

ANIMAL SCIENCE

***A Secondary School Science-based
Course Designed in the Context of
Animal Agricultural Education***

**MINNESOTA
AGRICULTURAL EDUCATION**

INTRODUCTION

This course of study is one of four courses that have been approved by the University of Minnesota Twin Cities and Duluth campuses to meet the three-year science preparation requirement. The course will be used to fulfill the one-year biological science component and/or the general science component of the three-year science requirement for admission to the University.

This guide should be used as the basis for the Animal Science course which has been approved by the University of Minnesota. Teachers of secondary agricultural education have a unique opportunity to provide a science-based course in the context of animal agricultural education. The course should not be viewed or taught from a traditional vocational context. Each unit has been organized around a lesson plan which provides a basic set of facts around a science concept. The teacher is expected to use this lesson as a basis for class discussion. Following the basic lesson are a series of activities which illustrate and present basic science principles or concepts in the context of animal science. These activities may be presented as laboratory exercises or research activities. Teachers are encouraged to reproduce these activity packets and provide one for each student as they each complete the activity. Prior to working on the activity students are expected to make predictions as to what they expect will occur as they complete the activity. At the close of the activity, the teacher should revisit each student's prediction and determine the differences or agreements students had with their final observations.

Teachers of agricultural education have a unique opportunity with this course. It should NOT be a duplicated biology course. It should NOT be a traditional vocational animal science course. Instead, it should be a unique course designed around various science concepts within a context of animals that are a part of the broad context of agriculture. Some programs may wish to focus on small animals and pets such as dogs, cats, birds and animals that are in homes, whereas others may wish to use the context of domesticated cattle (beef and dairy), swine, sheep, poultry and horses. The teacher should be continually ready to respond to students who may ask "Why should we study and learn this stuff?" It is the context of every day animal agriculture across the state of Minnesota that provides reality and meaningful learning experiences.

This course guide should have real value in improving secondary agricultural education programs.

Thanks is due a number of Minnesota teachers who have prepared the teaching materials presented in the course. First, Mr. Brad Burklund, Ms. Kristi Ruen and Mr. Mike Mastey, who have reviewed, typed and brought uniformity to the course. They have spent countless hours revising and bringing together the work of various teacher teams. The following teachers have spent time and effort in providing the lessons and activities:

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|-----|----------------|---|
| 1. | Glen Boettcher | Stillwater High School |
| 2. | Bob Bowman | Blaine High School |
| 3. | Kristi Brown | Maple River High School |
| 4. | Brad Burklund | St. Cloud Technical College |
| 5. | Lance Hagman | Hinckley-Finlayson High School |
| 6. | Kent Janssen | Martin County West High School |
| 7. | Bob Marzolf | Forest Lake High School |
| 8. | Jim Naggatz | North Branch High School |
| 9. | Darrel Ober | Barnum High School |
| 10. | Kevin Plante | Waterville/Elysian/Morristown High School |
| 11. | Nate Thompson | Hayfield High School |
| 12. | John Zimmerman | Kenyon-Wannamingo High School |

Graduate Students ...

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|-----|----------------|
| 13. | R. Todd Hartle |
| 14. | Andrea Nthole |
| 15. | Jo Ann Young |

1995

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|-----|------------------|---|
| 1. | Paul Aarsvold | Atwater-Grove City-Cosmos High School |
| 2. | Val Aarsvold | Willmar High School |
| 3. | Greg Adler | Buffalo High School |
| 4. | Dennis Bjorklund | Chaska-Waconia High School |
| 5. | Tim Fenlason | Evansville High School |
| 6. | Richard Finger | Lewistown High School |
| 7. | Lance Hagman | Hinckley-Finlayson High School |
| 8. | Wayne Kroneman | Truman High School |
| 9. | Denise Marti | Janesville-Waldorf-Pemberton High School |
| 10. | Bob Marzolf | Forest Lake High School |
| 11. | Mike Mastey | BOLD (Olivia) High School |
| 12. | Bruce Mathiowetz | Buffalo Lake - Hector High School |
| 13. | Jim Naggatz | North Branch High School |
| 14. | Ronald Nelson | Minnewaska-Glenwood |
| 15. | Kevin Plante | Waterville/Elysian/Morristown High School |
| 16. | Duane Pliscott | Cannon Falls High School |
| 17. | Kristi Ruen | Maple River High School |
| 18. | Kenneth Schroyer | Detroit Lakes High School |
| 19. | Nate Thompson | Hayfield High School |
| 20. | Dan VonBank | MACCCRAY/KMS High School |
| 21. | J. Reid Wahlin | Fosston High School |

Thanks is also due Professor Lou Reisenberg of the University of Idaho and The Idaho Agricultural Science and Technology Curriculum AG530 Zoology/Animal Science course for allowing the use of concepts and materials.

COURSE TITLE: Animal Science

COURSE DESCRIPTION:

This course will investigate scientific concepts relating to the biology of animals. Specific topics will include scientific methods, taxonomy and classification, cell structure and function, biological systems, anatomy and physiology, nutrition, genetics, reproduction, pathology, distribution and adaptation, and selection and evaluation. Laboratory activities will provide opportunities for problem-solving through practical applications to learn scientific concepts. Applications to current issues will also be presented.

COURSE OBJECTIVES:

1. Apply the scientific method to the study of animals.
2. Evaluate classification and selection practices and their relationship to distribution and adaptation.
3. Evaluate the processes of animal biology including cells, anatomy, physiology, growth, development, reproduction, and nutrition.
4. Evaluate the inter-relationships between biological systems.
5. Compare and contrast the biological systems of various animals.
6. Evaluate the processes involved in the transfer of genetic characteristics.
7. Evaluate the relationships between animals and their environment.
8. Select appropriate scientific techniques to solve problems relating to animals.
9. Justify a position related to issues of ethics and animal welfare.
10. Utilize approved practices in caring for and managing animals.

Animal Science

The scope and sequence of this course will be determined by the local school district.

- Unit I: Introduction to the Scientific Method and Techniques (1-2 weeks)**
- Unit II: Introduction to Animal Science (1 week)**
- Unit III: Taxonomy and Classification (1-2 weeks)**
- Unit IV: Cell Structures and Functions (2-3 weeks)**
- Unit V: Animal Anatomy and Physiology (4-6 weeks)**
- Unit VI: Growth and Development (1-3 weeks)**
- Unit VII: Animal Nutrition (3-4 weeks)**
- Unit VIII: Animal Reproduction (3-5 weeks)**
- Unit IX: Genetics and Animal Selection (3-4 weeks)**
- Unit X: Pathology and Health (3-4 weeks)**
- Unit XI: Environmental Factors Affecting Animals (1-2 weeks)**
- Unit XII: Science of Animal Products (1 week)**
- Unit XIII: Societal Issues Related to Animal Science (1-2 weeks)**

Animal Science

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Unit I: Introduction to the Scientific Method and Techniques (1-2 weeks)

Lessons:

- "Exploring Research Methods in Environmental Science - Observation"
- "Designing and Conducting Environmental Research"
- "Using Scientific Instruments and Measurements"
- "Evaluating and Reporting Scientific Results"

Unit II: Introduction to Animal Science (1 week)

Lessons:

- "Importance of Animals: National and International"
- "Current Trends and Statistics"
- "Introduction to the Science of Animals"

Unit III: Taxonomy and Classification (1-2 weeks)

Lessons:

- "Introduction to Taxonomy and Classification"
- "Animal Classification"
- "Adaptation and Distribution of Animals"
- "Domestication and Development of Breeds"
- "Variation"

Unit IV: Cell Structures and Functions (2-3 weeks)

Lessons:

- "Use of the Microscope in the Study of Animal Cells"
- "Cell Components and Functions"
- "Interaction of Cell Structures and Functions"
- "DNA Replication and Protein Synthesis"
- "Cellular Reproduction and Differentiation"
- "Comparative Anatomy: Plant and Animal Cells"

Unit V: Animal Anatomy and Physiology (4-6 weeks)

Lessons:

- "Introduction to the Animal Biological Systems"
- "Examining Features of the Skeletal Systems: Exo- and Endo-"
- "Examining Muscle Tissues"
- "Relationship of Muscular and Skeletal Systems"
- "Digestive System Anatomy and Physiology"
- "Reproductive System Anatomy and Physiology"
- "Nervous System Anatomy and Physiology"
- "Circulatory System Anatomy and Physiology"

"Components and Functions of Blood and Lymph"
"Endocrine System Anatomy and Physiology"
"Excretory System Anatomy and Physiology"
"Respiratory System Anatomy and Physiology"
"Integument System Anatomy and Physiology"
"Interactions of Animal Biological Systems"

Unit VI: Growth and Development (1-3 weeks)

Lessons:

"Cell Growth, Development, Differentiation"
"Factors involved in Tissue Growth and Development"
"Measuring Tissue Growth and Development"
"Effect of Hormones on Growth and Development"
"Comparison of Growth and Development between Species"

Unit VII: Animal Nutrition (3-4 weeks)

Lessons:

"Comparative Anatomy and Physiology: Digestive Systems"
"Classifications of Nutrients"
"Functions of Essential and Nonessential Nutrients"
"Absorption and Metabolism of Nutrients"
"Nutrient Deficiencies: Symptoms and Diagnosis"
"Functions of Feed Additives"
"Relationship of Nutrients to Animal Growth"
"Relationship of Nutrients to Gestation and Lactation"
"Effect of Environmental Factors on Nutrient Metabolism"
"Evaluation and Formation of Animal Rations"

Unit VIII: Animal Reproduction (3-5 weeks)

Lessons:

"Introduction to Animal Reproduction"
"Comparative Anatomy and Physiology: Reproductive Systems"
"Important Cycles in Animal Reproduction"
"Effect of Age on Animal Reproduction"
"Role of Hormones in Reproduction"
"Factors involved in Fertilization"
"Growth and Development During Gestation"
"Biological Processes Involved in Parturition"
"Natural vs. Artificial Insemination"
"Embryo Transplant"

Unit IX: Genetics and Animal Selection (3-4 weeks)

Lessons:

"Comparison of Mitosis and Meiosis"
"Chromosome and Gene Replication"

"Effect of Genes on Organism Growth and Development"
"Principles of Dominant and Recessive Traits"
"Comparison of Genotypes and Phenotypes"
"Determining Heritability Estimates"
"Interaction of Genetics and Environment"
"Characteristics of Ideal Animals"
"Evaluation of Genetic Characteristics and Selection"

Unit X: Pathology and Health (3-4 weeks)

Lessons:

"Introduction to Pathology and Health"
"Indicators of Animal Health"
"Biological Effect of Diseases on Animals"
"Classification of Common Diseases"
"Role of Vectors in Disease Transmission"
"Features of Bacteria and Effect on Animal Biology"
"Features of Virus and Effect of Animal Biology"
"Examination of Internal and External Parasites"
"Important Biological Cycles of Disease Organisms"
"Examination of Congenital and Environmental Disorders"
"Concepts of Prevention, Diagnosis, and Treatment"

Unit XI: Environmental Factors Affecting Animals (1-2 weeks)

Lessons:

"Introduction to the Environment of Animals"
"Affect of Air Quality on Animals"
"Sanitation and Animal Pathology"

Unit XII: Science of Animal Products (1 week)

Lessons:

"Introduction to the Science of Animal Products"
"Biological Processes: Food Processing and Preservation"
"Microbial Action in Food Products"
"Selection of Quality Animal Products"

Unit XIII: Societal Issues Related to Animal Science (1-2 weeks)

Lessons:

"Examining Animal Welfare Issues and Regulations"
"Determining Responsible Ownership of Animals"
"Biotechnology and Genetic Engineering"

Animal Science

I Introduction to the Scientific Method and Techniques

Science Concepts

Analysis
Calibration
Comparison
Control
Conversion
Dependent
Experimental
Independent
Manipulation
Measurements
Observation
Reliability
Replication
Validity
Variables

Animal Science Practices

Analyzing Research Problems
Collecting Data
Conducting Research
Designing Research
Identifying the Research Problems
Interpreting Research
Design Reporting Research Results
Using Research for Management
Decisions
Using Scientific Instruments
Using Scientific Measurements

Laboratory Exercises

Converting from English to Metric
Using a Scale
Using the Microscope

Laboratory Experiments

Conducting a Science Fair
Project

II Introduction to Animal Science

Science Concepts

Adaptation
Biology
Cell Theory
Comparison
Distribution
Selection
Systems

Animal Science Practices

Breeding Animals
Feeding Animals
Monitoring Animal Health
Production Areas
Uses of Animals

Laboratory Exercises

Design Posters on Various
Animal Species

Laboratory Experiments

Conduct Community Survey on
Average Animals

III Taxonomy and Classifications

Science Concepts

Adaptation
Class
Classification
Distribution
Domestication
Family
Genus
Kingdom
Measurements
Observation
Order
Phylum
Selection
Species
Taxonomy

Animal Science Practices

Classification of Animals
Domestication of Animals
Observation of Animals
Origin of Animals
Similarities of Animals
Uses of Animals

Laboratory Exercises

Comparison of Features of Animal Species
Impact of Selection on Various Animal Species
Selecting for Ideal Animals
Sorting Pictures of Animals Based on Features

Laboratory Experiments

Classify Animals Using a Key
Effect of Season on
Quality/Cost Feathers
Effect of Species on Growth
Performance

IV Cell Structures and Functions

Science Concepts

Cell Division
Diffusion
Excretion
Fertilization
Meiosis
Mitosis
Mutation
Osmosis
pH
Replication
Respiration
Synthesis
Transport

Animal Science Practices

Animal Growth and Development
Artificial Insemination
Cloning
Fertilization
Hormone Therapy
Nutrition
Sexual Reproduction

Laboratory Exercises

Construct a Cell Model
Observe Different Cells
Under Microscopes
Role Play the Activities
of a Cell

Laboratory Experiments

Compare Plant and Animal Cells

V Animal Anatomy and Physiology

Science Concepts

Absorption
Assimilation
Blood
Circulation
Control
Differentiation
Digestion
Dissection
Enzymes
Excretion
Growth
Hormone
Locomotion
Lymph
Metabolism
Nerve Impulse
Organs
Protection
Repair
Reproduction
Respiration
Response
Stimulus
Support
Synapse
Systems
Tissues
Translocation

Animal Science Practices

Animal Selection
Breeding
Carcass Evaluation
Conformation Evaluation
Debeaking
Declawing
Dehorning
Feeding Animals
First Aid
Grooming Animals
Growth Implants
Health Evaluations
Hoof Trimming
Measurement of Growth
Milking
Neutering
Reproductive Evaluations
Spaying
Tattooing
Training
Veterinary Care

Laboratory Exercises

Conformation Evaluation
Debeaking Poultry
Diagram Contrasting Systems
Diagram the Systems of the Body
Examine Bone Structure in Various
Meat Cuts
Grooming Animals
Measurement of Growth
Observe Features of a Normal Animal

Laboratory Experiments

Dissection of Animals
Effect of Growth Implants on Beef Cattle
Effect of Neutering on Growth Rate

VI Growth and Development

Science Concepts

Absorption
Differentiation
Digestion
Enzymes
Growth
Hormone
Metabolism
Nutrition
Organs
Respiration
Systems
Tissues
Translocation

Animal Science Practices

Comparison Between Breeds
Comparison Between Species
Comparison of the Effect of
Supplements
Feeding Animals
Growth Implants
Health Evaluation
Measurement of Growth

Laboratory Exercises

Chart Growth of Animals
Measure Growth of Animal
Observe Development of Chick
Embryos

Laboratory Experiments

Effect of Breed on Growth
Effect of Confinement on
Growth and Behavior
Effect of Gender on Growth
Effect of Nutrition on Growth
Effect of Supplements on Growth

VII Animal Nutrition

Science Concepts

Absorption
Amino Acid
Assimilation

Animal Science Practices

Administering Growth Hormones
Analyzing Effects of Nutrients
Analyzing Feed Labels

Laboratory Exercises

Calculation of Rations
Comparison of Feed Label
Ingredients

Laboratory Experiments

Effect of Feeding System on Animal Growth
Effect of Palatability on Animal Growth
Effect of Protein on Animal Growth

Balance
 Calorie
 Concentrate
 Decomposition
 Deficiency
 Digestion
 Energy
 Enzyme
 Formulation
 Lipids
 Mastication
 Minerals
 Nutrients
 Palatability
 Protein Quality
 Ration
 Roughage
 Rumination
 Solubility
 Symbiosis
 Toxicity
 Vitamins

Evaluating Inert Matter in Feeds
 Feeds Formulation
 Feed Quality Testing
 Identification of Feedstuffs
 Proper Storage of Feeds
 Ration Balancing
 Selection of Feed
 Supplementation of Ration
 Water Quality Testing

Determine Energy in Feed Ingredients
 Diagram Comparative Digestive Systems
 Enzymatic Fat Digestion
 Trial and Error Systems of Ration Balancing
 Use a Black Light to Identify Mold in Samples
 Use Pearson's Square to Balance Rations

Effect of Species on Fecal Nutrient Content
 Effect of Supplements on Animal Growth
 Testing Feed Quality
 Urease Testing for Protein Quality

VIII Animal Reproduction

Science Concepts

Anatomy
 Behavior
 Cell Division
 Cycles
 Egg
 Estrus
 Fertilization
 Gestation
 Heat
 Hormones
 Incubation
 Morphology
 Motility
 Ovulation
 Parturition Teasing
 Photoperiodism
 Physiology
 Puberty
 Sperm

Animal Science Practices

Artificial Insemination
 Castrating
 Ceaserian Deliveries
 Estrus Synchronization
 Heat Detection
 Monitoring Breeding Schedules
 Natural Insemination
 Neutering
 Palpation
 Pregnancy Diagnosis
 Reproductive Evaluations
 Sex Determination
 Spaying
 Sperm Viability Testing

Laboratory Exercises

Dissection of Reproductive Tracts
 Evaluation of Sperm Viability
 Incubation of Eggs
 Observe Development of Chick in Egg
 Pregnancy Testing
 Sexing Baby Chicks or Rabbits
 Simulated Artificial Insemination

Laboratory Experiments

Effect of Humidity on Egg Development
 Effect of Temperature on Egg Development

IX Genetics and Animal Selection

Science Concepts

Allele
 Cell Division
 Chromosomes
 Dominant
 Fertilization
 Gamete
 Genes
 Genotype
 Heritability
 Heterozygous
 Homozygous
 Hybrid Vigor
 Meiosis
 Mitosis
 Mutations
 Phenotype
 Probability
 Recessive
 Selection
 Traits

Animal Science Practices

Artificial Insemination
 Breeding Stock Selection
 Conformation Evaluation
 Cross-breeding
 Determining Heritability
 Embryo Transfer
 Improving Performance Through Selection
 Inbreeding
 Line-breeding
 Pedigree Evaluation
 Performance Evaluation
 Performance Testing
 Purebred Selection
 Use of Punnet's Square

Laboratory Exercises

Diagram Components of a Chromosome
 Examining Heretibility Traits
 Selecting Animals Based on Pedigrees
 Use Punnett's Square to Determine Traits

Laboratory Experiments

Comparison of Performance of Purebred/Grades
 Mating Chickens to Compare Phenotypes
 Mating Gerbils to Compare Phenotypes

X Pathology and Health**Science Concepts**

Antibodies
Bacteriology
Defense
Epidemiology
Host
Immunity
Immunology
Infection
Life Cycles
Parasitology
Pathology
Resistance
Susceptibility
Toxicity
Transmission
Vaccination
Virology

Animal Science Practices

Debeaking
Delousing
Deworming
Disinfecting Instruments
Docking Trails
Grooming
Identification of Disease Symptoms
Immunization
Inspection of Feces for Pathogens
Isolation of Disease Organisms
Prevention of Diseases
Providing Colostrum to Young Mammals
Providing Sanitary Facilities
Selection of Quality Feeds
Selection of Resistant Animals
Treatment of Diseases

Laboratory Exercises

Caring for Diseased Animals
Evaluate Fecal Samples for Parasites
Evaluate Sanitation Levels of Housing Systems
Identify Disease Organisms and Symptoms
Measurement of Liquids in Syringes
Simulate Needle Injections

Laboratory Experiments

California Mastitis Test
Effect of Colostrum on Health
Effect of Drugs on Bacterial Cultures

XI Environmental Factors Affecting Animals**Science Concepts**

Aeration
Animal Behavior
Behavior Modification
Condensation
Density
Development
Filtration
Growth
Immunization
Nutrition
Quality
Spectrum
Transmission
Treatment
Vaporization

Animal Science Practices

Aquarium Selection
Control for Animal Comfort
Designing Animal Facilities
Feeding Animals
Isolation of Disease Organisms
Proper Shipping and Handling Practices
Providing Proper Lighting
Providing Proper Training
Providing Proper Ventilation
Providing Sanitary Facilities
Selecting Aeration Systems
Selecting Filtration Systems
Testing Air Quality
Testing Water Quality

Laboratory Exercises

Calculate Animal Density
Designing a Filtration System
Measure Light Intensity
Setting up an Aquarium
Testing Water Quality

Laboratory Experiments

Effect of Confinement on Animal Behavior
Effect of Density on Animal Growth and Behavior
Effect of Light on Animal Growth and Behavior
Effect of Temperature on Animal Behavior
Effect of Ventilation on Animal Behavior
Effect of Water Quality on Animal Growth

XII Science of Animal Products**Science Concepts**

Bacteriology
Enzymes
Lipid Deposition
Preservation
Protein Quality
Sanitation
Tissue Development

Animal Science Practices

Animal Slaughtering
Evaluation of Animal Products
Identification of Animal Products
Labelling of Animal Products
Processing of Animal Products
Quality Grading of Animal Products

Laboratory Exercises

Analyze Labels on Food Products
Antibiotic Testing for Milk
Evaluating Animal Product Quality
Identify Cuts of Meat and Poultry
Dairy Product Testing and Evaluation

Laboratory Experiments

Effect of Salt and Phosphate on Meat Quality
Effect of Nitrates on Food Preservation
Effect of Marbling on Meat Quality
Survey Consumer Preferences on Food Products

XIII Societal Issues Related to Animal Science**Science Concepts**

Density
Fertilization
Growth & Development
Hormones
Immunization
Nutrition
Processing
Quality
Sanitation

Animal Science Practices

Breeding Animals
Calculating Animal Density
Sanitation Practices
Shipping and Handling Animals
Use of Confinement Housing
Use of Drugs
Use of Hormones

Laboratory Exercises

Case Studies on Ownership Responsibilities
Newspaper Article Collection

Laboratory Experiments

Survey Community on Animal Welfare Issues