I. PURPOSE

Technological advances in America continue to influence the way students must prepare for their futures. Students entering the workforce need a strong knowledge base and the ability to comprehend the interaction of complex systems. Employers want productive workers and managers that can access and use a broad range of information. The most sought after employees are those who communicate effectively, continue to stay current with modern technology and work successfully as individuals and as team members. Students with these skills and abilities are more competitive in the job market, receive financial rewards and are selected for advancement.

An agricultural mechanics education is comprised of strong technical content and complimented by the development of practical, hands-on skills. The subject matter areas and skill development practices have been grouped into five 'systems' areas, so named because of the complex interaction and synergistic processes common to agriculture mechanics. The term 'system' is used to emphasize the interactive relationship between each area of agricultural mechanics. These five systems areas are described and examples appear on the pages that follow.

Each agricultural mechanics activity is in response to a problem or need encountered in the workplace. The solving of such problems is dependent upon how each decision or solution, imposed on one component, will influence the other system components. Solving one component of a problem without using a 'systems approach' can, and often does, result in additional problems. An example of where this has occurred is observed in the many obstacles that agricultural producers currently face regarding environmental pollution, ground water contamination and stricter

governmental regulations. Decisions and solutions made earlier in this century have impacted the environment negatively and resulted in a new set of problems.

The National FFA Agricultural Mechanics Career Development Event recognizes students with agricultural mechanics competencies important to the modern workplace. The technical content and required skills continue to include all traditional areas of agricultural mechanics. Additionally, the operation of modern equipment, the application of new management strategies and the mastering of advanced technologies are increasingly emphasized. This career development event selects and awards those students and teams that demonstrate: (1) mastery of the subject matter and skills common to the systems areas (2) effective communication skills (3) superior problem solving techniques (4) an understanding of modern technology (5) the ability to function as team members working together and as individuals working alone.

Information specific to each annual event is available on the National FFA Agricultural Mechanics Event web page at http://web.missouri.edu/~pavt0689/natcon.html. This web site is updated in June, August and November of each year.

II. EVENT FORMAT

A. Team Make-Up

Teams may consist of three or four members. Team ranking is determined by combining the scores of the top three students from each team. Teams having fewer than three members, for whatever reason(s), are not eligible for team awards, but students may receive individual awards.

B. Equipment

1. Needed- Safety Materials Students Must Provide

Each event participant must adhere to the safe practices and work habits appropriate when performing required activities. Participants are responsible and must provide all personal safety equipment including:

a. Industrial-quality eye protection

INDIVIDUALS MUST WEAR STYLE B (SEE BELOW) INDUSTRIAL-QUALITY EYE PROTECTION during the team activity and the skill/problem solving activities. Those with prescription eyewear that is not Style B must also wear safety glasses or goggles while participating in this event. Safety glasses do not have to be worn while completing the written exam. Acceptable spectacles or goggles must adhere to the American National Standard Practice for Occupational and Education Eye and Face Protection, Z87.1-1979 (or Z87.1-1968) and revisions approved by ANSI. Descriptions of style A, B, and C Industrial Quality Eye Protection are as follows:

Style A. NOT ACCEPTABLE for use in the event. These are safety spectacles without side shields. They are for limited-hazard use requiring only frontal protection. The addition of accessory side shields that are not firmly secured does not upgrade style A to a style B or C.

Style B. Safety spectacles with wire mesh, perforated plastic or non-perforated side shields. The side shields shall be tapered, with an anatomical periphery extending at

least halfway around the circumference of the lens frame. Industrial-quality eye protection for those not wearing prescription glasses shall be style B.

Style C. NOT ACCEPTABLE for use in the event. Safety spectacles with semi- or flat-fold shield that must be firmly secured to the frame. style C glasses do not provide maximum protection from the top and bottom angles.

b. Clothing

Each individual shall furnish and wear appropriate clothing such as long pants and long sleeved cotton shirt, coveralls, etc. for this event. Clothing must be in good repair and fit properly. Oversized or loose fitting clothing is dangerous around agricultural equipment and is not allowed. Long-sleeves must be worn when welding or oxy-fuel cutting.

c. Other Materials

Each participant must have a clipboard, two sharpened No. 2 pencils and an electronic calculator. Calculators used in this event should be battery operated and silent.

d. Computers

Each state team is required to provide a laptop computer and printer for the team activity. Minimum computer specifications will be determined.

2. **Provided- Specialized safety equipment**
   a. Necessary equipment such as helmets, shields, gloves, welding leathers, hearing protection devices, etc., will be provided by the National FFA Agricultural Mechanics Career Development Event Committee.
   b. All tools and equipment will be furnished for the event. Individuals are allowed to use only the tools and equipment furnished by the national event committee.
   c. If a team member needs modified equipment due to physical size and stature, the student must supply this equipment. The team member or coach must present the student supplied equipment to the event superintendent prior to the start of the event for approval. Team members who need specialized or modified equipment due to disability as defined by the American Disabilities Act must submit the appropriate special needs request form and documentation with the team's certification form.

C. Event Areas

The National FFA Agricultural Mechanics Career Development Event is divided into the following five systems areas. Each system includes a broad range of information and performance skills common to agricultural mechanics.

1. **Machinery and Equipment Systems**: repair and maintenance, materials handling, processing, adjustments, metal fabrication

2. **Industry and Marketing Systems**: customer relations, accounting, communication, economics, service, sales, reading and interpreting regulations, safety, operating instructions, manufacturer's recommendations
3. **Energy Systems**: mechanical power, electrical power, chemical power, wind power, solar power, hydraulic power, engine operation, maintenance, trouble-shooting, repair
4. **Structural Systems**: structures, storage, concrete, masonry, plumbing, electrical, construction, building materials, ventilation, heating, air conditioning
5. **Environmental-Natural Resource Systems**: water quality, sustainable agricultural practices, soil and water conservation, waste handling

D. Team Activities

The individuals on each state team will work together and be evaluated as a team while solving complex, multi-system agricultural problems. The problem scenario is presented to the team on the day of the events and members utilize the materials and equipment provided to undertake and prepare a written, computer mechanics generated solution. Teams organize themselves, assigning duties and completing tasks together or separately depending on individual skills and abilities. Each team receives a score, and each team member receives one-third of the total team score.

E. Individual Activities

1. **Individual problem solving and skill development activities**
   Each student is individually evaluated in each of the five systems areas. The specific activities occurring in each event are not publicized prior to the event. Each student is allowed 20 minutes to complete each of the five activities (100 minutes total).
2. **Written examination**
   Each student completes an examination that consists of 100 multiple-choice questions. There are 20 questions from each of the five agricultural mechanics systems areas. Students will have 70 minutes to complete this portion of the career development event.

F. Schedule of Theme Announcement

Agricultural mechanics theme for the career development event will be selected one year in advance. This information is published and distributed through the National FFA Organization, and posted at http://web.missouri.edu/~pavt0689/natcon.html, the agricultural mechanics web site. The theme for each year will be determined by the National FFA Agricultural Mechanics Career Development Event Committee. The event superintendent will notify the National FFA Program Manager for Career Development Events of the theme selected for the next year's event following the completion of the current year's event.

The specific theme for each year is posted on the web site during November of the previous year and information specific to each year's event is updated periodically throughout the year. Updates generally occur during June and August. The schedule for announcing event information and details on equipment selection is governed by equipment availability and late changes by equipment manufactures, dealers and contributors. It is the committee's hope that the theme examples listed below will provide direction for students and their advisors. This short list should not stifle or limit the learning or instructional process as students and advisors prepare themselves to solve integrated system problems in the workplace of today and tomorrow.

Themes

The schedule for agricultural mechanics themes is:

Animal Production Systems	2006
Materials Handling Systems	2007
Processing Systems	2008
Plant production Systems	2009
Integrated Pest Management	2010

An example of the *integrated pest management* theme appears on page 57 at the end of this section. This example illustrates the complex interaction between systems in a typical theme. An individual solving a pesticide application problem must consider numerous variables and make a variety of decisions. The following list includes some of the systems competencies needed during the planning, preparation and implementation of the problem solution. Many other competencies exist and identical competencies may be required in more than one system.

Machinery and Equipment Systems- application and equipment calibration, and nozzle selection, equipment testing and maintenance

Industry and Marketing Systems- mixing, loading, and transport safety, economics, understanding and following label instructions, governmental regulations

Energy Systems- power requirements, variable rate applications, and electronically controlled equipment, and valves, pumps and pressure regulators

Structural Systems- storage, mixing and loading requirements, fire safety, temperature control, ventilation, construction requirements

Environmental and Natural Resource Systems- pesticide and pesticide container disposal, pesticide handling, drift control, impact on non-target plants, animals and insects

III. SCORING

Event participants are evaluated as follows:

INDIVIDUAL SCORING

Written examination 100
Individual activities (5 at 30 points each) . . . 150
Team activity (1/3 of total team score) 83.3
Total Possible Individual Score 333.3

TEAM SCORING

Top three written examinations 300
All individual activities for top three. 450
Team activity 250
Total Possible Team Score (top three). . . . 1000

IV. TIEBREAKERS

The team score for the event will be determined by summing the points earned by the top-three team members. The following activities are used to break a tie between teams or individuals. The win goes to the individual or team with the highest written examination score(s). If still tied, the win goes to the highest problem-solving/skill scores. If still tied, the win goes to the highest team problem-solving score.

V. AWARDS

The top five individuals and the top five teams in each of the five systems areas will be recognized with a certificate. The scores used to award this recognition include the exam questions and individual problem-solving/skill activity associated with each system area.

Awards will be presented at an awards ceremony. Awards are presented to teams as well as individuals based upon their rankings. Awards are sponsored by a cooperating industry sponsor(s) as a Special Project, and/or by the general fund of the National FFA Foundation.

VI. REFERENCES

This list of references is not intended to be inclusive. Other sources may be utilized and teachers are encouraged to make use of the very best instructional materials available. The goal of the National FFA Agricultural Mechanics Career Development Event is to guide and promote quality instructional programs in agricultural mechanics. The following list contains references that may prove helpful during event preparation. The multiple-choice test questions are written to be generic in nature and are selected from a variety of sources. It is the intent of the national event committee to reflect current technological practices, common to the agricultural production industry.

FOS. John Deere.

FMO John Deere

Agricultural Power and Machinery.(CD format) CEV Multimedia. LTD.

Mechanics in Agriculture. Interstate Publishers.

Agricultural Mechanics Fundamentals and Applications. Delmar Publishers.

Modern Agricultural Mechanics. Interstate Printers and Publishers.

Developing Shop Safety Skills. American Association for Vocational Instructional Materials.

Power Tool Safety and Operation. Hobar.

Agricultural Mechanics I Lesson Plans. UMC-IML.

Agricultural Mechanics II Lesson Plans. UMC-IML

Agricultural Buildings and Structures. Reston Publications.

Practical Farm Buildings. Interstate Publishers.

National Electrical Code (latest edition). NFPA.

Agricultural Structures, *Volumes I and II*. UMC-IML.

National FFA Agricultural Mechanics website:

http://web.missouri.edu/~pavt0689/natcon.html

VII. EXAMPLES

A. Event-Related Competencies

The following list of statements with specific understandings and performances are provided as examples for the systems areas identified. Examination questions are primarily developed from "problem solving" categories. The "skills" categories are the basis for performance activities. Problem-solving activities are developed from both "problem solving" and "skills" categories. In each systems area, the requirements for effective communication, problem solving activities and the application of modern technology - specifically computers and computer software - are strongly emphasized. Industry has recently identified important skills, abilities and competencies needed by new employees. These important attributes are described following the list of system competencies.

1. Machinery/Equipment Systems Competencies

Problem Solving

1. Identify safe machinery operation practices for field and highway conditions.
2. Identify the recommended service and maintenance operations from the operator's manual.
3. Select lubricants for machinery and equipment.
4. Identify functions of machinery components.
5. Identify parts and functions of hydraulic systems.
6. Identify and compute harvest losses.
7. Prepare machinery for storage.

8. Identify and select reduced tillage and conservation tillage equipment.
9. Explain principles of machinery management.
10. Describe functions of chemical application, fertilizing, harvesting, materials handling, processing, planting, seeding and tillage equipment.
11. Select arc welding machines and accessories.
12. Read drawings and welding symbols.
13. Control distortion in arc welding.
14. Select appropriate electrodes and wires.
15. Select hard surfacing alloys.
16. Prepare materials and equipment for arc welding.
17. Test weld quality and strength.
18. Select shielding gases.
19. Describe the science of the welding processes.
20. Select gas welding, plasma arc and cutting equipment and supplies.
21. Assemble gas welding, plasma arc and cutting equipment.
22. Check equipment for leaks.
23. Select welding rods and fluxes.
24. Select hard surfacing alloys
25. Start-up and shut down of welding equipment.
26. Select shielding gases.
27. Describe the science of welding and cutting processes.
28. Describe cylinder sizes and gas flow extraction rates. Calculate the volume of acetylene that can be delivered per cylinder per hour.
29. Explain the functions of flashback arresters and reverse flow check valves.
30. Identify appropriate shapes of tool and equipment cutting edges.
31. Select abrasives for grinding and sharpening.
32. Describe the application of simple machines to cutting edges.
33. Identify safe adjustment [level] on power equipment.
34. Identify kinds of metal used in tool construction.
35. Identify various types and shapes of metals.
36. Select soldering equipment and tools.
37. Prepare metals for soldering.
38. Identify hand metal working tools by types and sizes.
39. Determine tap and drill sizes.
40. Select files and saw blades.
41. Read metal working plans and prints.
42. Identify metal alloys and their strength.
43. Identify and select power shears, benders, brakes and saws.
44. Calculate materials costs.
45. Identify pipe, valves and fittings by type.
46. Select pipe threading and cutting tools.
47. Select types of pipe and tubing.
48. Calculate lengths of pipe.
49. Joining dissimilar plumbing materials.
50. Select pipe sizes to meet pressure and flow requirements.
51. Select valves and controllers for turf and drip irrigation systems.
52. Identify and select pipe sealants.
53. Identify characteristics and applications of fiberglass and plastic.
54. Identify types of damage that can occur to fiberglass and plastic.
55. Identify repair procedures and techniques.
56. Select repair material needed for specific jobs.
57. Identify the appropriate tools to use when welding plastics.
58. Identify the types and properties of plastics.

Skills

1. Check and adjust driveline components.
2. Adjust equipment hitches and drives.
3. Install, adjust and service belt and chain drives.
4. Select and use test equipment including meters, tachometers and timing devices to determine proper machine operation.
5. Adjust and/or calibrate chemical application, seeding, fertilizing, harvesting, processing and materials handling machinery.
6. Operate, test and maintain machine systems.
7. Install, adjust and evaluate machine systems.
8. Inflate tires to proper air pressure to carry the heaviest load.
9. Adjust equipment to field and crop condition.
10. Identify different types of metals.
11. Layout and prepare metal for arc welding.
12. Recommending metals based on load bearing strength
13. Weld basic joints in all positions.
14. Join pipe for welding.
15. Prepare for and apply hard surfacing alloys.
16. Adjust cutting machines for different metals, joints and thickness.
17. Start-up and shut down for welding equipment.
18. Light and adjust the torch flame for specific welding or cutting operations.
19. Layout and prepare metal for welding or cutting.
20. Fuse and braze welding basic joints on mild steel and cast iron.
21. Cut mild steel, including pipe, all shapes.
22. Join steel pipe, tubing or shapes by welding.
23. Estimate and calculate welding materials costs.
24. Adjust machines for various types of thickness of metal.
25. Identify the type of metals used in agricultural instruction.
26. Cut metal with plasma cutting unit.
27. Prepare grinding and sharpening equipment.
28. Recondition hand tools such as hammers, twist drills, chisels, punches and screwdrivers.
29. Recondition keen edge wood cutting tools.
30. Recondition keen edge metal cutting tools.
31. Recondition chain saw, horticultural and turf cutting tools.
32. Recondition rotary lawn mower blades.
33. Adjust bed knife on reel mowers.
34. Solder copper joints and sheet metal.
35. Solder electrical connections.
36. Join metals with appropriate fasteners.
37. Cut threads with taps and dies.
38. Layout and drill holes with twist drill.
39. Operate power tools such as nibblers, drills and saws.
40. Operate hand tools such as saws and files.
41. Bend sheet and strap steel to angles or shapes.
42. Repair damaged threads.
43. Select appropriate metals for projects (strength).
44. Shape hot and cold metals using power shears, benders, brakes and saws.
45. Cut and assemble plastic pipe.
46. Cut, thread and assemble steel pipe.
47. Connect flare and compression fittings.
48. Solder copper fittings and tubing.
49. Assemble dissimilar plumbing materials.

50. Installing and setting programmable timers.
51. Select tools and materials for specific repair jobs.
52. Repair structural or cosmetic damage using proper materials.
53. Select and use appropriate safety equipment.
54. Fuse plastic parts using plastic welding processes.
55. Construct plastic projects.
56. Compile thermoplastic welds.
57. Weld plastic using hot air method.
58. Identify the types of plastics to be welded.
59. Describe the methods of welding plastics.
60. Select and use plastic welding equipment.
61. Identify weldable plastic by burn tests.
62. Weld plastics using the basic weld parts.

2. Industry and Marketing Systems Competencies

Problem Solving

1. Complete and interpret pre-delivery and delivery instructions.
2. Describe importance of customer relations and communications.
3. Comprehend cab and environment controls (air conditioning and heating).
4. Compare costs of ownership, lease, rental and custom agreements.
5. Interpret and follow recommended service and maintenance schedules.
6. Determine proper practices and procedures for storing an engine.
7. Use of operator's manuals.
8. Identify safe machinery operating practices.
9. Select machinery parts using manufacturer's catalogs, microforms, microfiche or computers.
10. Evaluate building warranties.
11. Determine finance and insurance needs.
12. Identify and be able to describe safety practices.
13. Read and interpret drawings, plans, symbols and figuring of bill of materials.

Skills

1. Adhere to safe operating practices during the completion of all activities.
1. Perform pre-delivery setup and adjustment.
2. Demonstrate interaction with customer/ fellow employee.
3. Identify and use international operator symbols.
4. Adjust operator controls for best fit.
5. Select appropriate tools and equipment.

3. Energy Systems Competencies

Problem Solving

1. Identify safe machinery operation practices for field and highway conditions.
2. Identify the recommended service and maintenance operations from the operator's manual.
3. Describe how to repair a specific component or system.
4. Select fuels, lubricants, hydraulic fluids and coolants for proper operation.
5. Identify importance of oil analysis as a management tool.
6. Operation and interpretation of circuit diagrams and flowcharts for: electrical, hydraulic, fuel, oil, cooling, intake and exhaust systems.
7. Identify the function and operating principles of clutches, transmissions, control devices and brakes.
8. Explain and describe principles of power transmission.

9. Identify the parts and functions of electrical, hydraulic, lubrication, cooling, governor and fuel systems.
10. Interpret horsepower, torque and other power measurement criteria.
11. Identify and use OECD (Organization for Economic Cooperation and Development) *and/or Nebraska Tractor Test results.*
12. Interpret metric units in measurements.
13. Select proper ballast and machinery weighting.
14. Compare costs of alternative machine uses.
15. Understand interactive electronic components.
16. How to use load/inflation table for tires *(constant deflection table).*
17. Describe operating principles of two-stroke and four-stroke spark or compression ignition engines.
18. Identify the use and function of engine repair tools.
19. Evaluate engine performance under load and no-load operation.
20. Evaluate engine parts or short blocks for replacement or servicing.
22. Determine hydraulic cylinder force and speed.
23. Use appropriate standards for agricultural applications, including the National Electrical Code (NEC), Electrical Testing Laboratory (ETL), Factory Mutual, Underwriters Laboratory (UL), Canadian Standard Association (CSA) and/or OSHA standards.
24. Plan safe electrical circuits.
25. Select conductor type and size for specific applications.
26. Calculate voltage drop.
27. Determine electrical power requirements.
28. Identify the characteristics of single and three-phase circuits.
29. Plan and evaluate proper grounding systems and ground-fault protection.
30. Determine volt, amp and ohm relationships (Ohm's and other application laws).
31. Select adequate and appropriate lighting fixtures.
32. Make connections in a computer-simulated wiring task.
33. Select motors based upon type of application.
34. Interpret electric motor nameplate data.
35. Service electric motors.
36. Identify electric motors and motor parts.
37. Identify methods of providing electric motor protection.
38. Interpret power (horsepower, kilowatt), power factor, torque and other motor selection criteria.
39. Select, size and isolate standby power generators.
40. Calculate heating and cooling loads.
41. Interpret wiring diagrams.
42. Identify and describe basic principles of controls including thermostats; humidistat; photoelectric; magnetic relays; programmable controllers; proximity switches and sensors; ultrasonics; timers and other time-delay equipment; and pressure, motion, limit, float and sail switches.
43. Select controls from supply catalogs, microforms, microfiche or computers.
44. Select controls for electrical applications.
45. Use low-voltage electrical control equipment.
46. Identify and select devices for automated systems.
47. Select aquaculture air delivery systems.
48. Select aquaculture water heating devices.

49. Determine water filtration needs.
50. Establish ballast and tire pressures.
51. Use safe wiring practices for specific applications.
52. Select standby power generators and isolation equipment for specific applications.
53. Match tractors to implements.

Skills

1. Connect electrical and hydraulic motor drives.
2. Conduct a pre-operation inspection of a tractor.
3. Starting, stopping and operating machinery engines.
4. Perform recommended periodic service jobs (as found in operator's manuals).
5. Use measuring tools and test instruments such as: micro metering and telescoping gauges, dial indicator, compression tester, torque wrench, VOA (volt-ohm-amp)-meter, DMM (digital multi-meter), timing devices, tachometer and dynamometer for determining test procedures.
6. Test and troubleshoot electronic sensing devices.
7. Remove, service and replace electrical components.
8. Test and service batteries, charging, lighting, warning and cranking systems.
9. Test and service cooling systems.
10. Make hitch and PTO adjustments to the implement.
11. Adjust wheel tread spacing.
12. Adjust steering linkage.
13. Match tractors to implements.
14. Conduct on-board tractor monitor checks as identified in operator's manual.
15. Test and service air conditioning systems.
16. Test engine for emissions.
17. Select and use engine overhaul equipment, including valve, cylinder, piston, seal and bearing tools.
18. Service and maintain fuel, air intake and exhaust, cooling and lubrication systems.
19. Operate engine and adjust or check ignition timing, engine speed and carburetor adjustments.
20. Read schematics and sketch wiring circuits.
21. Attach conductors to terminals.
22. Install plugs and cord connector bodies.
23. Make proper splices and connections.
24. Troubleshoot electrical circuits using proper testing equipment and measuring devices.
25. Measure electrical circuits for voltage, amperage, resistance and wattage.
26. Install service entrance for single phase 120/240 V service or three-phase power.
27. Wire 120/240V service outlets.
28. Install electrical circuits, switching devices and appliances.
29. Install ground-fault circuit interrupters.
30. Make connections in a computer-simulated wiring task.
31. Troubleshoot electric motor circuits using proper testing equipment.
32. Connect a dual voltage motor to power source.
33. Change the direction of electric or hydraulic motor rotation.
34. Disassemble and reassemble an electric motor.
35. Provide suitable motor over-current protection.
36. Service and lubricate and electric motor.
37. Check the running amperage and voltage of a motor.
38. Select and mount an electric motor on a machine.
39. Connect electric motor controls.

40. Install timer circuits and automation devices.
41. Install thermal and solid-state delay/relay controls.
42. Install a low-voltage motor control system.
43. Install sensing devices including thermostats, humidistat; photoelectric; magnetic relays; programmable controllers; proximity switches and sensors; ultrasonic; timers and other time delay equipment; and pressure, motion, limit, float and sail switches.
44. Wire devices that are capable of providing artificial heat.
45. Select and install aquaculture control and sensing systems.

4. Environmental and Natural Resources Systems Competencies

Problem Solving

1. Identify environmental problems in livestock and crop handling and processing buildings.
2. Read and interpret maps including conservation, land use, soils, topographic, aerial and remote sensing and geological surveys.
3. Describe principles involved in appropriate conservation and/or land use planning.
4. Read legal land descriptions.
5. Determine land areas.
6. Identify the types and parts of leveling instruments.
7. Determine the difference in elevation of two or more points.
8. Determine cuts, fills, cut/fill ratios and volumes.
9. Describe the characteristics of a profile-leveling plot.
10. Identify water quality criteria for aquaculture.
11. Read and interpret a topographic map.
12. Select terracing and water diversion options for soil conservation.
13. Selecting strip-cropping principles and practices.
14. Select water management techniques including grassed waterways, parallel terrace outlets, tile outlet systems and erosion control structures.
15. Determine types of vegetative cover and mulch for erosion stabilization.
16. Determine and select appropriate cultural tillage or mechanical practices of equipment for specific soil type and residue management.
17. Compare effects of traffic patterns on soil compaction.
18. Calculate soil loss using universal equations and determine effects of the components of the equations.
19. Determine practices to improve or maintain water quality and recharge.
20. Determine appropriate types, locations and uses of erosion and sedimentation control basins.
21. Determine appropriate types, locations and uses of water impoundment structures.
22. Describe surface and subsurface drainage and irrigation techniques.
23. Calculate subsurface drainage and irrigation requirements.
24. Determine if drainage or irrigation is economically and physically feasible.
25. Select appropriate drainage including open drainage, closed gravity and pumping systems.
26. Determine land shaping and grading requirements.

27. Determine economics of alternative systems.
28. Determine water needs.
29. Select irrigation systems for specific conditions.
30. Select irrigation equipment and techniques.
31. Determine soil moisture and temperature.
32. Select surface and subsurface irrigation systems for specific application.
33. Identify and select fittings for irrigation systems.
34. Identify size system components.
35. Determine power requirements and pump size for specific applications.
36. Calculate irrigation system requirements.
37. Make water management choices.
38. Understand water quality impacted by drainage and irrigation.
39. Understand pressure, flow and head.
40. Select pumps and power sources and compare efficiencies.
41. Interpret pump characteristics curves.
42. Determine appropriate waste disposal methods.

Skills

1. Set up and level the surveying instrument.
2. Take rod readings.
3. Measure distance with tape and/or instruments.
4. Lay out corners using instruments.
5. Determine direction by use of a compass.
6. Record field notes for differential, profile and topographic leveling.
7. Lay out contour lines.
8. Lay out grade stakes for cut/fills.
9. Determine soil types and selecting appropriate structures or practices.
10. Use automatic leveling and laser equipment.
11. Use water-testing equipment.
12. Lay out and mapping contour lines.
13. Measure crop residue on the land.
14. Determine soil losses.
15. Measure cross-sectional areas of a grass waterway, drainage ditch and earthen embankment.
16. Determine field slope and length.
17. Identify soil limitations and determine the effects on land use.
18. Use maps to make selection and determine location of conservation practices or land use changes.
19. Assemble turf irrigation equipment.
20. Determine soil moisture.
21. Estimate soil permeability and infiltration rates.
22. Determine and compare evaporation losses.
23. Install drainage systems or components.
24. Determine cuts, fills and grade lines.
25. Lay out contour ditches, basins, borders, contour levees, furrow and corrugation systems for irrigation.
26. Determine proper waste disposal procedures.
27. Layout and assemble solid-set, lateral move, center-pivot and traveling gun irrigation systems and components.
28. Layout and assemble trickle and drip irrigation systems or components including mainlines, lateral lines, control devices, valves, pressure regulators, gauges and filters.
29. Select and install components of irrigation systems for specific applications.
30. Calculate well capacity and demand.
31. Determine delivery rates of pumps.
32. Select pumps and power units.
33. Calculate chemical injection rates.
34. Determine percent of slope or grade.

5. Structures Systems Competencies

Problem Solving

1. Select and evaluate building sites.
2. Determine the size, specifications and layout of building.
3. Select appropriate framing, siding, roofing, insulation and vapor barrier materials.
4. Develop a bill of materials.
5. Interpret plans and working drawings.
6. Identify structural components of buildings.
7. Select preservatives for building materials.
8. Evaluate building construction techniques.
9. Select hand, electric and pneumatic tools.
10. Estimate handling materials, cost and construction time.
11. Plan footings, foundations and concrete finishing.
12. Identify and select materials for concrete form construction.
13. Determine quantity and cost of materials for concrete and masonry jobs.
14. Determine the appropriate water-cement ratio and aggregate for concrete masonry construction.
15. Select materials for concrete and masonry construction.
16. Order "ready-mix" concrete.
17. Identify procedures for mixing and placing concrete in cold or hot weather.
18. Identify materials and techniques to reinforce concrete and masonry construction.
19. Identify techniques for placing, finishing and curing concrete and masonry units.
20. Identify concrete additives to increase strength and reduce cracking.
21. Identify concrete additives to control hydration rate.
22. Identify and select masonry materials.
23. Describe and select masonry mortar.
24. Identify and select tools and equipment for concrete and masonry construction.
25. Interpret lumber and manufactured wood product grade stamps.
26. Determine ventilation air inlet size based on exhaust fan capacity.
27. Identify alternative construction styles (stud frame, post frame, rigid arch and stressed skin).
28. Identify structural components for each alternative construction style.
29. Specify materials for the construction of wood foundation systems.
30. Develop plans for selected enterprises.
31. Calculate and compare the installation and maintenance costs of crushed rock and concrete materials in the construction of feedlot surfaces.
32. Determine size and quality of aggregates and materials.
33. Select aggregates, concrete and mortar-mixes and prepare a trial mix.
34. Calculate masonry units needed for a given application.
35. Use traditional, electronic and laser tools in concrete and masonry construction.
36. Evaluate building systems and construction practices based on standards provided in one of the following model building codes: UBC, BOCA or SBC.
37. Specify and plan windbreak structures for livestock protection and reduction of snow accumulation in feedlot and farmstead drive areas.

Skills

1. Lay out a building foundation.
2. Identify, select and apply construction fasteners.

3. Use and maintain hand, electric and pneumatic tools and measuring instruments for building construction.
4. Construct buildings or building components.
6. Layout and cut structural components.
7. Install composition shingles, metal and fiberglass roofing materials.
8. Apply paint and other finishing materials.
9. Prepare a site for concrete and masonry construction.
10. Construct forms.
11. Calculate concrete or mortar mix.
12. Determine moisture content in sand.
13. Mix concrete or mortar on the job site.
14. Conduct and evaluate a slump test.
15. Place concrete or masonry reinforcement.
16. Lay out and make isolation, control and construction joints.
17. Place, consolidate, finish and cure concrete.
18. Place and finish concrete masonry units.
19. Produce special finishes on concrete.
20. Use and maintain concrete and masonry tools and equipment.
21. Calculate types and amount of concrete or mortar mix for a job.
22. Adjust ventilation air inlet openings.
23. Fabricate and install reinforcing steel bar and welded wire mesh.
24. Specify and use admixtures that entrain air, retard set, reduce water requirements and/or improve concrete mix workability in concrete mixes.
25. Set-up manufactured form systems for poured-in-place foundation walls.
26. Select and apply appropriate framing, siding, roofing, insulation and vapor barrier materials.

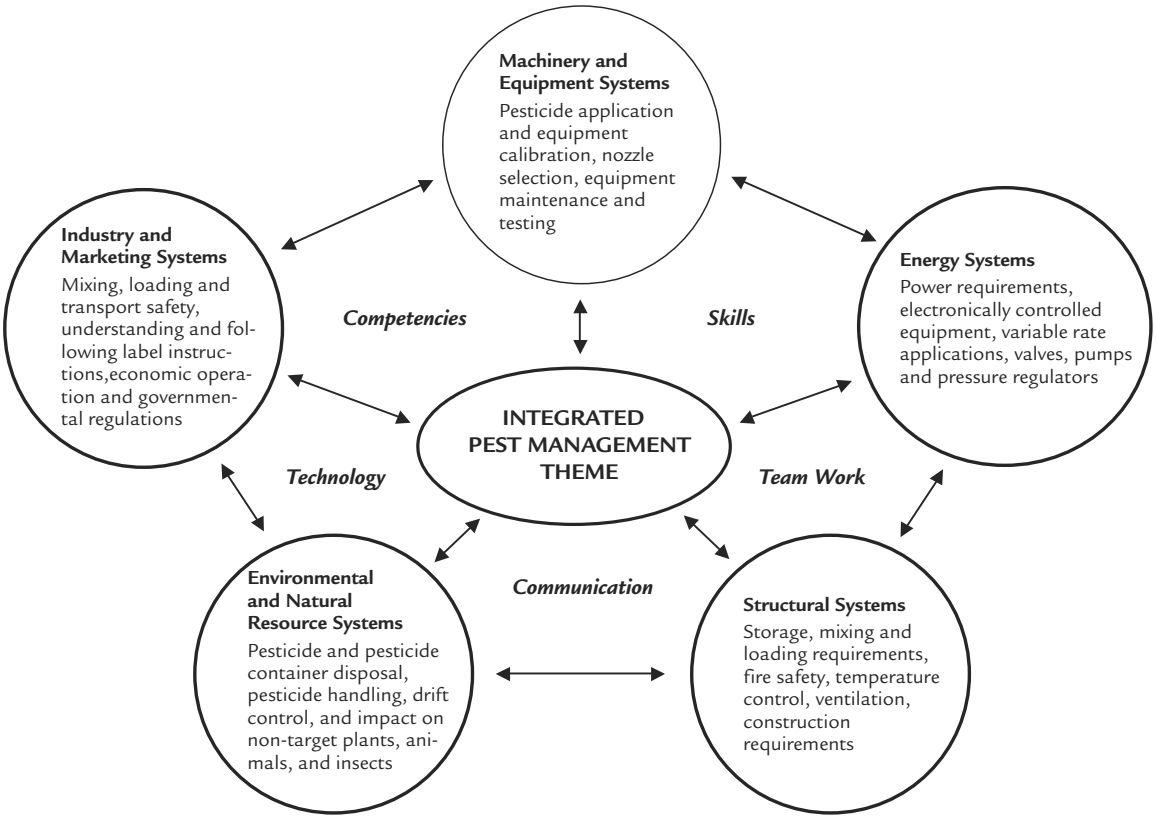
B. General Skills

1. Strong interpersonal communication abilities.
2. Knowledge combined with leadership qualities and the ability to delegate responsibilities .
3. People skills to deal with customers, the public and large groups.
4. Identify and interpret the correct resources to make an educated decision.
5. Understand and apply principles of mathematics, economics, biology and physics.
6. Have a high level of common sense, logic and critical thinking skills.
7. Be an independent thinker with an analytical mind.
8. Ability to understand and follow detailed instruction - written and oral.
9. Motivated to learn and having the ability to learn from various methods of instruction.
10. Be literate and remain literate in current technologies - computers, electronics, mechanical systems, etc.
11. Know how to calculate cost per units, per hour, per bushel, per acre, etc.
12. Know how to estimate value of equipment and recommend future buying decisions.
13. Know how to use technology to eliminate waste of time and resources.
14. Know about computer hardware, software, Internet, etc.
15. Know how to be productive with time, money and people.
16. Be knowledgeable with global agriculture - encompassing planning, production, marketing and finance.
17. Understand how cash flow is critical for business planning and operation.
18. Know how to measure and estimate costs and develop plans for business/industry improvements.

19. Be able to write annual goals with specific objectives and measurement tools for review.
20. Have skills in business operations and management.
21. Have experience with general accounting and cash flow management.
22. Be able to effectively implement the use of technology in the workplace.
23. Understand how to use a systematic approach to diagnose equipment problems.
24. Know how to service and maintain equipment so that productivity can be maintained.
25. Understand on-board computerized systems that monitor, test, store and report equipment operation.
26. Be familiar with computerized recognition of crop productivity and quality, field conditions and pests.
27. Understand electrical circuits - amperage, watts, voltage, resistance and transistors.
28. Understand hydraulic system operation - flow, resistance and temperature.
29. Understand mechanical system operation - mechanical advantage, material specifications and gear design.
30. Have experience in reading schematics, replacing components – including control modules.
31. Know how to diagnosis electrical, computer, mechanical and hydraulic systems.
32. Have experience in analyzing mechanical system failures.
33. Have experience with CAD software and know how to produce mechanical drawings.

National FFA Agricultural Mechanics Career Development Event

SAMPLE THEME



This chart illustrates an integrated pest management problem that depicts interaction between all five agricultural mechanics systems. Alternative themes would emphasize related competencies and other versions of an integrated pest management theme could include other competencies. Individuals and teams must possess knowledge and skills in all systems areas to determine acceptable problem solutions.

A number of other issues also influence the systems associated with integrated pest management. Such things as: turf versus agriculture applications, non-restricted versus restricted use pesticides and recent changes in governmental regulations are just a few of the additional concerns that affect the planning, preparation and completion of this activity. The complexity of this theme is further compounded by the number of competencies and skills involved in the solving of such intricate problems. Given the complexity of such problems, individuals are better prepared when they have information/knowledge, experience and expertise within several of the systems areas.