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ABSTRACT

With the introduction of specialized courses of study in the third and fourth year of high school, it has become necessary to do more specialized work in the area of livestock production. The course is designed to provide a guideline to encourage intensified studies in this area, and outlines materials and methods, time allotment, and the use of course materials. The course is divided into three sections and, within each section, into units and jobs. Each job is broken down into five sections: objective, motivation, references, teaching outline, and teaching procedures; in most cases illustrative material is provided. Section A, Livestock Selection, is 27 pages long and reviews herd selection, and the selection of swine, beef animals, sheep, and dairy cattle. Section B, 96 pages, covers the history and present day methods of livestock breeding, trends in Livestock Improvement, and 13 sections covering aspects of reproduction and inheritance. The topics treated in Livestock Nutrition, Section C, 80 pages, are the monogastric and ruminant digestive systems, six sections on nutrients, fcllowed by the digestive process, metabolism and absorption of nutrients, and four sections on rations. (NH)

ADVANCED LIVESTOCK PRODUCTION:

A COURSE OF STUDY

Prepared by

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Agricultural Education Service
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1973

ACKNOW LEDGEMENTS

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A Virginia Polytechnic Institute and State University
Extension Division
Education Field Service Publication

TABLE OF CONTENTS

INTRODUCTION

With the introduction of specialized courses of study in the third and fourth year of high school, it has become necessary to do more specialized work in the area of livestock production. This work has been done in the hope of providing a guideline to encourage intensified studies in this area. This unit should not be considered to be inclusive. Much expansion should be done by the individual instructor to adjust this to his locality and the needs of his students.

The problem of developing a course of study for advanced livestock production has been attacked from the standpoint of this course being fundamentally a science, and that the thorough understanding of that science is the foundation for further study.

MATERIALS AND METHODS

The following source list was developed to allow deliberation upon selection of teaching aids prior to teaching of this course of study. Careful consideration should be given to the selection of these references. The teaching aids listed were selected from the recommended book list, and have definite application to specific areas. In an era when facts are constantly changing, there can be no one best reference for teaching such a broad area as livestock production.

The reference, Selected References and Aids for Teaching Animal Science to Students of Vocational Agriculture, has been of valuable assistance in selecting the films and other publications. Without this comprehensive reference, it would have been impossible to select such appropriate teaching aids.

Special attention should be given to the selection of appropriate references and teaching aids before the time arises for their use.

Publishing companies or mailing addresses are given to aid in securing the needed references and teaching aids.

TIME ALLOTMENT

Based on one fifty-minute period per day.

Job	Days	Job	Days
I	2	XVIII	2
II	3	XIX	3
III	3	XX	4
IV	3	XXI	2
V	3	XXII	3
VI	2	XXIII	3
VII	2	XXIV	2
VIII	2	XXV	3
IX	3	XXVI	2
X	3	XXVII	3
XI	2	XXVIII	3
XII	2	XXIX	2
XIII	2	XXX	2
XIV	2	XXXI	2
XV	2	XXXII	4
XVI	3	XXXIII	5
XVII	2	XXXIV	2
		Lost Days	4

HOW TO USE THIS BOOK

There are three areas within this course: Livestock Selection, Livestock Breeding and Livestock Nutrition. Careful planning should go into the preparation for each area. Careful attention should be given to securing the needed references. Slides, films and other publications should be ordered well in advance. This will necessitate the formulation of a calendarized course of study in order to anticipate the dates for which these materials will be needed. Once the calendar is made, it must be followed closely if one hopes to conclude this course of study within a semester.

Arrangements for field trips, guest speakers and jobs requiring periodical information (Job VIII) should be pre-planned in order to secure the maximum benefit.

Pages containing the letter "H" are recommended as handouts while the pages containing the letter "T" are recommended as transparencies. Some instructors may find it of greater convenience to assemble a "slide-bank" of these materials.

SOURCE LIST

An attempt should be made to keep this source list up to date and comprehensive as new materials become available.

BOOKS

Livestock Selection

Animal Science. Ensminger, The Interstate.

Livestock and Poultry Production, Bundy and Diggins Prentice-Hall.

Livestock Judging Handbook, Nordby, Beeson, and Fourt The Interstate.

Swine Production 2nd Edition, Bundy and Diggins Prentice-Hall.

Swine Service 3rd Edition, Ensminger, The Interstate.

Beef Production, Diggins and Bundy, Prentice-Hall.

Selection, Fitting, Showing Beef Cattle, Nordby and Lattig, The Interstate.

Dairy Cattle Judging and Selection, Yapp, John Wiley and Sons.

Livestock Breeding

Breeding and Improvement of Farm Animals, Rice and Andrews, McGraw-Hill

Introduction to Breeding Farm Animals, Winters, John Wiley and Sons.

Genetics of Livestock Improvement, Lasley, Prentice-Hall.

Livestock and Poultry Production, Bundy and Diggins, Prentice-Hall.

Livestock Nutrition

Feeds and Feeding, Morrison, Morrison Publishing Company.

Animal Nutrition, Maynard and Loosli, McGraw-Hill.

SLIDES

"Animal Science," Iowa State University.

"101 Cuts of Meat", National Livestock and Meat Board.

FILMS

"The Story of Breeds," Texaco, Inc., Sales Promotion Manager, 322 South Michigan Avenue, Chicago, Illinois 60604.

"New Ideas in Livestock Production," The Venard Organization, 113 North East Madison, Peoria, Illinois 61602.

"Tomorrow's Beef Today," Soil Conservation Service, Film Library, Regional Technological Service Center, 134 South 12th Street, Lincoln, Nebraska 68508.

"An Angus in Your Future", American Angus Association, 3201 Frederick Street, St. Joseph, Missouri 64501.

"Modern Beef Cattle," American Angus Association.

"Culling Sheep", Union Pacific Railroad, 1416 Dodge Street, Omaha, Nebraska 68102.

"Sheep Shape", The Venard Organization.

"Story of Sheep", Texaco, Inc.

"Animal Wonders." American Guernsey Cattle. Promotion Department. 70 Main Street, Peterborough, New Hampshire 03458.

"National Dairy Congress," Purdue Audio Visual Center. Purdue University, Lafayette, Indiana 47907.

"Raising Dairy Calves," Union Pacific Railroad.

"Selecting and Judging Guernseys," American Guernsey Cattle.

"Animal Breeding," Public Relations Department, Indiana Farm Bureau Cooperative Association, Inc., 47 South Pennsylvania Street, Indianapolis, Indiana 46209.

"Heredity," Communication Department, 119 Whitten Hall, Columbia, Missouri 65201.

"The Rumen Story," Ralston Purina Company, St. Louis, Missouri.

"Trip Through a Pig Factory," Ralston Purina.

OTHER PUBLICATIONS

"Successful Farming Livestock" 6th Edition.

"Animal Science," State Department of Education, Agricultural Education Section and University of Missouri, Agricultural Education Department.

"Wilson Meat Charts." Wilson and Company, Inc., Prudential Plaza, Chicago, Illinois 60601.

"101 Cuts of Meat," National Livestock and Meat Board. (Handbook)

"101 Cuts of Meat," The Interstate. (Cards)

"Dairy Bull Unified Score Care," American Guernsey Cattle Club, Peterborough, New Hampshire 03458.

"Dairy Cow Unified Score Card," American Guernsey Cattle Club.

"Dairy Herd Improvement Association," Alfred Lane, 126 Eckles Hall, Columbia, Missouri 65201.

"Dairy Cattle Breeds," U.S. D.A. 1443, Office of Information, Washington, D. C. 20250.

"Dairy Cattle Selection," U. S. D. A. 1769, Office of Information, Washington, D. C. 20250.

"M. U. Guides", Cooperative Extension Service, University of Missouri, Columbia, Missouri.

"Reproduction of Farm Animals," Bulletin 305, Mailing Room, Cornell University, Ithica, New York.

"Doane's Agricultural Reports," Doane's, St. Louis, Missouri.

"Improvement of Swine Through Breeding," B775, J. F. Lasley, B. N. Day and L. F. Tribble, University of Missouri, Agricultural Experiment Station, Columbia, Missouri 65201.

"Beef Cattle Breeding," Publications Divisions, Office of Information, U. S. Department of Agriculture, Washington, D. C. 20250.

"The How and Why of Beef A. I.," Curtiss Breeding Service, Inc., Curtis Farm, Cary, Illinois.

"The How and Why of the Complete Cow," Curtiss.

"Nutrient Requirements of Beef Cattle," No. 4, publication 1137, National Academy of Sciences, National Research Council, 2181 Constitution Avenue, Washington, D. C. 20418.

"Nutrient Requirements of Horses," No. 6, publication 1401, National Research Council.

"Nutrient Requirements of Dairy Cattle," No. 3, publication 1349, National Research Council.

"Nutrient Requirements of Swine," No. II, publication 1192, National Research Council.

"Life Cycle Swine Nutrition," A. S. 90, Iowa State University, Ames, Iowa.

LIVESTOCK SELECTION

ADVANCED LIVESTOCK PRODUCTION

A Course of Study

Course: Advanced Livestock Production

Area: Livestock Selection

Unit: Basis for Selection of Foundation Stock

Job I: Herd Selection and Improvement

Objectives: To instruct students in the proper method of selecting foundation stock

To teach the student how to improve existing herds

Motivation: Show pictures or slides of livestock of today and those of thirty years ago. Ask the students why these differences have resulted.

References: 1. "Animal Science" unit

2. Animal Science, Ensminger

3. Livestock and Poultry Production, Bundy and Diggins.

4. Successful Farming Livestock, 6th Edition

5. Films: (a) "The Story of Breeds"

(b) "New Ideas in Livestock Production"

(c) "Tomorrow's Beef Today"

Teaching Outline:[1]

I. Important factors to consider in the selection of a breed

A. Availability of good stock in local community or area

B. Prolificy -- ability to produce large litters

C. Carcass quality--ability to produce carcasses that are high in lean meat and low in fat

D. Efficient use of feed-- can covert feed into pork

E. Growth ability--are they able to make rapid gains

F. Personal likes and dislikes.

II. Selection of Animals

A. Physical traits as a means of selection

1. Review "Animal Science" unit (pp. 25-30)

B. Genetic traits as a means of selection

1. Heritability estimates

C. Other important traits

1. Weaning weight

2. Rate of gain

3. Efficiency of gain

4. Carcass quality

D. Records, health, pedigrees, and selection

1. Pedigree important, but commercial producer more concerned with production records

a. Consider record of sire, dam, and to a lesser degree that of grandsire and granddam

b. Check for certification, pacesetter or superior meat sire on sire side

c. Check for production registry information on the dam side.

2. Production and performance records

a. Swine

(1) Production registry requirements

(a) A mature sow must farrow and raise eight or more pigs to a 56-day weight of at least 320 pounds.

(b) A first litter gilt must raise the same number of pigs to a 56-day weight of at least 275 pounds.

(c) A sow qualifies for production registry after producing two production registry litters.

(d) To qualify as production registry sires, boars must sire five qualified daughters or fifteen daughters that have produced one production registry litter.

(2) Meat certification requirements

(a) Litter must qualify for production registry

(b) Two pigs from the litter must be slaughtered and meet the following requirements:

(1) Weigh 200 pounds at 180 days

(2) Weigh less than 220 pounds at slaughter

(3) Meet these carcass measurements:

Length--29 inches

Maximum back fat--1.6 inches

Minimum loin eye--4 square inches

(4) Litter mates have about 50% of their genes in common and carcass traits' are highly heritable

(3) Testing stations

(a) Boars and gilts are tested for

(1) Daily rate of gain

(2) Pounds of feed per pound of gain

(3) Inches of back fat

(b) Litter mate barrows are tested for

(1) Carcass length

(2) Back fat thickness

(3) Per cent of ham and loin in carcass

(4) Size of loin eye area

(5) Carcass grade

(4) Health

(a) Animals large for age are usually in good health. Know herd that animal came from and purchase from disease-free herd.

(b) Negative blood tests for brucellosis and leptospirosis are a must. Vaccination for erysipelas is a must. Animal should be free from internal and external parasites.

Teaching Procedure:

I. Introduce Unit.

II. Show films on livestock selection.

III. Discuss performance testing, production, registry, certified meat sires, etc.

IV. If possible, tour a testing station and obtain testing information, illustrating to students how they can use this information in selecting new and replacement animals.

V. Discuss places to purchase boars and gilts and factors to consider in purchasing.

VI. If possible, attend area purebred or testing station sales.

VII. Summarize and evaluate trips and other learning activities.

Course: Advanced Livestock Production

Area: Livestock Selection

Unit: Basis for Selection of Foundation Stock

Job II: Selection of Swine

Objectives: To instruct students in the proper method of selecting breeding and feeding stock and to tell the reasons

To be able to recognize the cuts of meat as taken from swine

Motivation: "How much can you afford to pay for a herd sire?"

"Is a boar really half a herd?"

References:

1. "101 Cuts of Meat" Cards, The Interstate
2. "101 Cuts of Meat" Handbook, National Livestock and Meat Board
3. "101 Cuts of Meat" Slides, National Livestock and Meat Board
4. Livestock and Poultry Production, Bundy and Diggins
5. Livestock Judging Handbook, Nordby, Beeson and Fourt
6. Swine Production 2nd Edition.
7. Swine Science 3rd Edition, Ensminger (pp. 67-81)
8. "Wilson Meat Chart," Wilson and Company, Inc.
9. "How to Buy a Better Boar", Successful Farming, Aug. 1965. (p. 32).

Teaching Outline:

I. Parts of a hog

II. Wholesale cuts of a hog

III. Ideal conformation of a hog

IV. Common Faults of conformation

V. Student judging of a class of hogs

VI. Important breed characteristics

VII. Identification of pork meat slides

Teaching Procedures:

I. Introduce unit.

II. Discuss common faults and judging a class of hogs.

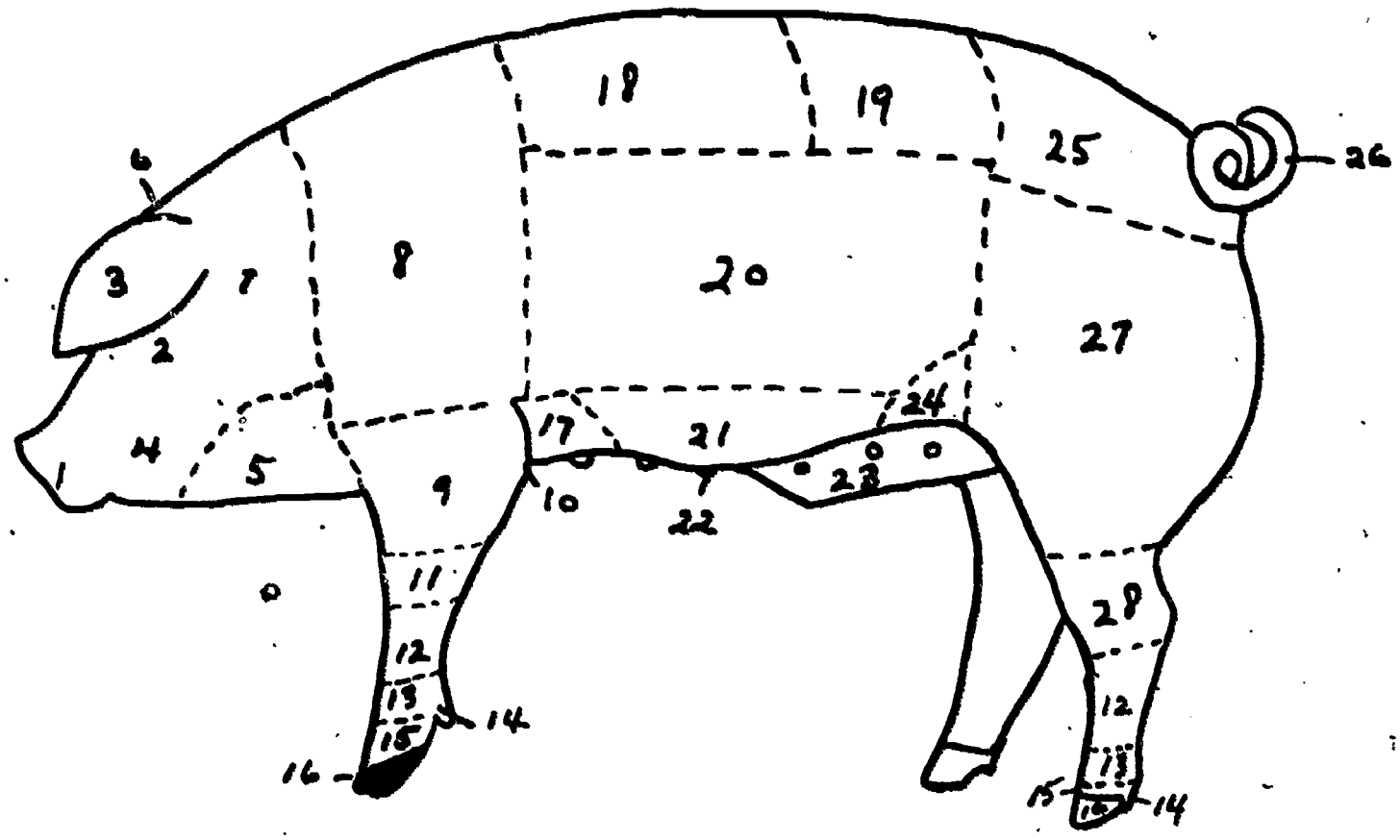
III. Take a pre-arranged field trip and require oral or written reasons for the students' selections.

IV. Discuss the characteristics of each breed.

V. Review slides of cuts of meat from swine and their value as related to selection.

VI. Summarize and evaluate the learning activities.

PARTS OF A HOG



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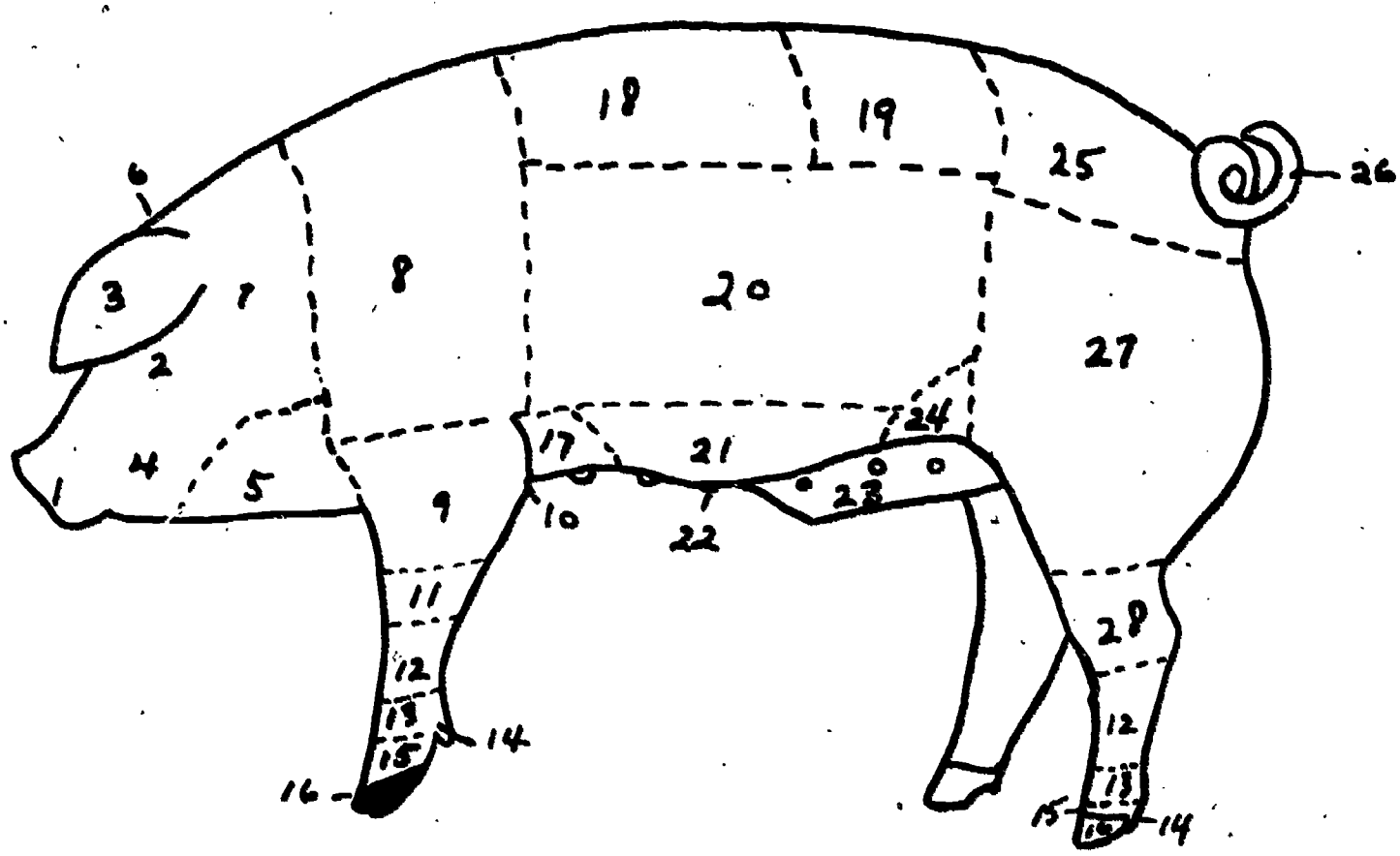
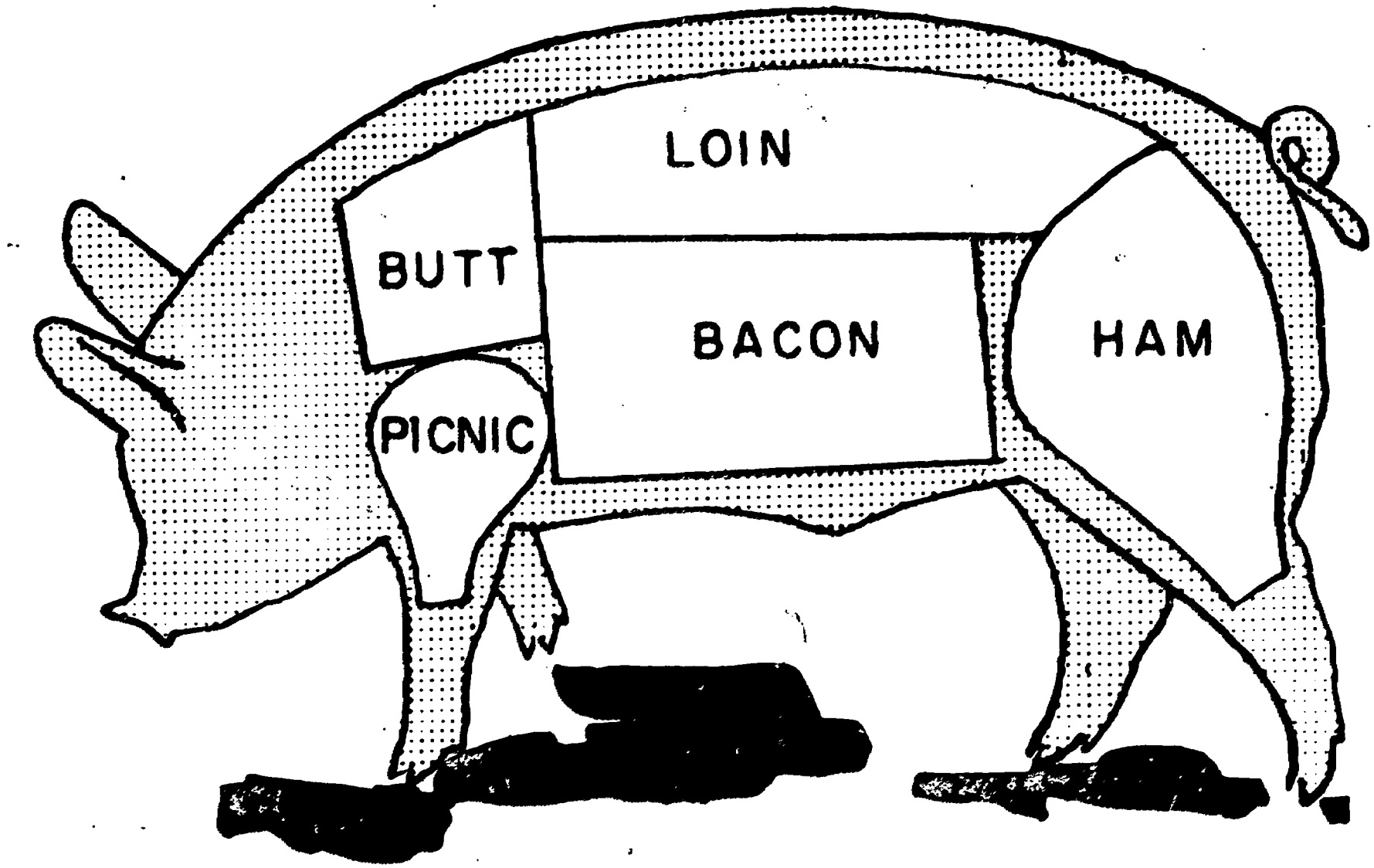
PARTS OF A HOG

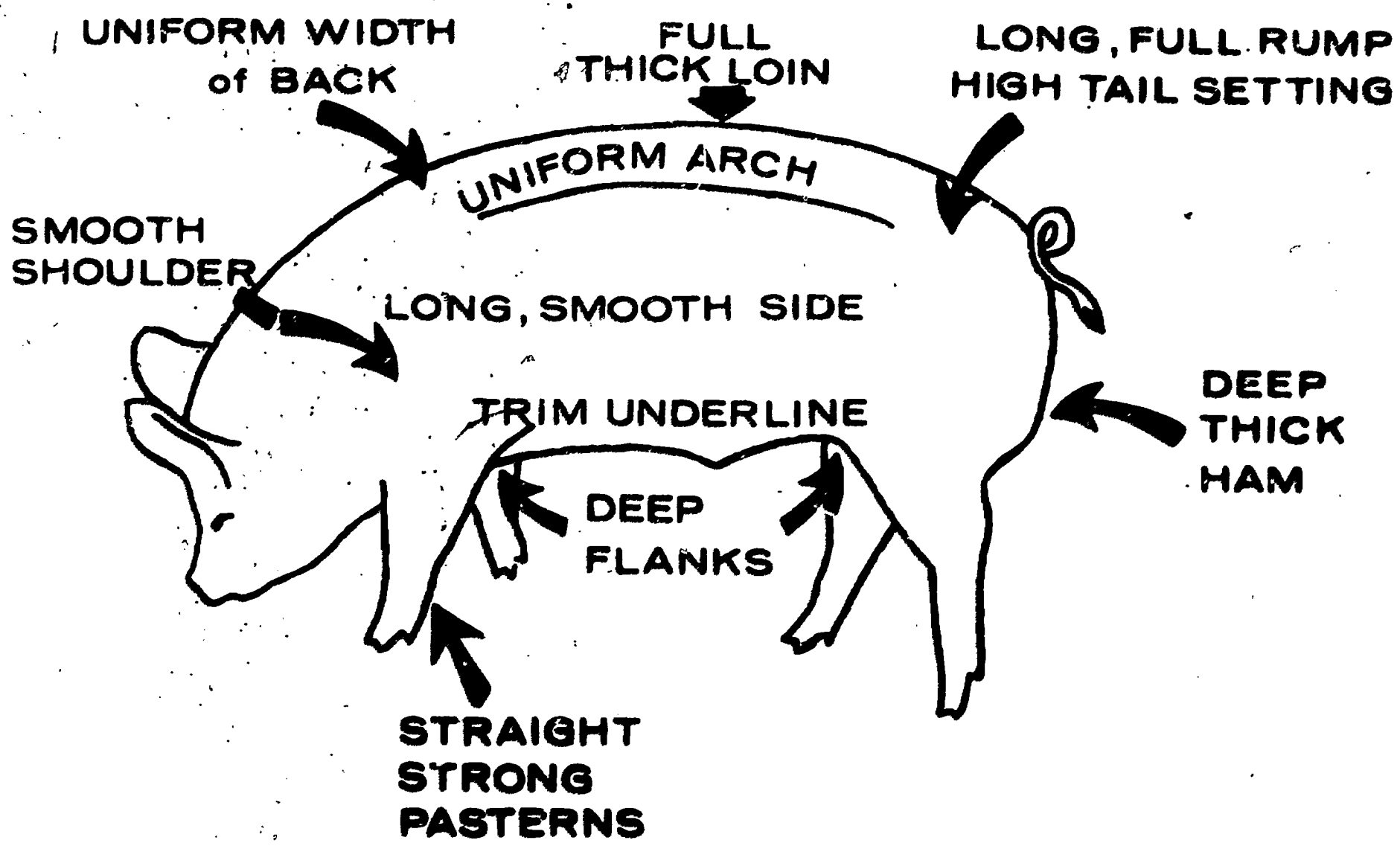


1 SNOUT	11 KNEE	21 BELLY
2 EYE	12 SHANK	22 TEATS
3 EAR	13 ANKLE	23 SHEATH
4 CHEEK	14 DEW CLAW	24 HIND FLANK
5 JOWL	15 PASTERN	25 RUMP
6 POLL	16 TOE	26 TAIL
7 NECK	17 FOREFLANK	27 HAM
8 SHOULDER	18 BACK	28 HOCK
9 FORELEG	19 LOIN	
10 ELBOW	20 SIDE	



WHOLESALE CUTS OF A PORK CARCASS

MAJOR PARTS OF A HOG



Course: Advanced Livestock Production

Area: Livestock Selection

Unit: Baisis for Selection of Foundation Stock

Job III: Selection of Beef Animals

Objectives: To acquaint the students with the proper method of selecting breeding and feeding stock

To teach students to identify beef meat cuts

Motivation : "Do you own a good bull?" "Why is he good?"

References:

1. "101 Cuts of Meat" Handbook, National Livestock and Meat Board
2. "101 Cuts of Meat" Slides, National Livestock and Meat Board
3. "101 Cuts of Meat" Cards, The Interstate
4. Livestock and Poultry Production, Bundy and Diggins
5. Livestock Judging Handbook, Nordby, Beeson, and Fourt
6. Beef Production, Diggins and Bundy (pp. 20-87)
7. "Successful Farming Livestock" 6th Edition
8. Selection, Fitting, Showing Beef Cattle, Nordby and Lattig
9. Film: "An Angus in Your Future", American Angus Association
10. Film: "Modern Beef Cattle", American Angus Association

II. "Selection of Beef Breeding Animals" Filmstrip

Teaching Outline:

I. Parts of a beef animal

II. Wholesale cuts of a beef animal

III. Ideal conformation of a beef animal

IV. Common faults in conformation

V. Important breed characteristics

VI. Identification of beef meat cuts

VII. Student judging of a class of beef animals

Teaching Procedure:

I. Introduce unit.

II. Present and discuss the cuts of meat as they pertain to economic importance.

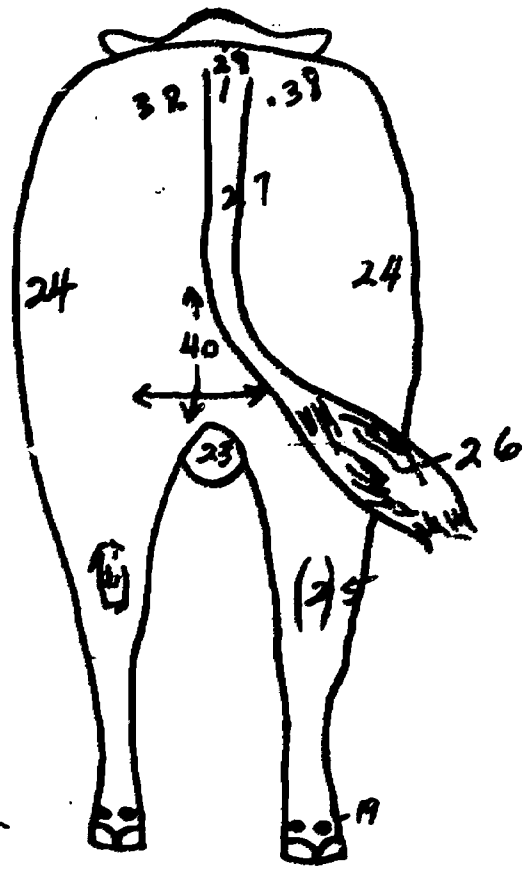
III. Arrange a sufficient number of field trips to study breeding and feeding stock for both market and feeder stock.

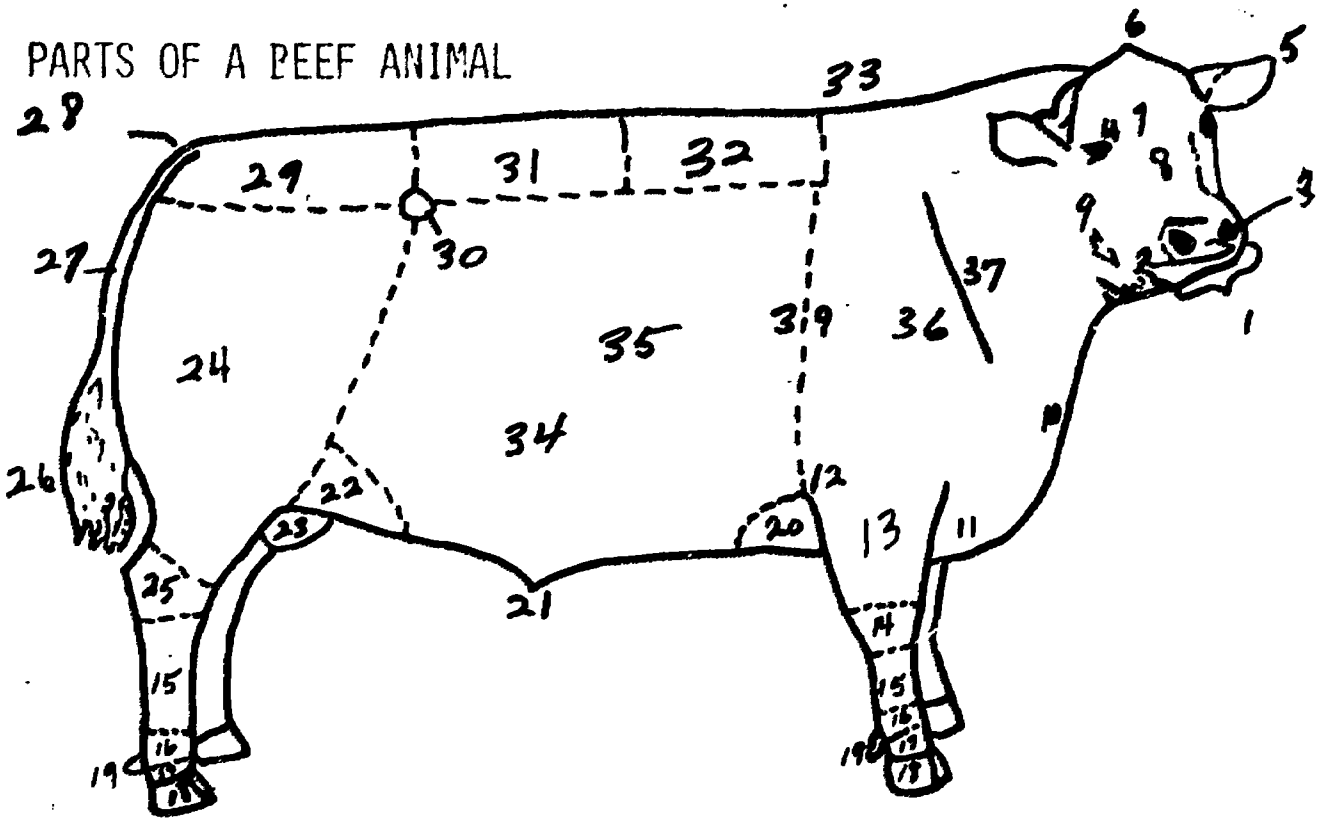
IV. Require oral or written reasons for students' selections as well as placing of animals.

V. Show films relating to beef selection.

VI. Summarize and evaluate the learning activities.

PARTS OF A BEEF ANIMAL





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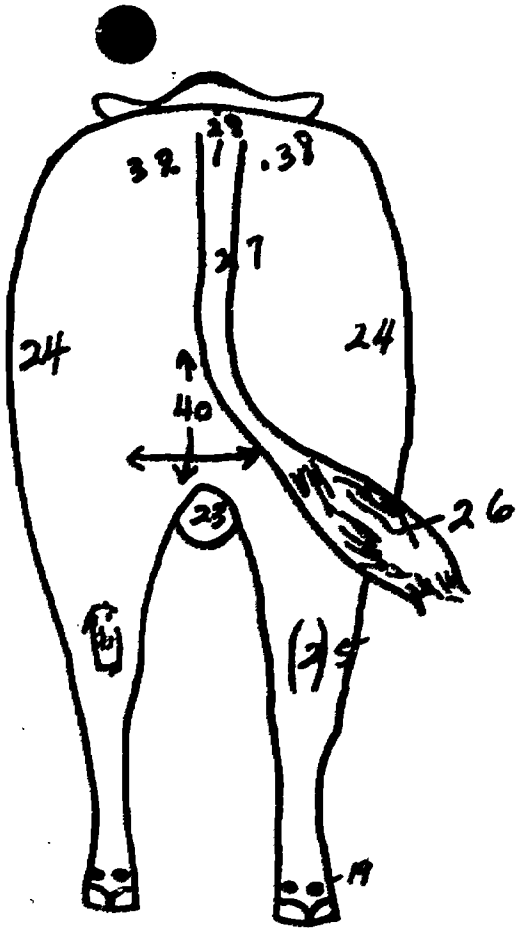
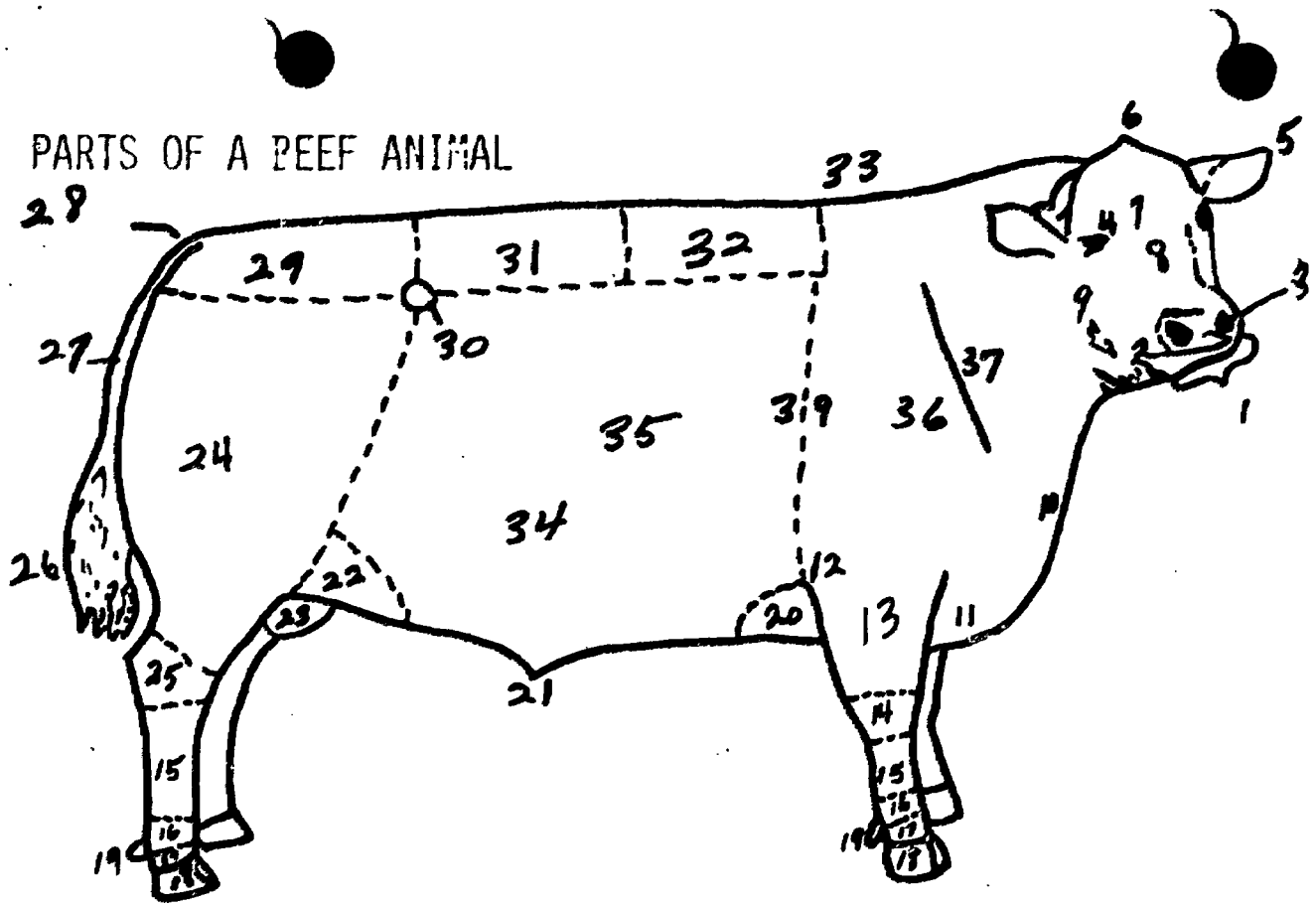
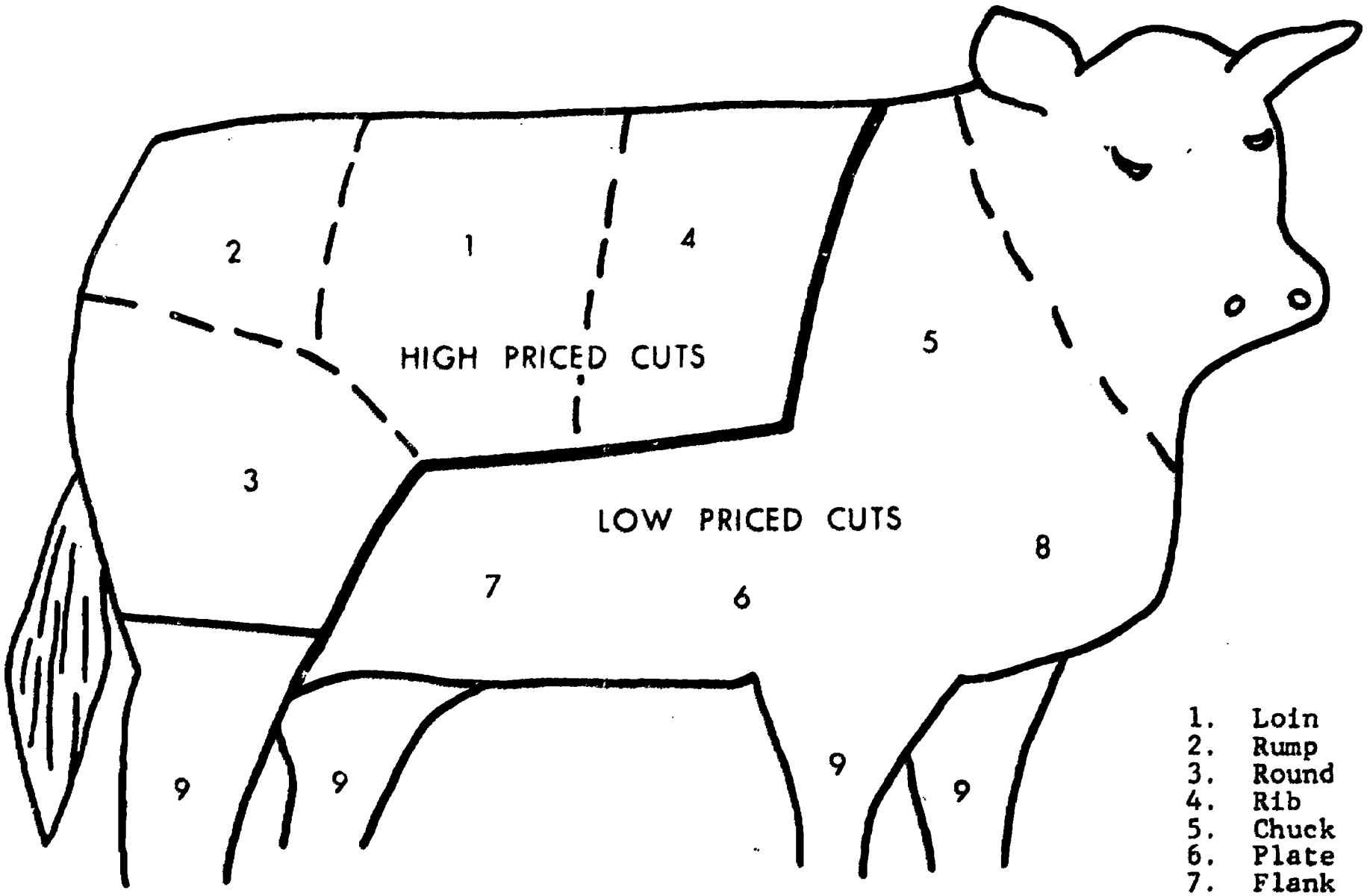


PARTS OF A BEEF ANIMAL

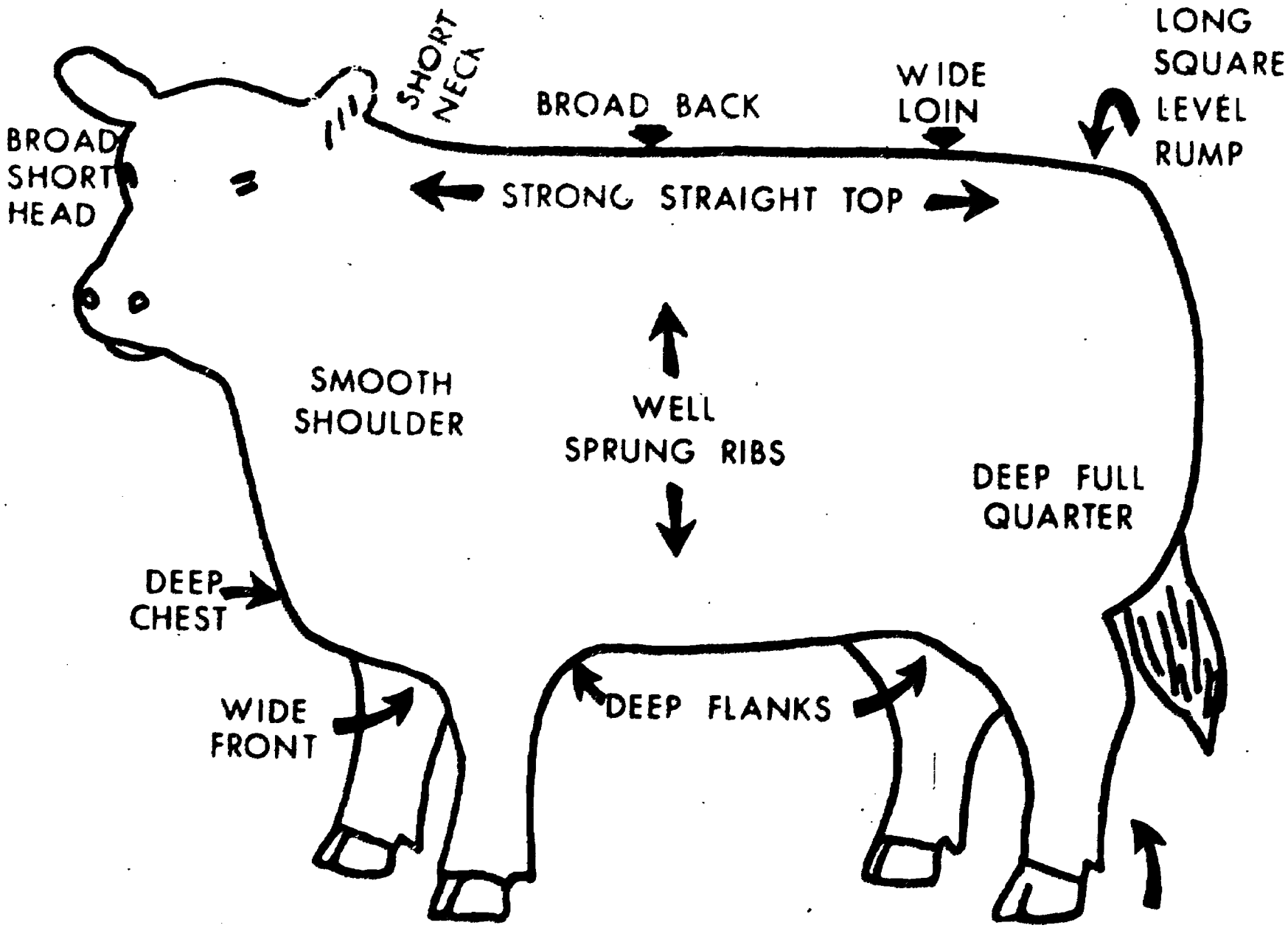


1 MUZZLE	11 BRISKET	21 PENIS AND SHEATH	31 LOIN
2 MOUTH	12 ELBOW	22 HIND FLANK	32 BACK
3 NOSTRIL	13 FOREARM	23 COD	33 TOP OF SHOULDERS
4 EYE	14 KNEE	24 ROUND OR THIGH	34 PAUNCH OR BELLY
5 EAR	15 SHANK	25 HOCK	35 RIBS
6 POLL	16 PASTERN JOINT OR ANKLE	26 SWITCH	36 SHOULDER
7 FOREHEAD	17 PASTERN	27 TAIL	37 SHOULDER VEIN
8 FACE	18 TOE OR HOOF	28 TAIL HEAD	38 PIN BONES
9 JAW	19 DEW CLAW	29 RUMP	39 HEART GIRTH
10 DEW LAP	20 FORE FLANK	30 HOOK	40 TWIST



1. Loin
2. Rump
3. Round
4. Rib
5. Chuck
6. Plate
7. Flank
8. Brisket
9. Shank

WHOLESALE CUTS OF A BEEF CARCASS



MAJOR PARTS OF A BEEF ANIMAL

Course: Advanced Livestock Production

Area: Livestock Selection

Unit: Basis for Selection of Foundation Stock

Job IV: Selection of Sheep

Objective: To teach students to recognize the ideal mutton type and to identify the meat cuts of lamb

Motivation: "Is there a place for sheep on your farm?"

"Can you tell an ideal sheep from a cull?"

"What makes sheep judging so deceptive?"

References:

1. "101 Cuts of Meat" Handbook, National Livestock and Meat Board
2. "101 Cuts of Meat" Slides, National Livestock and Meat Board
3. "101 Cuts of Meat" Cards, The Interstate
4. Livestock and Poultry Production, Bundy and Diggins (pp. 440-446)
5. Livestock Judging Handbook, Nordby, Beeson, and Fourt

7. Films:

   (a) "Culling Sheep", Union Pacific Railroad

   (b) "Sheep Shape", The Venard Organization

   (c) "Story of Sheep." Texaco, Inc.

Teaching Outline:

I. Parts of a sheep

II. Wholesale cuts of a sheep carcass

III. Ideal conformation of sheep

IV. Common faults in conformation

V. Important breed characteristics

VI. Identification of the cuts of meat of sheep

VII. Student judging of a class of sheep

Teaching Procedures:

I. Introduce unit.

II. Arrange a sufficient number of field trips to study breeding stock and apply classroom information.

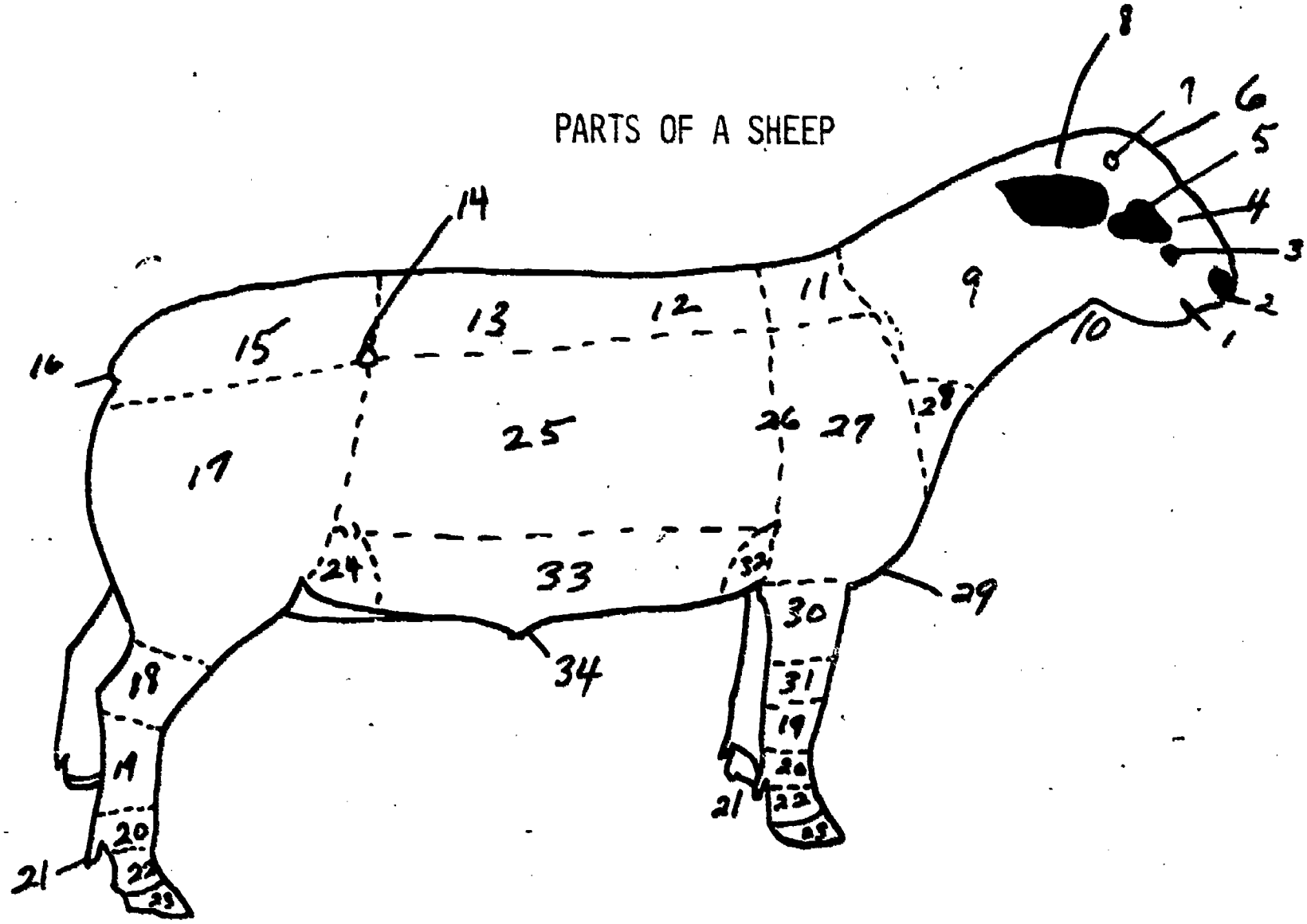
III. Require oral or written reasons for students' selections as well as for placing of animals.

IV. Present and discuss the cuts of meat as they pertain to economic importance.

V. Show films relating to selection of sheep.

VI. Summarize and evaluate the learning activities.

PARTS OF A SHEEP



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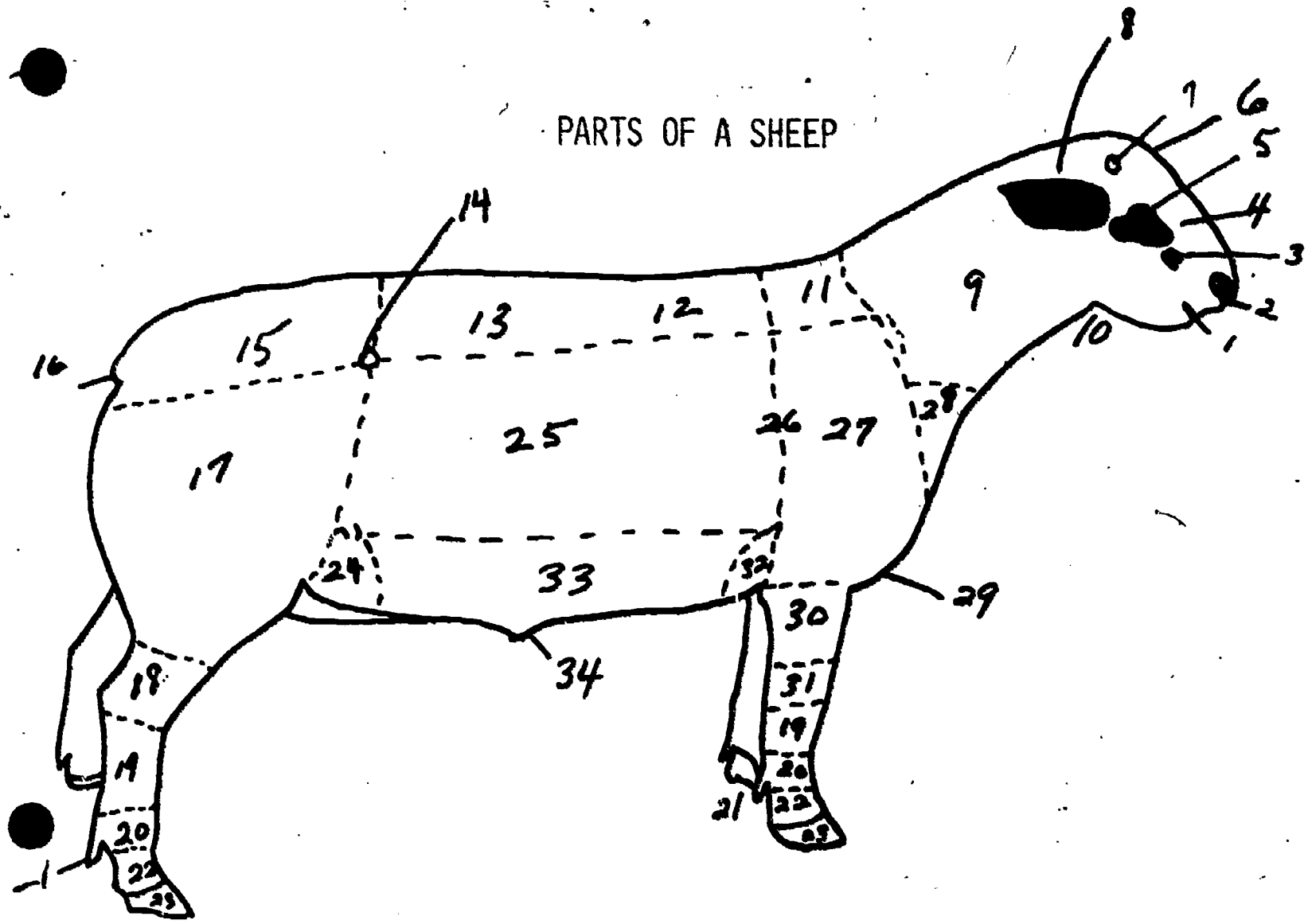
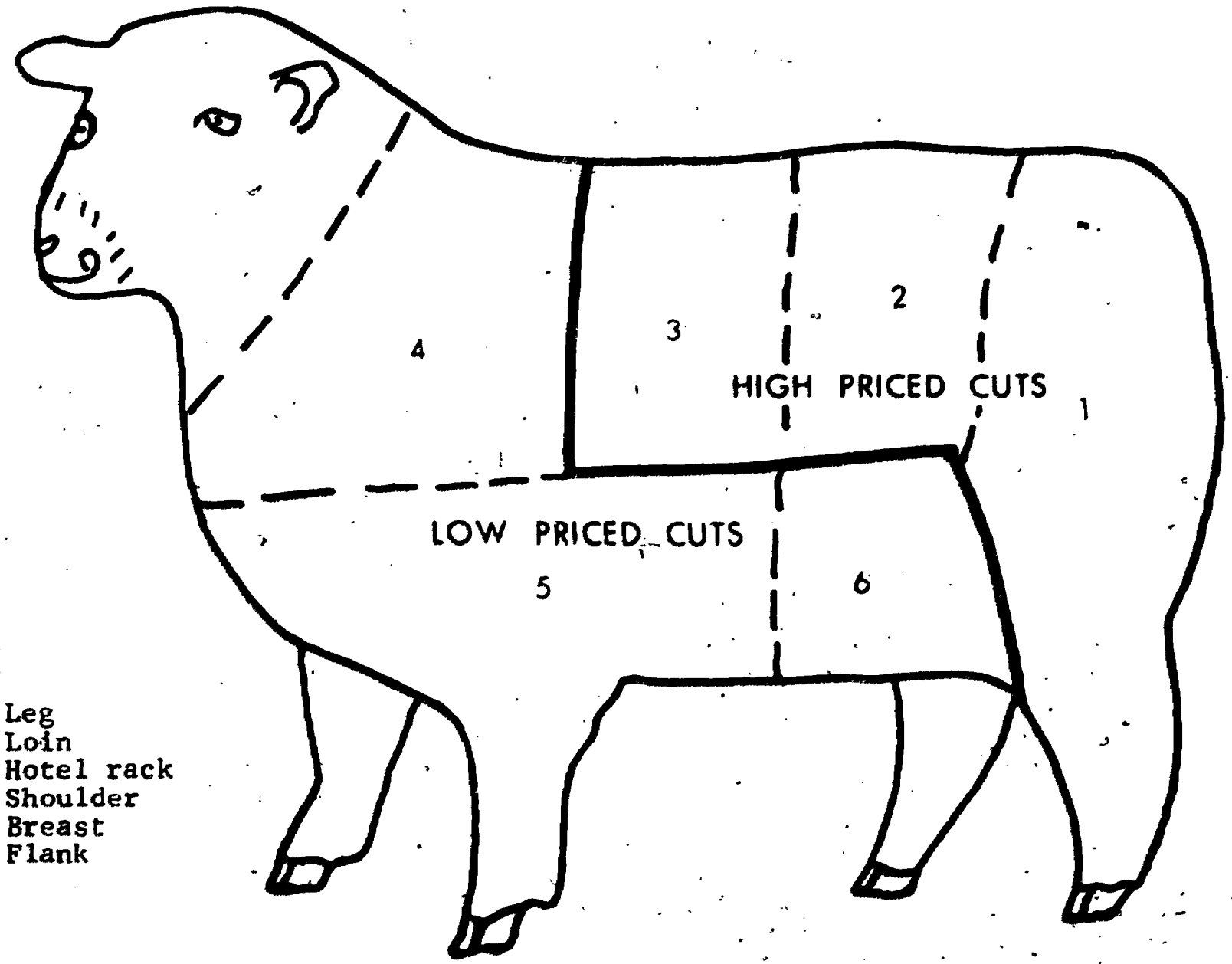
PARTS OF A SHEEP



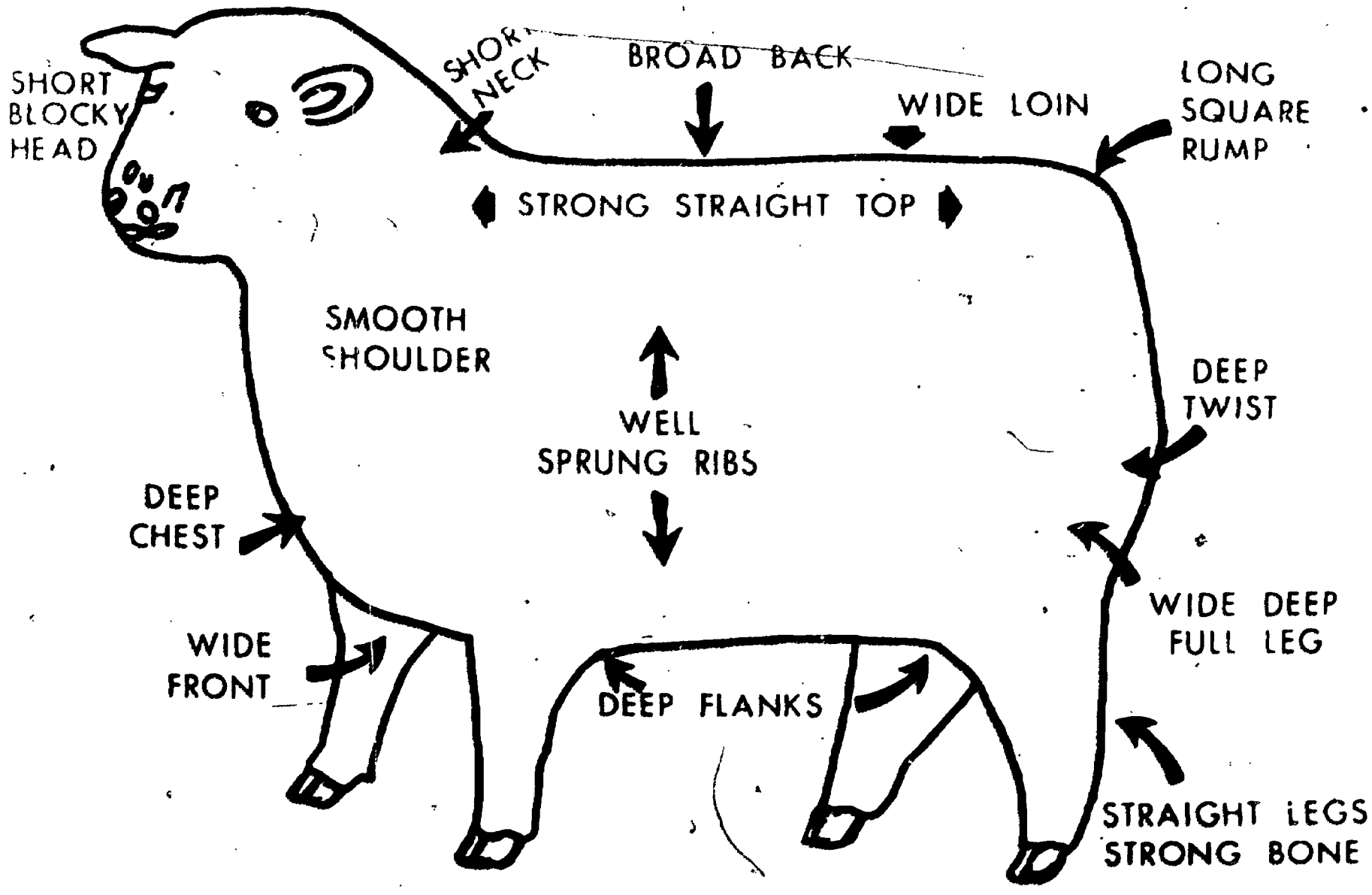
1 MOUTH
2 NOSTRIL
3 SUBORBITAL GLAND
4 FACE
5 EYE
6 FOREHEAD
7 HORN PIT
8 EAR
9 NECK
10 THROAT
11 TOP OF SHOULDER
12 BACK
13 LOIN
14 HIP
15 RUMP
16 DOCK
17 LEG OF LAMB
18 HOCK
19 SHANK
20 PASTERN JOINT OR ANKLE
21 DEW CLAW
22 PASTERN
23 TOE
24 HIND FLANK
25 RIBS
26 HEART GIRTH
27 SHOULDER
28 BREAST
29 BRISKET
30 FOREARM
31 KNEE
32 FOREFLANK
33 BELLY
34 PENIS



Key:

1. Leg
2. Loin
3. Hotel rack
4. Shoulder
5. Breast
6. Flank

Wholesale Cuts of a Lamb Carcass.



Major Parts of a Sheep

Course: Advanced Livestock Production

Area: Livestock Selection

Unit: Basis for Selection of Foundation Stock

Job V: Selection of Dairy Cattle

Objectives: To understand the importance of type in dairy selection

To practice using judgment in selecting dairy individuals

Motivation: "Which breed of dairy cattle is best?" "Why?"

References:

1. Livestock and Poultry Production (pp. 299-320)
2. Dairy Cattle Judging and Selection, Yapp, John Wiley and Sons
3. Livestock Judging Handbook, Nordby, Beeson, and Fourt
4. "Dairy Cattle Unified Score Card"
5. "Dairy Bull Unified Score Card"
6. "Dairy Herd Improvement Association" Records
7. "Annual Missouri D. H. I. A. Summary"
8. "Dairy Cattle Breeds," U. S. D. A. 1443
9. "Dairy Cattle Selection," U. S. D. A. 1769
10. "Improving Dairy Cattle Through Selection," M. U. Guide (p. 3710)
11. Films:
    (a) "Animal Wonders", American Guernsey Cattle

(b) "National Dairy Cattle Congress," Purdue Audio Visual Center

(c) "Raising Dairy Calves," Union Pacific Railroad

(d) Selecting and Judging Guernseys," American Guernsey Cattle

13. Breed association information

14. Hoard's judging units

Teaching Outline:

I. Importance of breed character and dairy type

II. Dairy herd improvement associations

III. Use of unified score cards

IV. Placement of classes

Teaching Procedure:

I. Introduce unit.

II. Show films and review breed information concerning the selection of dairy animals.

III. Discuss unified score cards.

IV. Review judging materials.

V. Arrange for field trips to make application of learned materials.

VI. Require written or oral reasons on classes placed.

VII. Summarize and evaluate the learning activities.

LIVESTOCK BREEDING

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Improvement of Livestock

Job VI: History of Livestock Breeding

Objectives: To develop an appreciation of past vork accomplished in the breeding of animals

To understand how livestock breeders have used genetic principles to improve livestock

Motivation: "What improvements have been made in the methods of breeding livestock over the past five centuries?"

Show a picture of a crossbred animal and ask students to identify the breeds of its parents.

References:

1. Breeding and Improvement of Farm Animals. Rice and Andrews, 1951 (Chapters 1 and 2)
2. Introduction to Breeding Farm Animals, Winters (pp. 1-18)
3. "Reproduction of Farm Animals", Cornell Bulletin 305
4. "Livestock Breeding Pointers", M. U. Guide 2908
5. Slides (AS 65), Iowa State University
6. Genetics of Livestock Improvements, Lasley

7. Livestock and Poultry Production, Bundy and Diggins

8. Film: "Animal Breeding", Indiana Farm Bureau

Teaching Outline:

I. Early breeders and their breeding principles

II. Origins of present day breeds of livestock

III. Implications of early breeding practices on present day livestock

Teaching Procedure:

I. Introduce unit.

II. Discuss who early breeders of livestock were and what advancements they made.

III. Present information concerning origins of breeds of livestock and discuss implications of origins of these breeds.

IV. Show film relating to history of animal breeding.

V. Show pictures of present day and past types of livestock and discuss how these improvements were brought about.

VI. Summarize and evaluate the learning activities.

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Improvement of Livestock

Job VII: Present day Livestock Breeding

Objective: To instruct students in proper methods of livestock improvement

Motivation: "If you had a dairy cow producing 10,000 pounds of milk per year and you wanted 15,000 pounds, how would you go about attaining your goal?"

References:
1. Introduction to Breeding Farm Animals, Winters
2. Livestock and Poultry Production (pp. 55-60)
3. Swine Production, Bundy
4. "Improvement of Swine Through Breeding." Lasley (Bulletin)
5. Iowa State Slides
6. "Animal Science" Slides (numbers 76-112) Iowa State
7. Doanes Agricultural Report, "Advances in Beef Cattle Crossbreeding" (p. 267)
8. Doanes Agricultural Report, "Principles of Beef Production Testing" (p. 269)

Teaching Outline:

I. Students should understand the systems of breeding and their place in livestock production.

A. Upgrading

B. Purebred breeding

C. Cross breeding

D. Inbreeding

E. Crisscross breeding

F. Rotation breeding

G. Line breeding

H. Crossline breeding

Teaching Procedure:

I. Introduce unit.

II. Give handouts from the unit.

III. Have students plan a hypothetical breeding program for a given kind of livestock.

IV. Discuss how breeding systems can be applied to the home situation.

V. Summarize and evaluate the learning activities.

TABLE I

SAMPLE RECORD KEEPING FORM

LITTER RECORD

SOW NUMBER _____ DATE FARROWED _____ SIRE _____

NO. FARROWED _____ NO. BORN ALIVE _____ NO. WEANED _____

NO. MARKETED _____

LITTER NUMBER _____

PIG NO.	SEX	BIRTH WT.	WEANING WT.	AGE AT 200 POUNDS	B. F. PROBE 200 LBS.	COMMENTS

TABLE II

BOAR INFORMATION SHEET

BREEDER _____ ADDRESS _____

BREED _____ EAR MARKS OR NO. _____

A. HEALTH INFORMATION:

DOUBLE TREATED FOR CHOLERA (YES OR NO)_____ DATE

TREATED _____

ERYSIPELAS (YES OR NO) _____ DATE _____

OTHER _____ DATE _____

BLOOD TEST ___

BRUCELLOSIS, DATE AND RESULTS

_____

LEPTOSPIROSIS, DATE AND RESULTS

_____

PARASITE CONTROL: EXTERNAL, DATE & MATERIAL USED _____

INTERNAL, DATE AND MATERIAL USED _____

B. RATIONS FED:

COMPLETE RATION (YES OR NO) _____

ANTIBIOTIC (YES OR NO) _____

PER CENT PROTEIN _____

C. PERFORMANCE TESTING DATA:

DATE FARROWED _____ NO. FARROWED _____

NO. WEANED _____

PR WEIGHT _____ CERTIFIED LITTER _____

AV. DA. GAIN _ _ _ _ _ _ _ _ _ ADG ON LITTERMATES

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

FEED EFFICIENCY _

ADJ. BACK FAT PROBE _

BACK FAT PROBE ON LITTER MATES _ _ _ _ _ _ _ _ _ _ _ _ _ _

CARCASS DATA LITTERMATES:

LENGTH _ _ _ _ _ _ _ _ _

BACK FAT _ _ _ _ _ _ _ _

LOIN AREA _ _ _ _ _ _ _ _

% LEAN CUTS _ _ _ _ _ _ _

TESTED ON FARMS _

TESTED STATION _

Course: Advanced Production

Area: Livestock Breeding

Unit: Improvement of Livestock

Job VIII: Trends in Livestock Improvement

Objective: To foster a knowledge of current happenings in the science of livestock breeding.

Motivation: "Would it be possible for one proven sow to furnish the embryos for an entire herd?"

References: 1. Current magazine articles

2. "Beef Cattle Breeding" Bulletin

3. Film: "Animal Wonders"

4. "Improvement of Swine Through Breeding" Lasley, Day, Tribble, University of Missouri Bulletin

Teaching Outline:

I. Embryo transplant

II. Hormonal usage

III. Inheritable docking of lambs

IV. Multi-gestational births (superfetation)

V. Influencing multibirths with hormones

Teaching Procedure:

I. Discuss innovations in the field of animal breeding to enlighten the students upon the scope of the field .

II. Assign each student a report to be obtained from current publications concerning new aspects of the animal breeding area.

III. Discuss the reports plus previously acquired material concerning new advancements in animal breeding.

IV. Summarize and evaluate activities.

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Reproductive Physiology

Job IX: Male Reproductive System

Objective: To develop an understanding of the vocabulary, parts and function of the male reproductive system

Motivation: "Is it possible that a male animal can produce between two and three million live, viable sperm?"

References:
1. Livestock and Poultry Production, Bundy and Diggins.
2. Introduction to Breeding Farm Animals, Winters (pp. 32-35)
3. Breeding and Improvement of Farm Animals, Rice and Andrews
4. "The Reproduction of Farm Animals," Cornell Bulletin 305
5. "Animal Science" Slides

Teaching Outline:

I. Parts of male animal's reproductive system

II. Function of parts

III. Comparison among animals

IV. Major defects of the male reproductive system

Teaching Procedure:

I. Introduce unit.

II. Hand out and discuss sheets relating to male reproductive parts.

III. Hand out sheets relating to function of parts of the male reproductive system and discuss the function of each part.

IV. Compare and contrast the reproductive parts of farm animals.

V. Secure the reproductive system of a male animal for students to study.

VI. Discuss what malfunctions of the reproductive system can occur.

VII. Summarize and evaluate the learning activities.

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Reproductive Physiology

Job X: Female Reproductive System

Objective: To develop an understanding of the vocabulary, parts and function of the female reproductive system

Motivation: "Why is it that cows generally have only one calf and sows have multiple births?"

Reference:

1. Livestock and Poultry Production, Bundy and Diggins
2. Introduction to Breeding Farm Animals, Winters
3. Breeding and Improvement of Farm Animals, Rice and Andrews
4. "The Reproduction of Farm Animals," Cornell Bulletin 305
5. "Animal Science" Slides (numbers 59-60)

Teaching Outline:

I. Parts of female system of reproduction

II. Functions of parts of female system

III. Comparisons among farm animals

IV. Defects likely to occur in the female system

Teaching Procedure:

I. Introduce unit.

II. Use handout sheet as a basis for a discussion of the parts of the female reproductive system.

III. Hand out sheet concerning the function of the female reproductive system and discuss the role of the system's parts in the overall scheme of the female reproductive system.

IV. Secure the reproductive system of a female animal for students to study.

V. Hand out sheet showing comparison of the female reproductive systems of animals.

VI. Discuss what malfunctions of the reproductive system can occur.

VII. Summarize and evaluate learning activities.

FIGURE 1

TYPES OF UTERI

DUPLEX

RAT

OPPOSUM

BICORNUATE

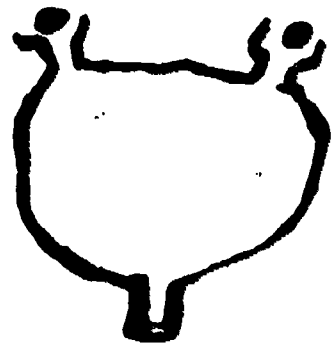
PIG

BIPARTITE

EWE

COW

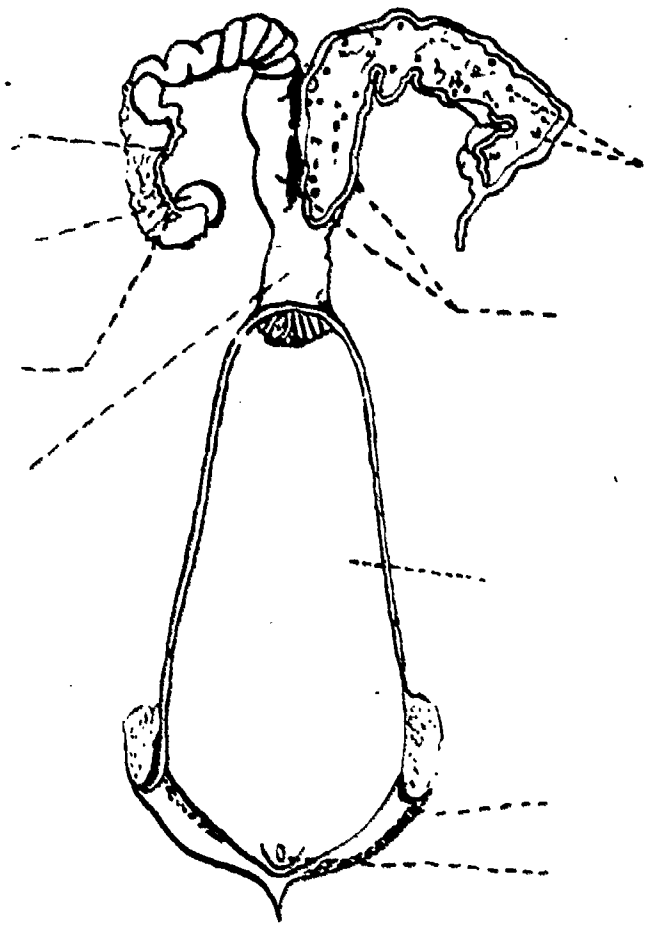
MARE



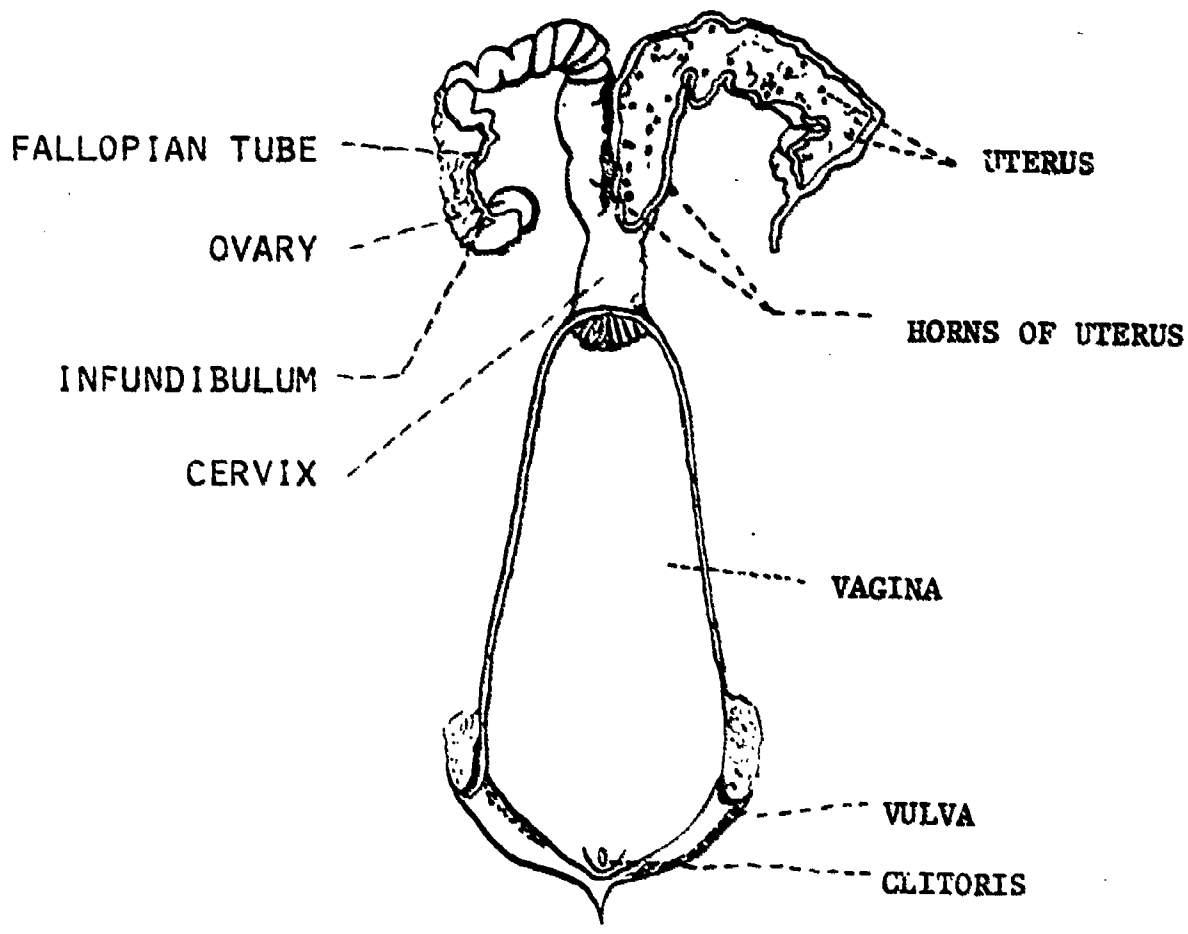
SIMPLEX

HUMAN

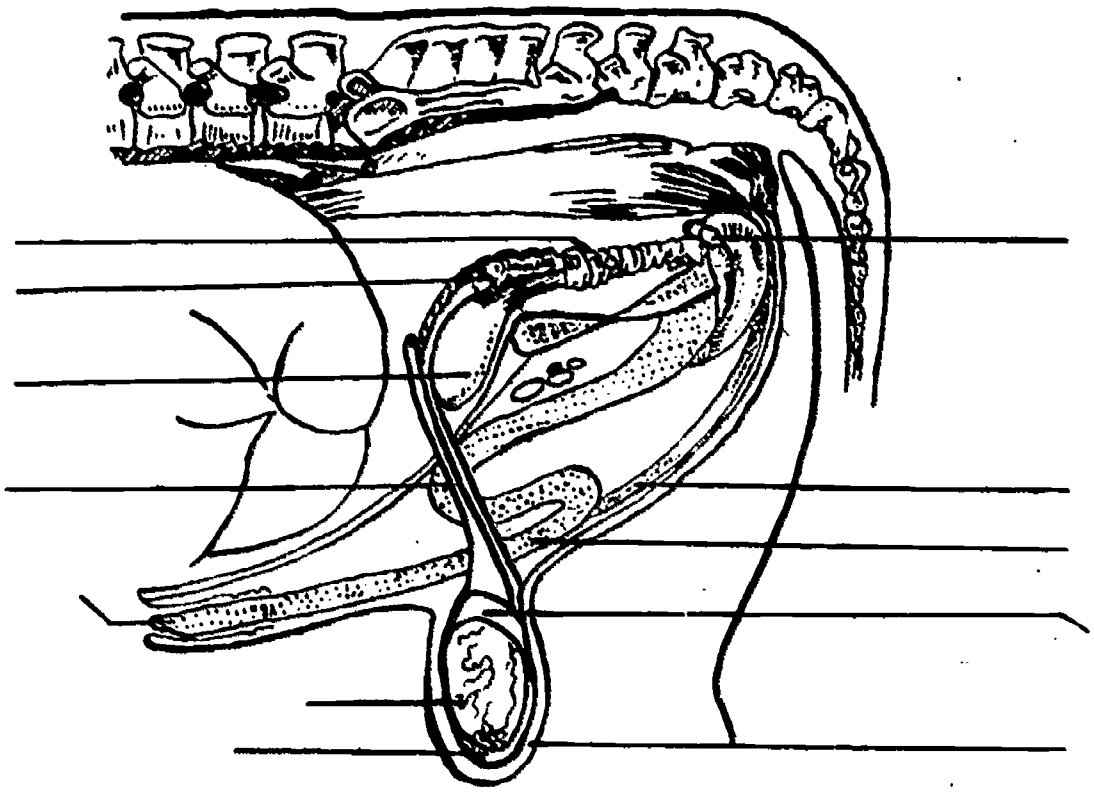
REPRODUCTIVE ORGANS OF A COW



REPRODUCTIVE ORGANS OF A COW



REPRODUCTIVE ORGANS OF A BULL



REPRODUCTIVE ORGANS OF A BULL

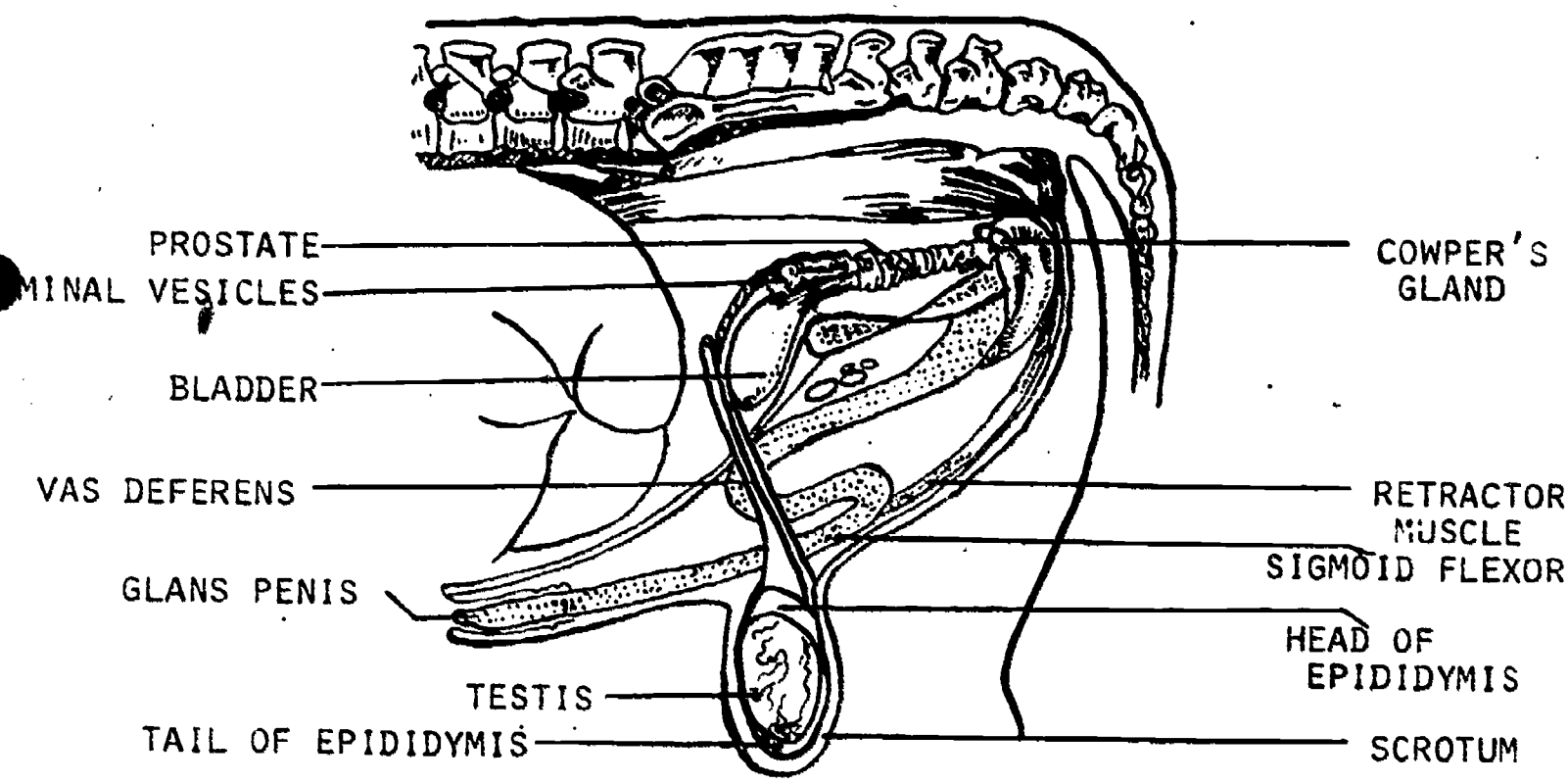
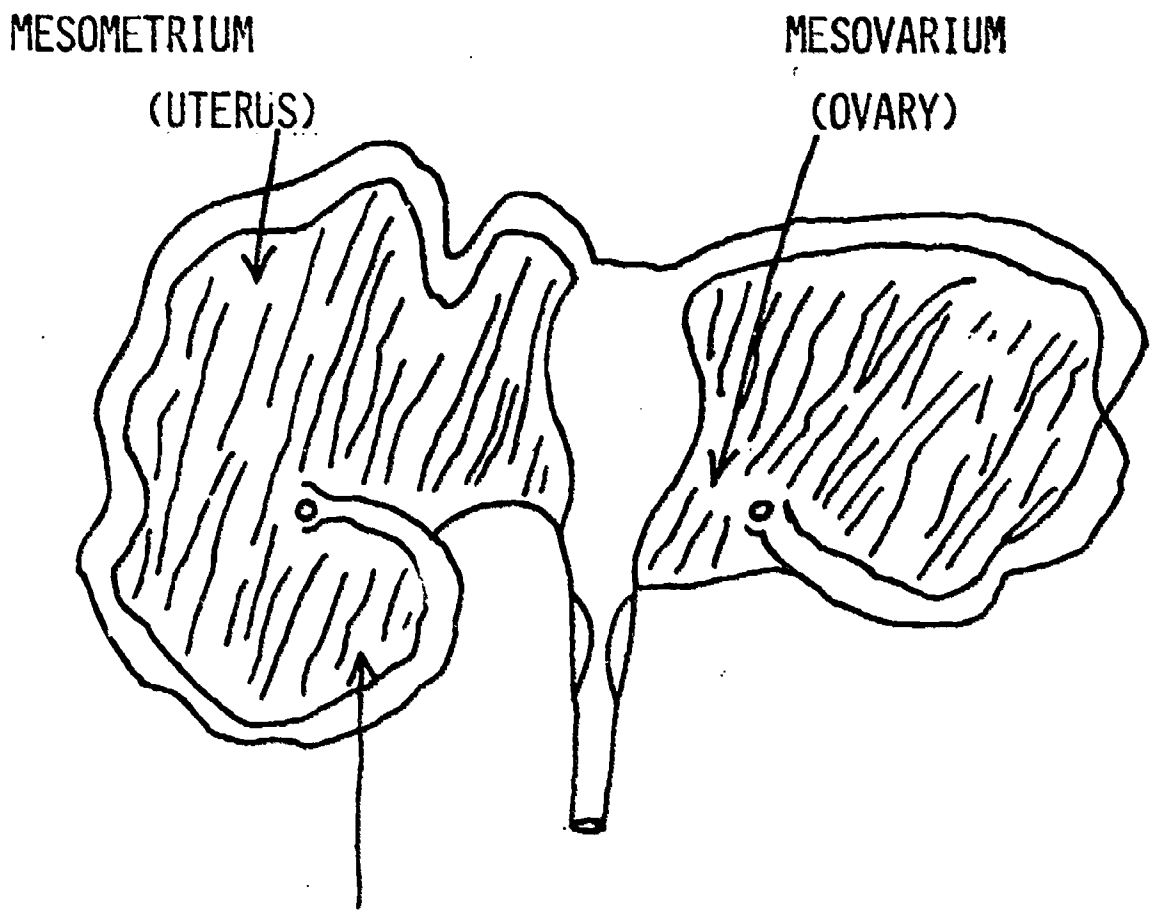


FIGURE 2

FEMALE REPRODUCTIVE TRACT

BROAD LIGAMENT



Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Reproductive Physiology

Job XI: Physiology of Reproduction

Objectives: To develop an understanding of how a testicle functions

To develop an understanding of how an ovary functions.

Motivation: "How are sperm produced?" "How is an ovum produced?"

References:
1. Introduction to Breeding Farm Animals, Winters
2. Breeding and Improvement of Farm Animals, Rice and Andrews
3. "The Reproduction of Farm Animals," Cornell Bulletin 305
4. "Animal Science" Slides (numbers 57-58, 61-65)
5. "Livestock Breeding Pointers," M. U. Guide (p. 2908)

Teaching Outline:

I. Parts and function of the testicle

II. Parts and function of the ovary

Teaching Procedure:

I. Discuss the parts of the testicle and their functions.

II. Discuss the parts and functions of the ovary.

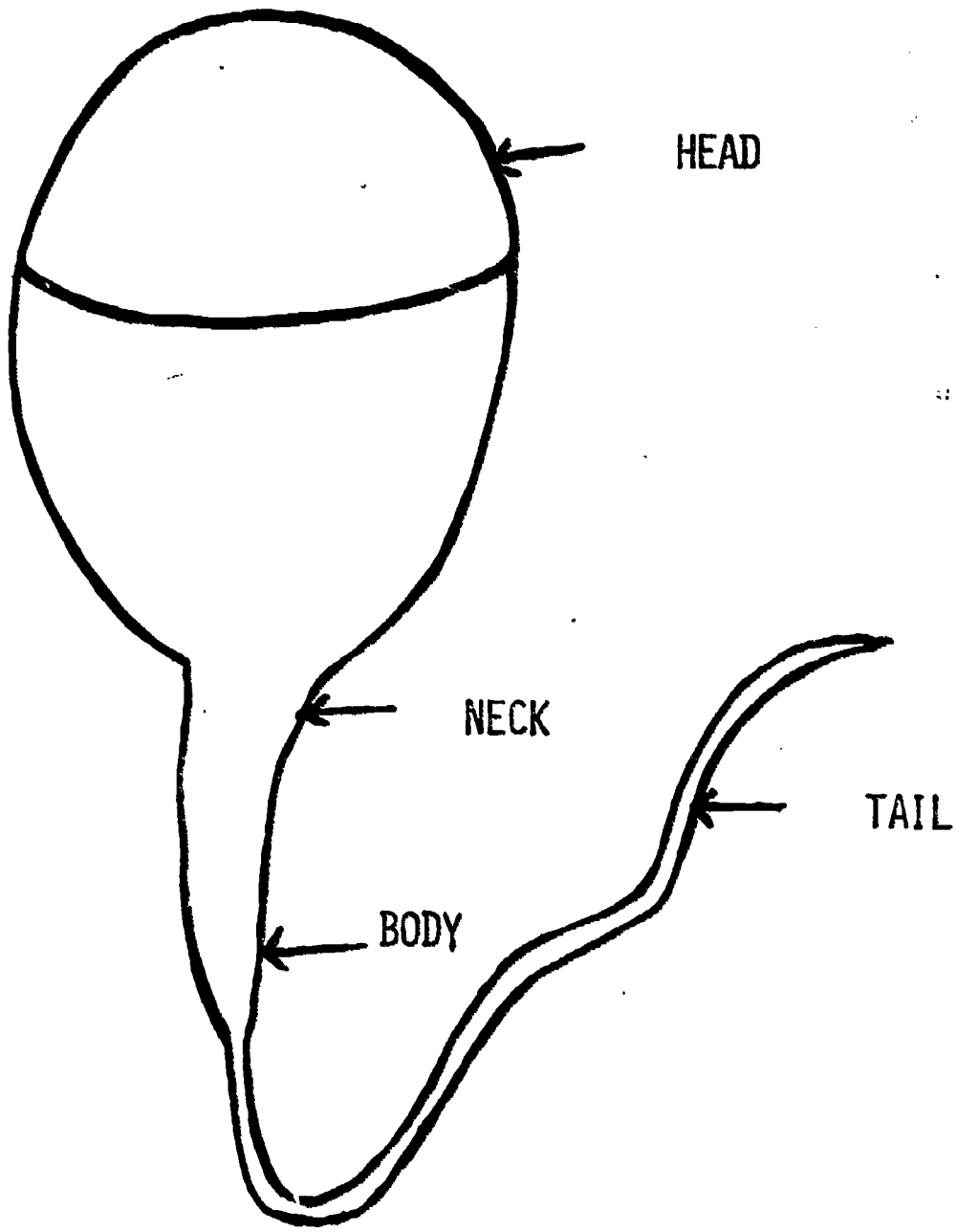
III. Discuss complexity and variability within reproductive systems.

IV. Relate sperm mortality rate within the female reproductive system to conditions within the system.

V. Summarize and evaluate the learning activities.

FIGURE 3

SPERMATOZOON



"From Breeding and Improvement of Farm Animals by Rice et al. Copyright (c) 1957 by McGraw-Hill, Inc. Used with permission of McGraw-Hill Book Company."

FIGURE 4

SECTIONAL OF TESTIS

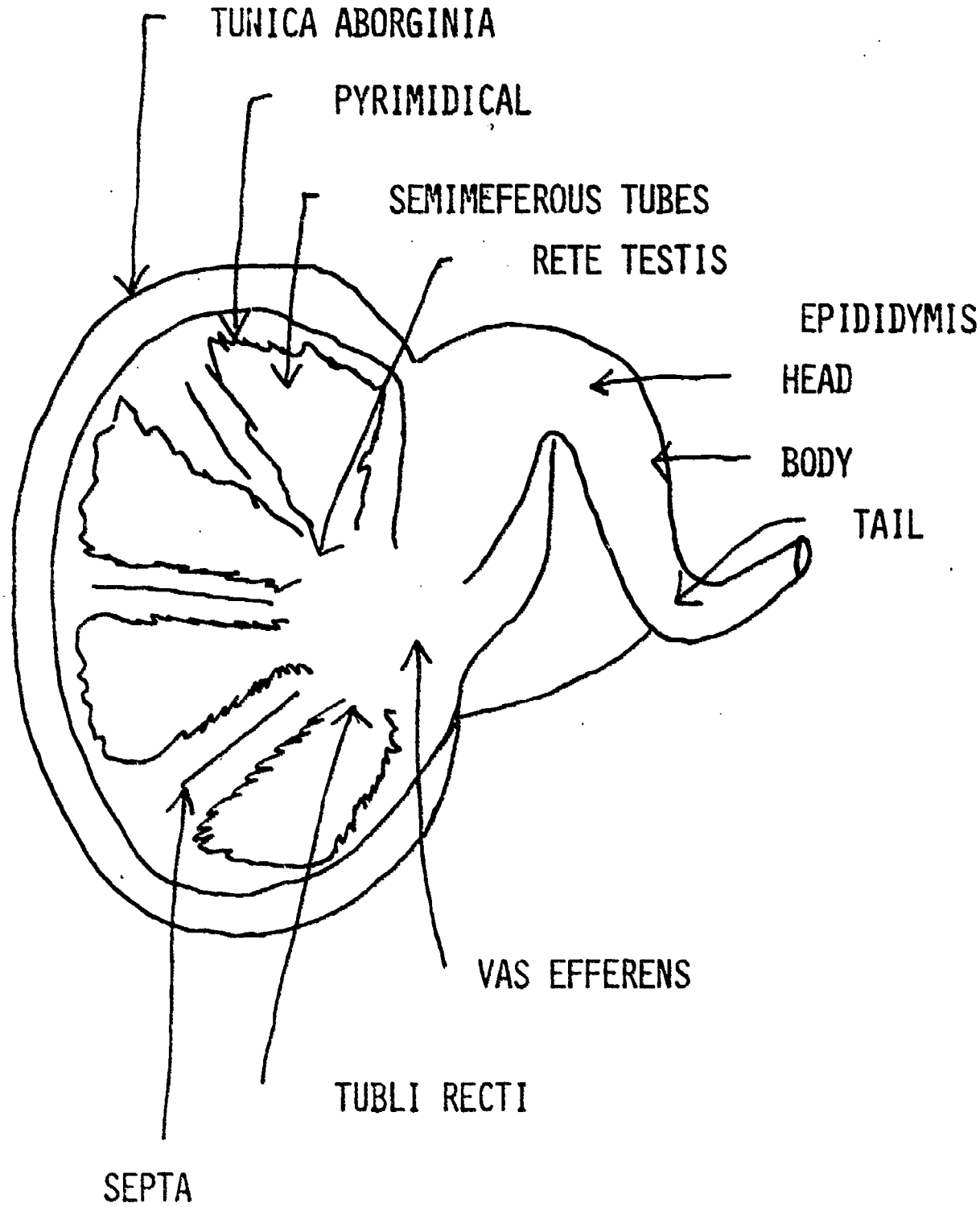
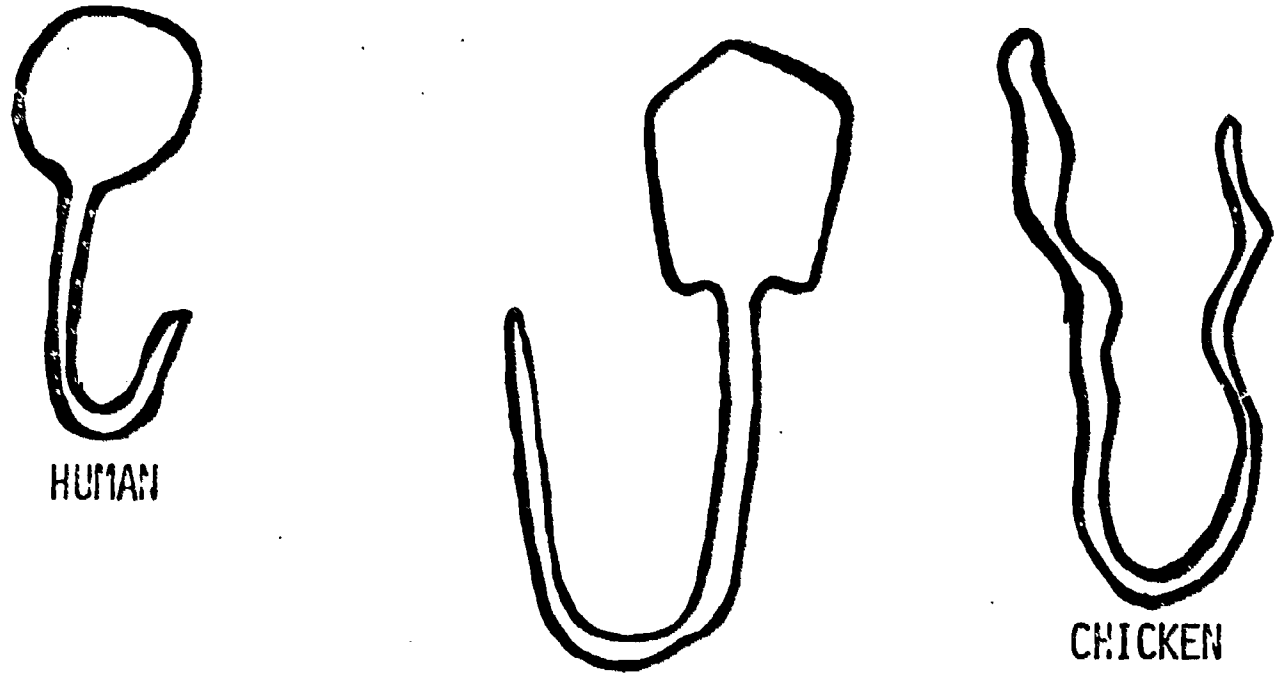


FIGURE 5

SPERMATOZOA



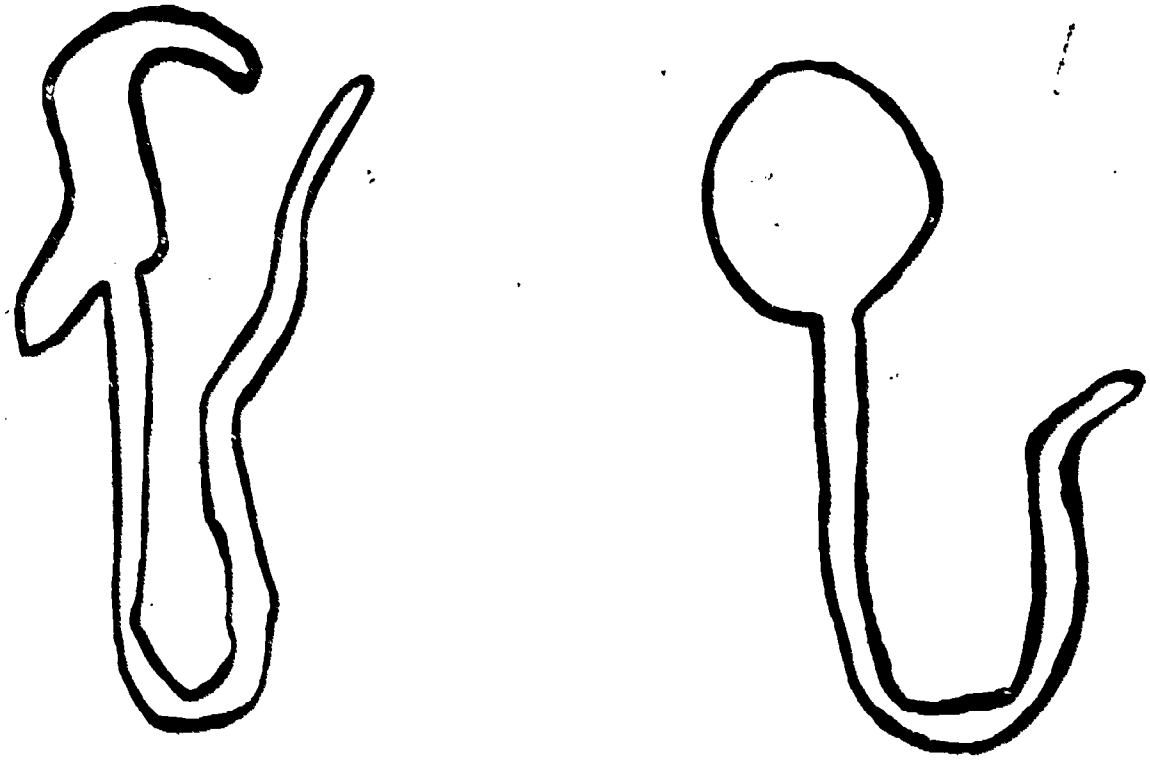


FIGURE 6

GRAAFIAN FOLLICLE

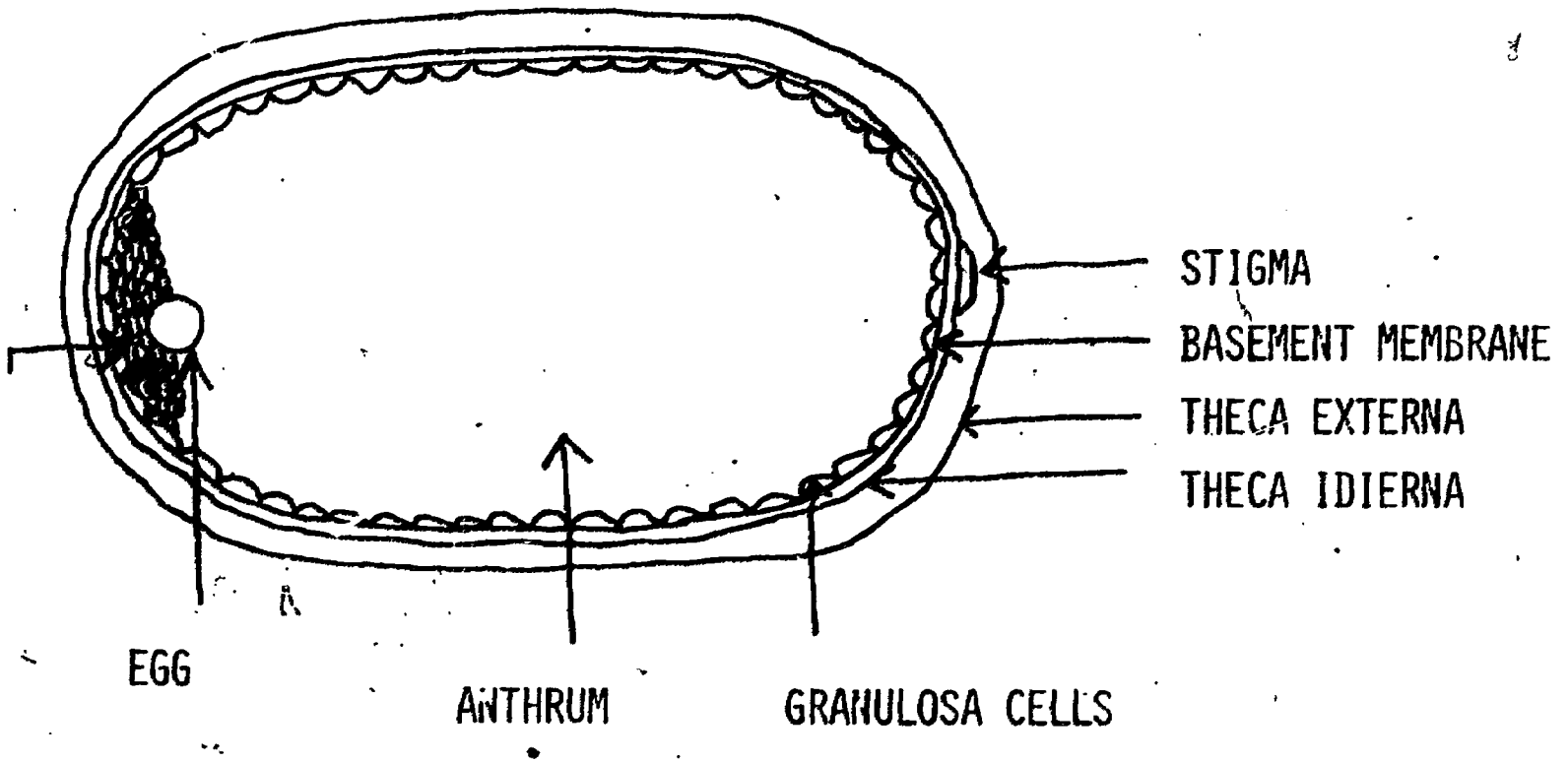


FIGURE 7

OVARY

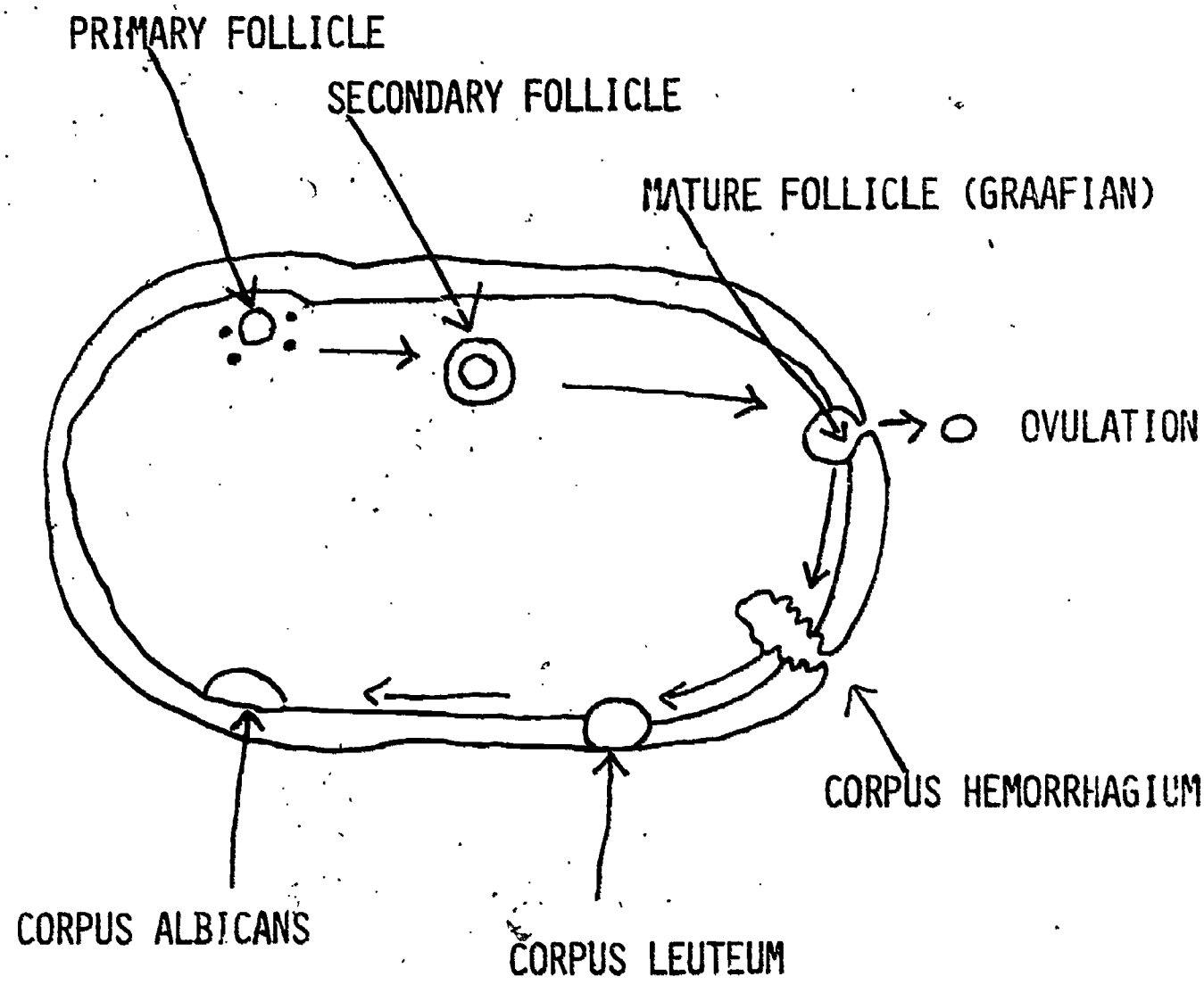


FIGURE 8

OVUM

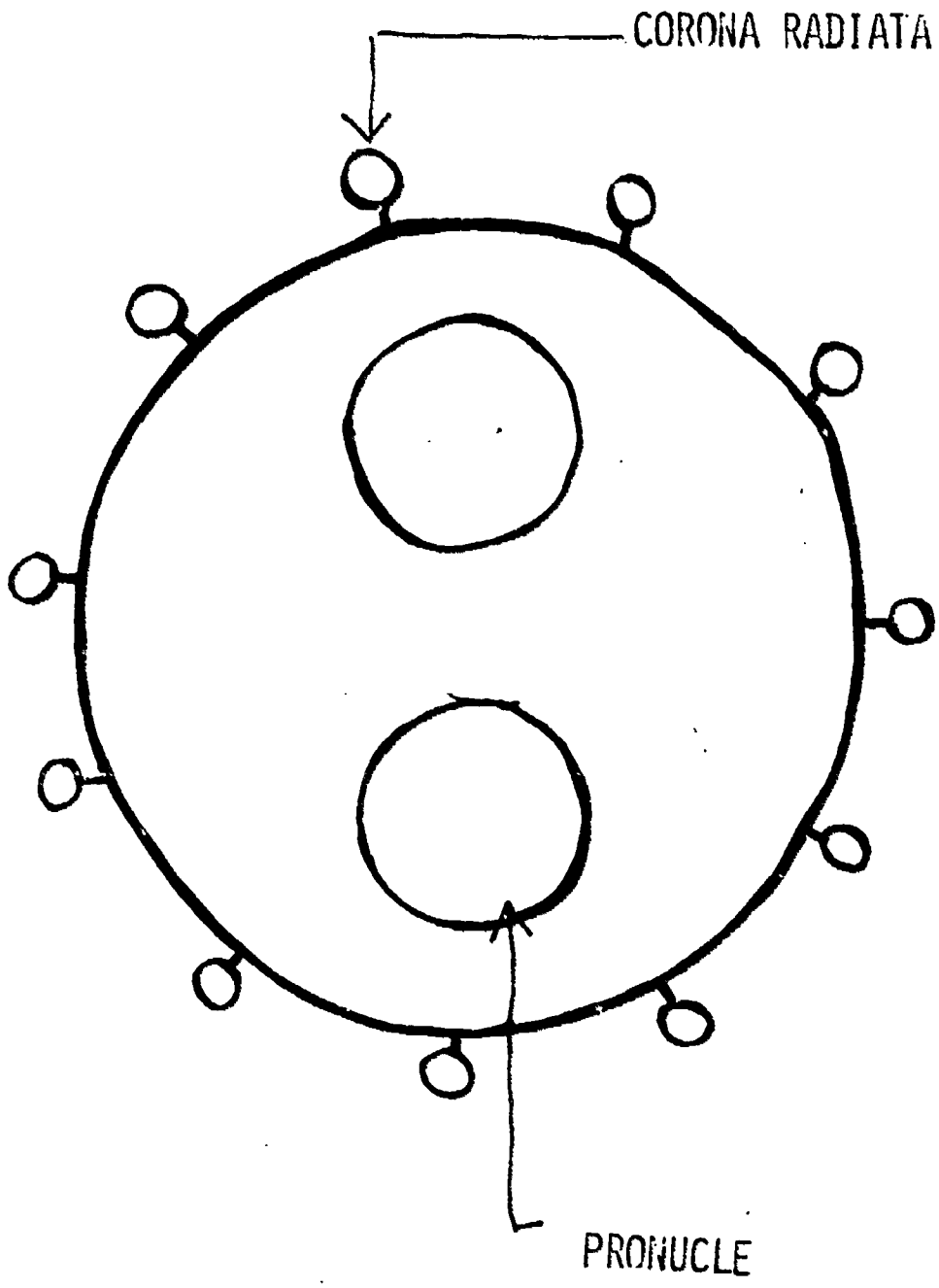


TABLE III

FOLLICLE TERMS

Primary Follicle--During the first stage there are many primary follicles within a female at birth.

Secondary Follicle--Anthrum begins to form in the follicle.

Graafian Follicle--Estrus begins when this stage is reached.

Ovulation--The causes of ovulation are not known.

Corpus Hemorrhagicum--The condition of the follicle after ovulation is known as corpus hemorrhagicum.

Corpus Luteum--The condition of the follicle two to three days after corpus hemorrhagicum, which prepares uterus for estrus and will maintain the pregnancy, is known as corpus luteum.

Corpus Albicans--Corpus albicans, the condition of the follicle after corpus luteum if pregnancy hasn't resulted, is generally absorbed by the body. In cow, sow, and mare, it takes 21 days to regress, while in ewes, it takes 16 days.

TABLE IV

FACTORS RELATED TO SPERM PRODUCTION

1. SPECIES

	SEMEN/ EJACULATION	SEMEN/ MM3	VOLUME IN CC
BOAR	20 BILLION	100.000	200
BULL	4 BILLION	1 MILLION	4-6
RAM	2 BILLION	2 MILLION	.8
STUD	6 BILLION	100.000	100
CHICKEN	4 BILLION	4 MILLION	.2-1.5

2. AGE

3. GENETIC - - HYBRIDS

   (A) CATTALO - - MALE STERILE (SMALL SCROTUM)

   (B) MULE OR HINNEY

      1. HORSE - - 60 CHROMOSOMES

      2. JACK - - 64 CHROMOSOMES

      3. MULE - - 62 CHROMOSOMES - - MALE STERILE, A FEW FEMALES FERTILE

4. NUTRITION

   (A) VITAMIN E - - RATS ONLY

   (B) VITAMIN A - - HEALTHY MUCOUS MEMBRANES

   (C) OVERFITTING DETRIMENTAL TO FERTILITY

5. SEASON

   (A) RAM

   (B) BIRDS - - LIGHT

6. FREQUENCY OF USE - - RECOMMENDED

(A) BOAR - -

AGE IN MONTHS	PASTURE MATING	HAND MATING
7 OR LESS	NONE	NONE
7-9	6-8	10-15
9-12	8-10	15-20
18 OR OVER	12-15	25-30

(B) RAM LAMB - - SPARINGLY

RAM - - 40-50 EWES

(C) STALLION -- SPARINGLY UNTIL 3 YEARS OLD

MATURE -- 1 PER DAY

(D) BULL -- PER YEAR

	HAND	PASTURE
YEARLING	25	20-25
MATURE	50-75	25-35

7. DISEASE AND DEFECTS

(A) INFLAMMATION OF TESTICLE

(B) ACCIDENTAL INJURY

(C) LACK OF LIBIDO -- INHERITABLE

(D) DEFECTIVE RETRACTOR MUSCLE -- INHERITABLE

(E) SCROTAL HERNIAS -- MONORCHIDS CRYPTORCHIDS.

(F) INBREEDING DECREASES FERTILITY

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Hormonal Influences on Reproduction

Job XII: Endocrine System

Objective: To develop an understanding of the function of the endocrine system and its role in reproduction

Motivation: "Why is such emphasis being placed upon the study of hormones today?" "Where are hormones produced?"

References: 1. Introduction to Breeding Farm Animals, Winter

2. Breeding and Improvement of Farm Animals, Rice and Andrews

Teaching Outline:

I. The endocrine system

II. The glands and their functions

Teaching Procedure:

I. Introduce unit.

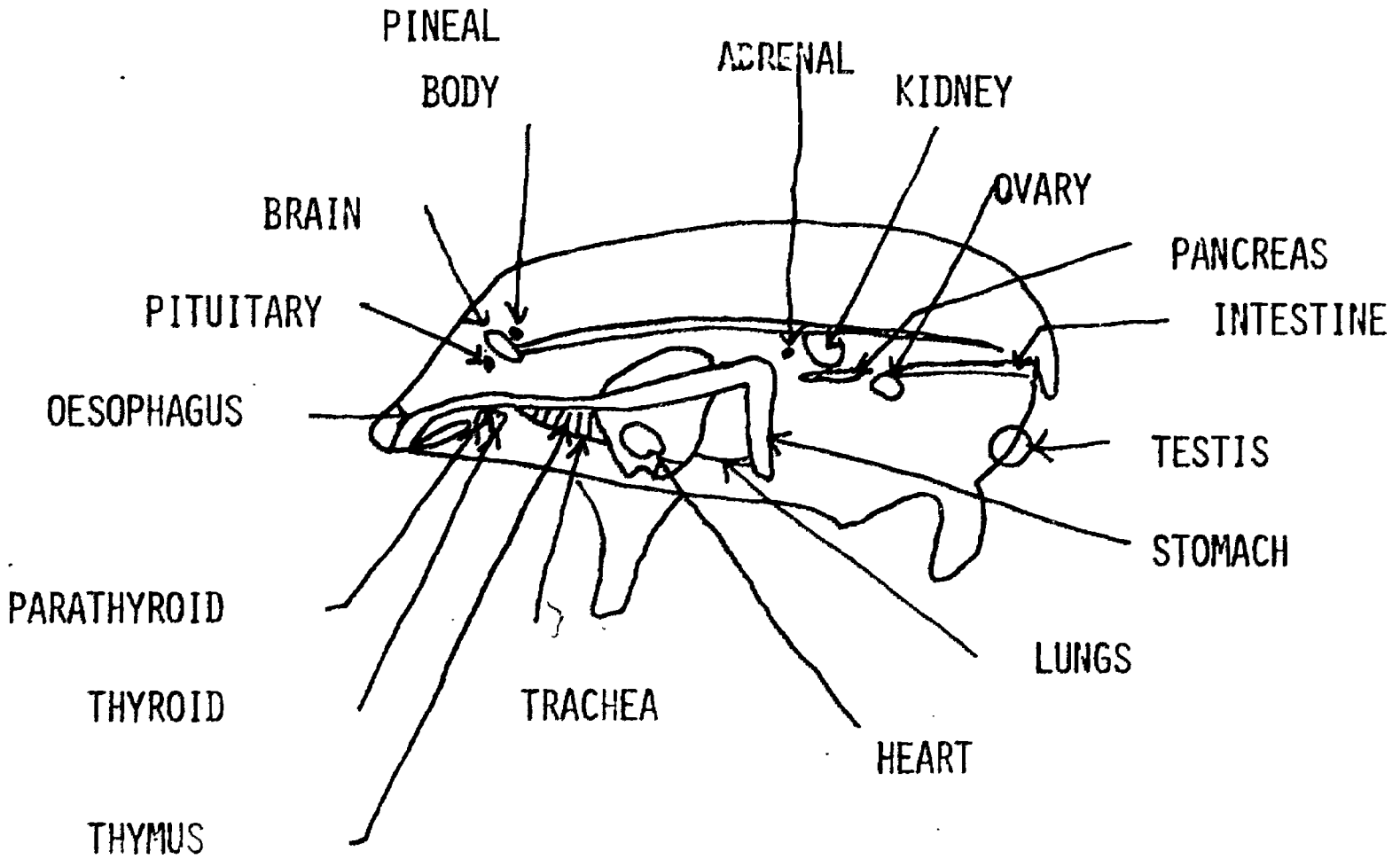
II. Review the endocrine system and assign students appropriate reading or questions from the references.

III. Construct a chart of glands and their functions.

IV. Summarize activities.

FIGURE 9

DRAWING OF THE PIG INDICATING THE LOCATIONS OF THE PRINCIPAL GLANDS OF INTERNAL SECRETION



"From Winters: Animal Breeding (1954) John Wiley & Sons, Inc."

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Hormonal Influences on Reproduction

Job XIII: Male Hormones

Objective: To teach an understanding of the influences of the hormones upon the male

Motivation: "Why does a bull develop a crest, a boar, tuskes and a rooster, brilliant feathers?"

References: 1. Introduction to Breeding Farm Animals, Winters

2. Breeding and Improvement of Farm Animals, Rice and Andrews

Teaching Outline:

I. Male hormones production

II. Function of male hormones

III. Target of hormones

Teaching Procedure:

I. Introduce unit.

II. Discuss male hormones--where they are produced and their target organ.

III. Discuss what the secondary sex characteristics are for various animals.

IV. Discuss the role of social dominance within herds, flocks, etc.

V. Discuss and explain puberty and the function of hormones.

VI. Relate puberty to breeding age, etc.

VII. Summarize and evaluate the learning activities.

TABLE V

MALE HORMONES

HORMONE	PRODUCED	FUNCTION OR TARGET ORGAN
ACTH	PITUITARY	ADRENAL GLAND
FSH	PITUITARY	TESTICLE
LH OR ICTH	PITUITARY	TESTICLE
TESTOSTERONE	TESTICLE	1. SEXUAL BEHAVIOR 2. ACCESSORY SEX GLAND 3. SECONDARY SEX CHARACTERISTICS (A) FEATHER PATTERNS (B) VOICE (C) TUSKS (D) ANTLERS 4. SOCIAL DOMINANCE 5. INFLUENCE SPERMATOGENESIS 6. INFLUENCE PITUITARY FUNCTION

ANDROSTERONE	SAME AS TESTOSTERONE: ONLY 1/6 AS POTENT
ANDROGEN	COLLECTIVE TERM FOR MALE HORMONES

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Hormonal Influences on Reproduction

Job XIV: Female Hormones

Objective: To teach an understanding of the influences of hormones upon the female

Motivation: "Why does a cow come in heat?" "Why doesn't she when she is settled?"

References: 1. Introduction to Breeding Farm Animals. Winters

2. Breeding and Improvement of Farm Animals. Rice and Andrews

Teaching Outline:

I. Hormonal interrelationship

II. Female hormones and their functions

Teaching Procedure:

I. Introduce unit.

II. Discuss the interrelationships of hormones upon other body processes and upon their own production.

III. Discuss the female hormones and their functions.

IV. Discuss the female hormones and their relationship to puberty and breeding age.

V. Discuss the female role in sperm life and the interrelationship between sperm motility and uterine functions.

TABLE VI

PITUITARY GLAND (ANTERIOR)

SECRETES

GONADOTROPHIC HORMONES

FOLLICLE STIMULATING HORMONE (FSH)

CAUSES

GRAAFIAN FOLLICLE TO GROW

GRAAFIAN FOLLICLE PRODUCES ESTROGEN

ESTROGEN CAUSES DECREASE IN FSH PRODUCTION AND INCREASE IN LH WHICH IS SECRETED BY THE PITUITARY

GONADOTROPHIC HORMONES

LUETENIZING HORMONE (LH)

CAUSES

OVULATION OF GRAAFIAN FOLLICLE

AND

GROWTH OF CORPUS LUTEUM

CORPUS LUTEUM PRODUCES PROGESTERONE

PROGESTERONE CAUSES DECREASE IN LH PRODUCTION AND INCREASE IN FSH WHICH IS SECRETED BY THE PITUITARY

TABLE VII

HORMONAL INTERRELATIONSHIPS

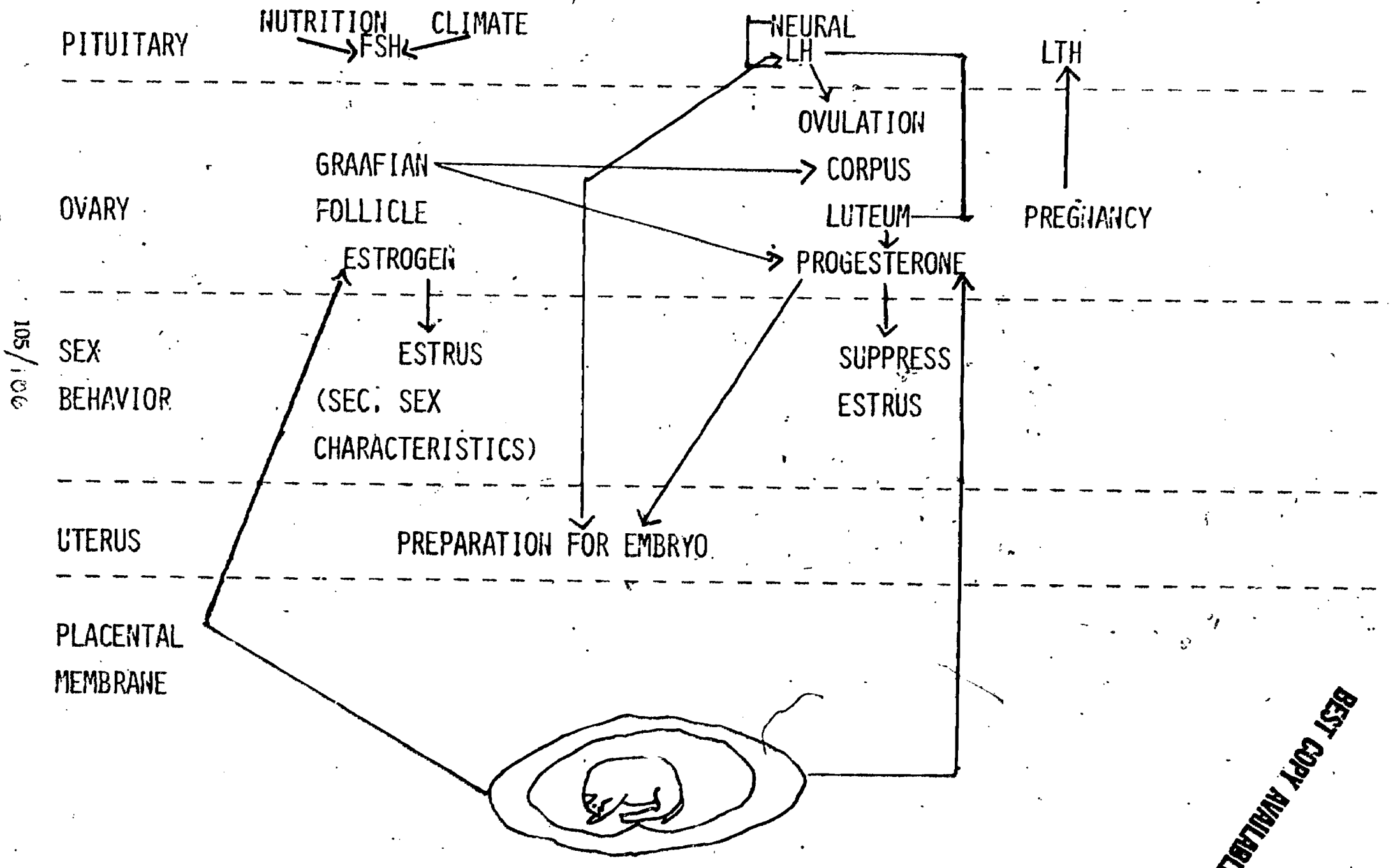


TABLE VIII

FEMALE HORMONES

HORMONE	FUNCTION
ESTROGEN	1. INITIATES DEVELOPMENT OF UTERUS 2. INDUCES ESTRUS 3. REGULATES GONADOTROPHIN 4. INCREASES UTERINE MOTILITY 5. AFFECTS GROWTH 6. DIRECTS GROWTH OF MAMMARY GLAND 7. STIMULATES IMPLANTATION
PROGESTERONE	1. COMPLETES UTERINE GROWTH 2. MAINTAINS PREGNANCY 3. GROWTH OF MAMMARY GLAND DUCT 4. AFFECTS GROWTH 5. FORMS CERVICAL PLUG 6. USED AS HUMAN MEDICINE
FSH	1. STIMULATES GRAAFIAN FOLLICLE 2. REGULATES LH PRODUCTION 3. AFFECTS ESTRUS 4. AFFECTS SECONDARY SEX CHARACTERISTICS 5. INFLUENCES ESTROGEN
LH	1. AFFECTS OVULATION 2. SUPPRESSES ESTRUS 3. AFFECTS PROGESTERONE PRODUCTION

LTH	1. MAINTAINS PREGNANCY
OXYTOCIN	1. CAUSES EGG MOVEMENT 2. STIMULATES CERVIX
ADRENYLIN	1. OVERRIDES OXYTOCIN
RELAXIN	1. RELAXES BIRTH CANAL 2. PRODUCED BY PLACENTA 3. IT IS A PROTEIN

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Reproductive Processes

Job XV: Fertilization

Objective: To develop an understanding of how fertilization takes place within an animal

Motivation: "Why are so many sperm deposited if only one sperm is needed for fertilization?"

References: 1. Introduction to Breeding Farm Animals, Winters

2. Breeding and Improvement of Farm Animals, Rice and Andrews

3. "The Reproduction of Farm Animals", Cornell

Teaching Outline:

I. Introduction

II. Ovulation

III. Sperm motility

IV. Fertilization

V. Sperm survival in genital tract

Teaching Procedure:

I. Discuss the types of ovulation.

II. Discuss sperm motility.

III. Discuss the steps in fertilization.

IV. Discuss how sperm survive in the genital t ract, including the detrimental aspects of survival.

V. Discuss the function of the cervical plug.

VI. Relate this discussion to the last lesson concerning how, hormonally, pregnancy is maintained.

VII. Summarize and evaluate the learning activities.

TABLE IX

TYPES OF OVULATION

1. SPONTANEOUS - OVA RELEASED WITHOUT MATING.
2. INDUCED - OVULATION OCCURS WHEN MATING OCCURS. SWINE WON'T OVULATE ALL EGGS AT SAME TIME.

TABLE X

SPERM EVALUATIONS

1. HOW SPERM ARE SCORED

NUMBER		CRITERIA
5	=	80-100 PER CENT PROGRESSIVE MOTILITY. SWIRLING MOTION OF THE DROP AS A WHOLE.
4	=	60-80 PER CENT PROGRESSIVE MOTILITY. SWIRLING MOTION INDEFINITE OR ABSENT
3	=	40-60 PER CENT PROGRESSIVE MOTILITY. MOVEMENT LIMITED TO INDIVIDUAL SPERMATOZOA.
2	=	20-40 PER CENT OF SPERMATOZOA SHOWING UNDULATORY MOVEMENT.
1	=	20 PER CENT OR LESS OF SPERMATOZOA EXHIBITING UNDULATORY MOVEMENT
0	=	NO MOTILITY

2. CONCENTRATION OF SPERM
   A. COUNTED LIKE RED BLOOD CELLS

3. LIVE-DEAD PER CENT
   A. STAINING OF DEAD CELLS

4. PER CENT ABNORMAL CELLS
   A. COILED TAILS
   B. BEADS ON TAILS
   C. HEADLESS OR TAILLESS SPERM

5. VOLUME OF SEMEN

6. PH OF SEMEN (MOST 6.3 TO 6.8)

7. PURITY -- FREE OF DEBRIS AND URINE

8. METABOLIC MEASUREMENT WITH METHYLENE BLUE -- MOST ACTIVE ARE LIGHTEST BLUE

TABLE XI

STEPS IN FERTILIZATION

1. INSIMINATION -- NATURAL OR ARTIFICIAL DEPOSITING OF SPERM

2. TRANSPORTATION -- MOVEMENT OF SPERM FROM POINT OF INSIMINATION TO OVARIAN END OF FALLOPIAN TUBE

3. OVULATION

4. PENETRATION OF OVUM BY SPERM

5. UNION OF MALE AND FEMALE PRONUCLEI

TABLE XII

SPERM SURVIVAL

1. USEFUL LIFE GENERALLY IS NOT GREATER THAN 36-48 HOURS.

2. FERTILIZING CAPACITY OF MAMMAL SPERM IS:
   A. BULL -- 24-30 HOURS
   B. RAM -- 24-36 HOURS

3. CHICKENS AND TURKEYS HAVE A 43-DAY AVERAGE.

4. ONLY ONE SPERM FUNCTIONS IN FERTILIZATION.

5. SOME SPERM MUST UNDERGO CAPACITATION, WHICH MEANS THEY MUST BE IN THE REPRODUCTIVE TRACT AND MUST DEVELOP SOMEWHAT BEFORE FERTILIZATION.

COMPARISON OF ONE AND TWO SERVICES

	Number	Per Cent Settled	Pigs Farrowed
1 Service	149	61	7.9
2 Services	124	94	8.9

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Reproductive Processes

Job XVI: Gestation

Objective: To develop an understanding of how the fetus is implanted and the processes it undergoes during gestation.

Motivation: "How is it possible for an animal to have a different blood type than its parent?"

References:
1. Introduction to Breeding Farm Animals, Winters
2. Breeding and Improvement of Farm Animals, Rice and Andrews
3. "Animal Science" Slides (numbers 63-65)

Teaching Outline:

I. Implantation

II. Placenta

III. Gestation

Teaching Procedure:

I. Introduce unit.

II. Discuss how implantation occurs.

III. Discuss the functions of the placenta.

IV. Include the nourishing of the fetus.

V. Discuss gestation, gestation periods, gestation variability, and birth weight determinants.

VI. Summarize and evaluate.

TABLE XIII

IMPLANTATION

1. EMBRYO IS NOURISHED FROM OVUM YOLK AND UTERINE MILK, FROM THE GLAND IN UTERUS, UNTIL IT IS IMPLANTED.

2. TIME OF IMPLANTATION VARIES:
   A. MARE -- 36-40 DAYS
   B. COW -- 30-36 DAYS
   C. EWE -- 17-18 DAYS
   D. SOW -- 10-12 DAYS
   E. HUMAN -- 6-8 DAYS

3. ABNORMAL IMPLANTATION (ECTOPIC) OCCURS:
   A. IN BODY CAVITY
   B. IN FALLOPIAN TUBES
   C. ON OVARY.

4. DELAYED IMPLANTATION CAN CAUSE LENGTHENED GESTATION PERIOD.

5. IN SWINE, IT TAKES SIX TO EIGHT INCHES OF SPACE PER PIG IN THE UTERUS.

TABLE XIV

FUNCTIONS OF PLACENTA

1. TRANSMISSION OF NUTRIENTS
   A. PROTEINS MUST BE BROKEN DOWN TO AMINO ACIDS.
   B. BACTERIA ARE TOO LARGE: VIRUSES AREN'T.
   C. GERMAN MEASLES ARE ESPECIALLY BAD.
2. TRANSMISSION OF WASTE PRODUCTS
3. PROTECTION FROM SHOCK AND BACTERIA
4. PRODUCTION OF SOME HORMONES
   A. ESTROGEN IS PRODUCED.
   B. PROGESTERONE IS PRODUCED.
   C. TWO GONADOTROPIC -- LIKE HORMONES -- ARE PRODUCED:
      (1) HUMAN CHORONIC GONADOTROPHIC (HCG) -- WILL INDUCE OVULATION IN RABBIT.
      (2) PREGNANT MARE SERUM (PMS).

FIGURE 10

THE PLACENTA

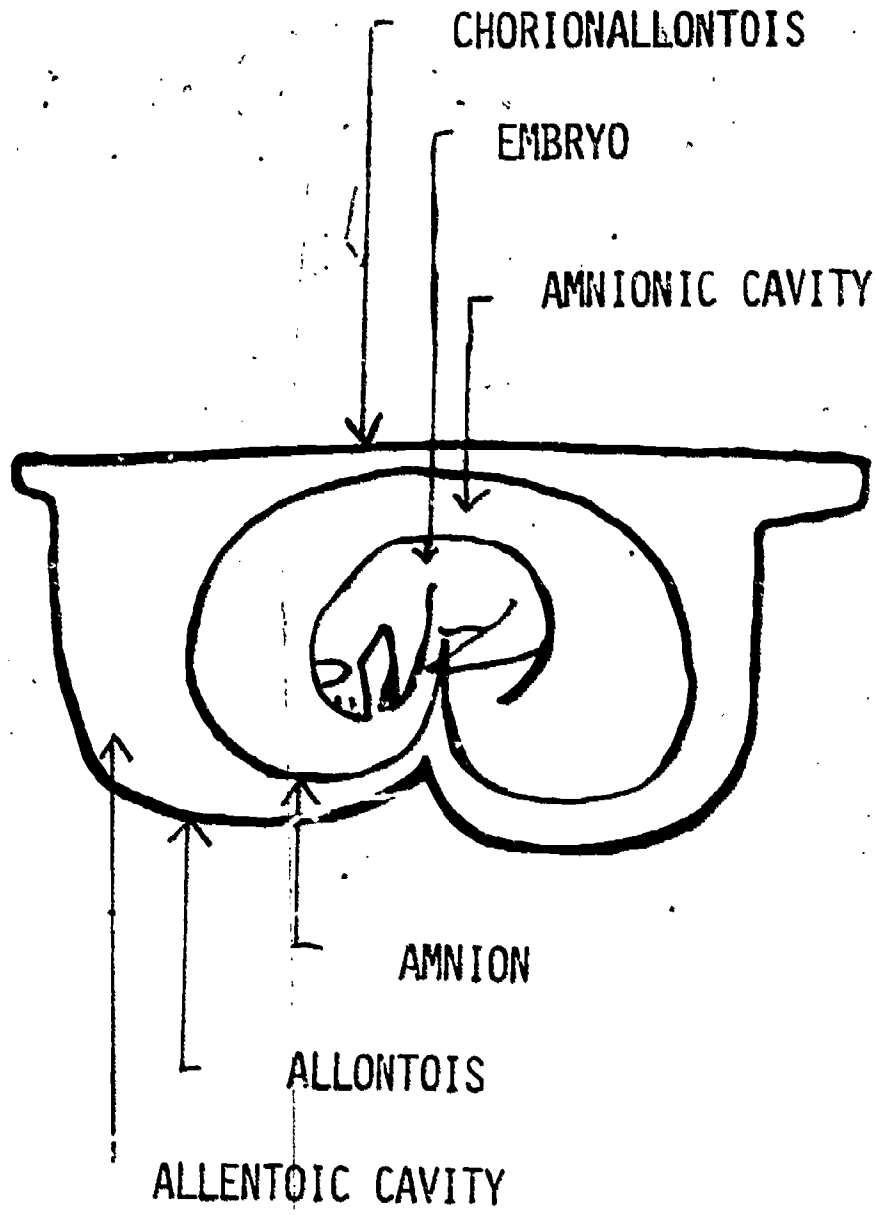
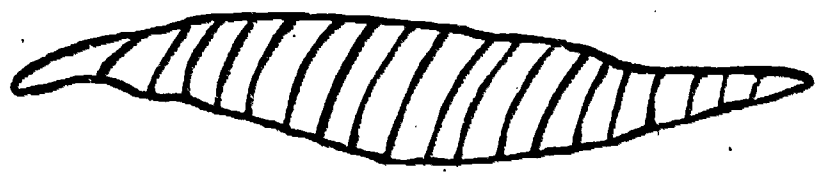


FIGURE 11

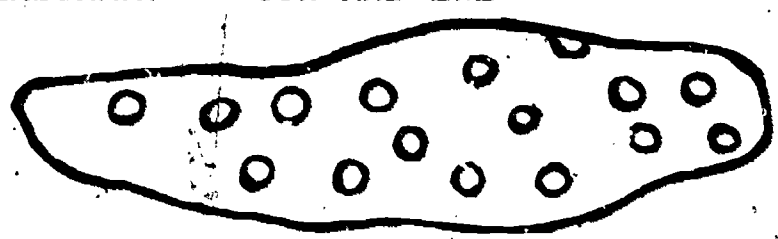
TYPES OF PLACENTA

1. DIFFUSE -- MARE AND SOW



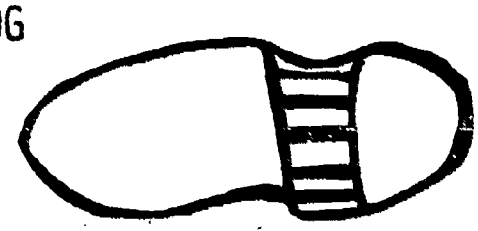
TRANSFERS ANYWHERE IT IS IN CONTACT

2. COTYLENDONARY -- COW AND EWE



LOCALIZED -- 100 TO 120 COTYLEDONS

3. ZONARY -- DOG



4. DISCOIDAL -- HUMAN AND RABBIT

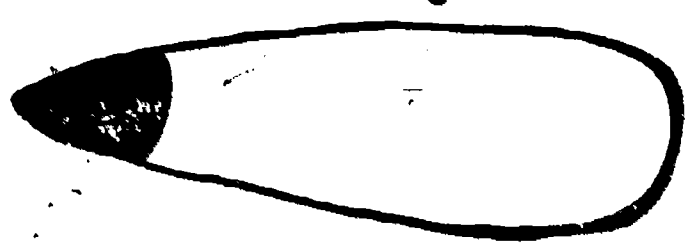


TABLE XV

VARIATION IN GESTATION

1. BREEDS
   A. HEREFORD -- 286 DAYS
   B. SHORTHORN -- 282 DAYS
   C. ANGUS -- 279 DAYS

2. SEX -- MALES GENERALLY CARRIED A DAY LONGER.

3. AGE OF DAM -- THE OLDER THE DAM, THE LONGER THE GESTATION PERIOD.

4. GENOTYPE OF CALF

5. MULTIPLE BIRTHS -- TWINS CARRIED SHORTER PERIODS OF TIME

6. TIME OF IMPLANTATION

TABLE XVI

PREGNANCY DIAGNOSIS

1. CESSATION OF HEAT
   A. 5% OF PREGNANT CATTLE SHOWING ESTRUS

2. MANUAL MANIPULATION OF UTERUS
   A. 35 DAYS IS EARLIEST POSSIBLE.
   B. VERY EASY AT 60-90 DAYS
   C. BUMPING -- IN LATE STAGES OF GESTATION

3. BIOLOGICAL TEST
   A. PMS AND HCG

4. FALSE PREGNANCY (PSEUDOPREGNANCY)
   A. 2/3 TO 3/4 AS LONG AS USUAL GESTATION PERIOD
   B. MAMMARY GLAND DEVELOPMENT
   C. MAINTAINS CORPUS LEUTEUM
   D. MAKE NEST AND HAVE MOTHERING INSTINCT
   E. NOT PREGNANT
   F. WON'T SHOW HEAT

TABLE XVII

BIRTH WEIGHT

---

1. BIRTH WEIGHT WILL NOT VARY SIGNIFICANTLY WITH FEED RECEIVED.

2. MOTHER'S BEING OVERWEIGHT WILL CAUSE MORE DAMAGE THAN BEING UNDERWEIGHT.

3. A STARVED MOTHER WILL ALWAYS PROTECT HER YOUNG. (FAT, MUSCLE, BONE, NERVE, ETC. WILL BE SACRIFICED BEFORE THE FETUS WILL BE HARMED.)

4. THE LARGER THE UTERUS, THE LARGER THE FETUS IS LIKELY TO BE.
   A. IN HORSES, A SHIRE FEMALE MATED WITH A SHETLAND MALE WILL YIELD A LARGER COLT THAN VICE VERSA.

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Reproductive Processes

Job XVII: Parturition

Objective: To investigate the processes involved in parturition

Motivation: "What determines when a calf will be born?"

"How can one tell when an animal is about to give birth?"

References: 1. Introduction to Breeding Farm Animals, Winters

2. Breeding and Improvement of Farm Animals, Rice and Andrews

3. Film: "Trip Through a Pig Factory", Ralston Purina Company

Teaching Outline:

I. Parturition detection

II. Types of births

III. Parturition and hormones

Teaching Procedure:

I. Introduce unit.

II. Show film "Trip Through a Pig Factory" and discuss its implication.

III. Discuss what to look for in telling parturition.

IV. Discuss the types of births and how to care for abnormal births.

V. Discuss the role of hormones in parturition -- when hormones can be used to aid parturition.

VI. Invite a veterinarian to talk to the class about how to help at parturition and to discuss use of hormones with the class.

VII. Summarize the discussion.

VIII. Evaluate.

TABLE XVIII

HOW TO TELL PARTURITION

1. GENERAL NERVOUSNESS
2. DROOPING TAIL AND HEAD
3. LOSS OF APPETITE
4. SOW'S PRODUCTION OF MILK 12-24 HOURS BEFORE PARTURITION
5. SEEKING OF SECLUSION
6. NESTING INSTINCT
7. UTERINE DISTENSION

TABLE XIX

TYPES OF BIRTHS

I. NORMAL

A. FRONT FEET FIRST -- HEAD ON FEET

B. HIND FEET FIRST -- NORMAL

II. ABNORMAL

A. HEAD . LEG FOLDED BACK

(1) WAIT 2 HOURS BEFORE DOING ANYTHING.

(2) AVOID INFECTING UTERUS

(3) DON'T PULL WITH ROPES, ETC.

B. DYSTOCIA (DIFFICULT LABOR)

(1) SIZE AND SHAPE OF FE

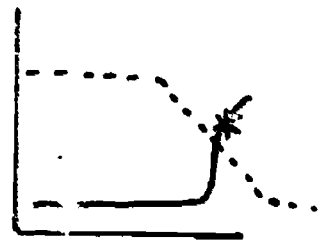
(2) BREEDING FEMALES TO YOUNG

(3) PIGS -- FEMALE TOO FAT

TABLE XX

PARTURITION AND HORMONES

1. RELAXIN -- RELAXES PELVIC LIGAMENTS
2. PROGESTERONE (----)
3. ESTROGEN (——)



4. OXYTOCIN -- AIDS PARTURITION

---

* PARTURITION

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Handling Breeding Animals

Job XVIII: Improvement of Breeding Efficiency

Objective: To instruct students in some of the reasons for low breeding efficiency among farm animals

Motivation: "Why would you think judges are going away from the overfitted heifers in the show ring?"

References:
1. Introduction to Breeding Farm Animals", Winters
2. Breeding and Improvement of Farm Animals, Rice and Andrews
3. "The Reproduction of Farm Animals", Cornell Bulletin 305

Teaching Outline:

I. Breeding efficiency to be expected from farm animals

II. Common causes of low breeding efficiency

III. Disease--breeding efficiency relationship

IV. Purchase of healthy animals

V. Nutrition--breeding efficiency relationship

Teaching Procedure:

I. Introduce unit.

II. Assign and discuss reading from references as applied to teaching outline.

III. Discuss causes of low breeding efficiency.

IV. Include freemartins and monor chidism in discussion.

V. Relate and discuss diseases that relate to breeding efficiency.

VI. Relate feeding prior to breeding, during gestation and parturition.

VII. Discuss health papers and how one can increase herd breeding efficiency through the sound purchasing of animals.

VIII. Include semen testing and pregnancy checking.

IX. Summarize and evaluate.

Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Handling Breeding Animals

Job XIX: Artificial Insimination

Objective: To acquaint students with the procedures, techniques, and wise use of artificial insimination

Motivation: "Why does Denmark breed 100% of its cows artificially?" "Is A.I. practiced on your farm?"

References:
1. "The How and Why of Beef A.I." Bulletin, Curtiss Breeding Service, Inc., Curtiss Farm, Cary, Illinois
2. "The Why and How of the Complete Cow", Curtiss Bulletin
3. Introduction to Breeding Farm Animals, Winters, (pp. 327-360)
4. Breeding and Improvement of Farm Animals, Rice and Andrews (p. 160)

Teaching Outline:

I. History of A.I.

II. Advantages and disadvantages of A.I.

III. Semen collection, dilution, storage, and costs

IV. Insimination process

V. Use on different animals

Teaching Procedure:

I. Introduce unit.

II. Assign the students to do a study of the history of artificial insimination and discuss their findings.

III. Review the advantages and disadvantages of artificial insimination and discuss them.

IV. Discuss the process of insimination.

V. Invite an insiminator to visit the class or take a field trip to see the actual service.

VI. Discuss use of A.I. on different farm animals.

VII. Assign reading in Winters and discuss any current information available.

VIII. Summarize and evaluate.

TABLE XXI

A. I.

ADVANTAGES:

1. THE MANAGER CAN INCREASE USE OF SUPERIOR SIRES.
2. THE MANAGER HAS A BETTER CONTROL OVER DISEASES.
3. HE DOESN'T HAVE TO MAINTAIN A BULL.
4. HE CAN COLLECT FROM GOOD BULLS THAT CAN'T SERVE NATURALLY.
5. HE CAN MATE TWO ANIMALS OF DIFFERENT SIZES.
6. HE WILL PROBABLY BECOME MORE INTERESTED IN TECHNOLOGICAL ADVANCEMENTS.

DISADVANTAGES:

1. IF THE BREEDING SERVICE SHOULD GET AN INFERIOR SIRE, THE OFF-SPRING WOULD BE WIDESPREAD.
2. ARTIFICIAL INSIMINATION WILL HURT THE SALE OF PUREBRED SIRES.

3. THE LABOR REQUIREMENTS WILL BE INCREASED.

4. THE COST OF EQUIPMENT WILL INCREASE.

TABLE XXII

SEMEN COLLECTION

1. ARTIFICIAL VAGINA -- BEST WAY IN MOST SPECIES (USES WARM WATER)

2. ELECTRO-EJACULATOR

   ADVANTAGES :

   A. CAN BE USED ON IMPOTENT BULLS

   B. CAN BE USED ON INJURED BULLS

   DISADVANTAGES:

   A. CAN GET URINE

   B. GENERALLY NOT AS CLEAN

   C. DOESN'T WORK WELL IN BOARS

3. RECOVERY OF SEMEN FROM FEMALE REPRODUCTIVE TRACT

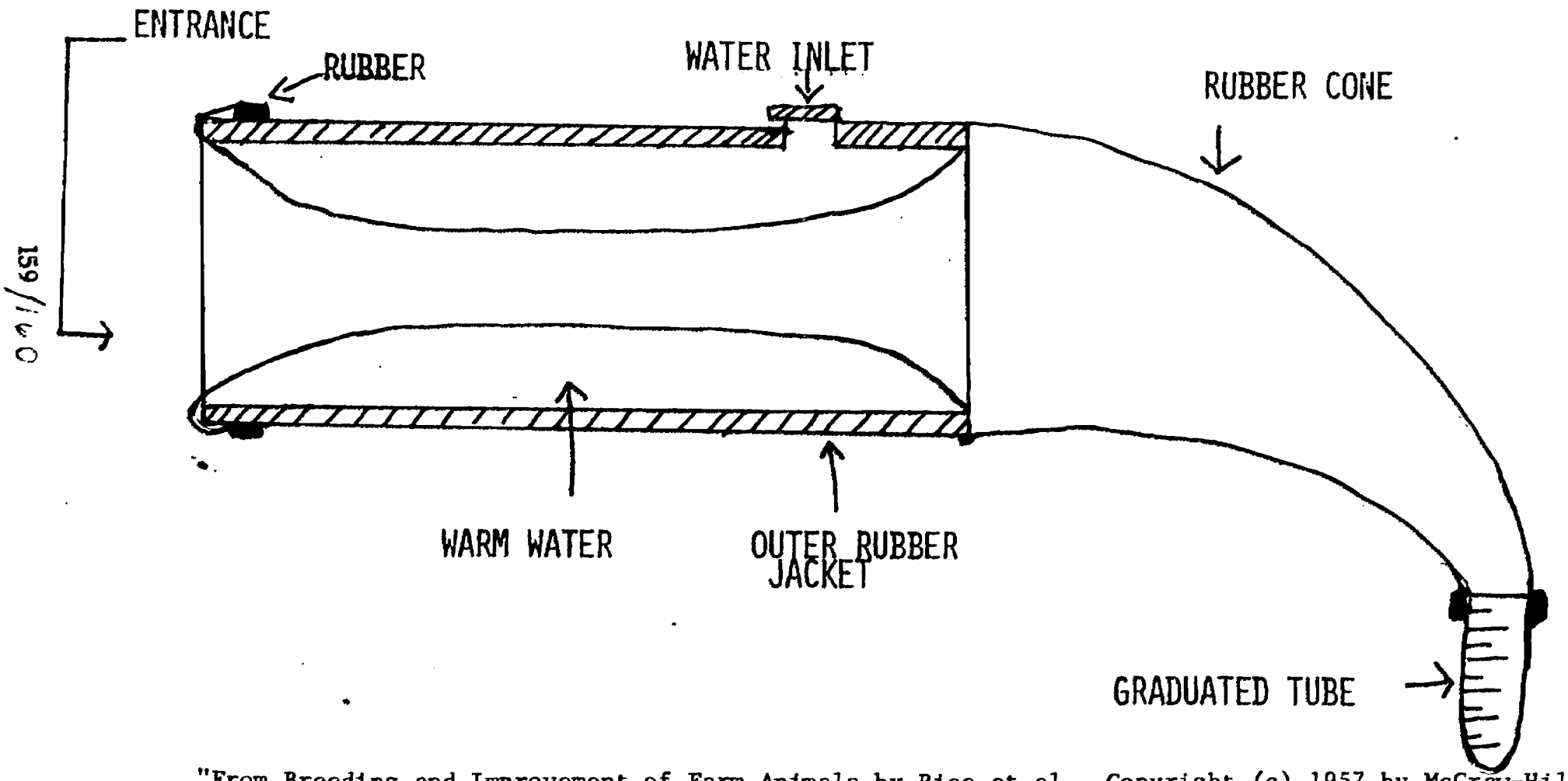
   A. HAS A LOT OF DEBRIS, MUCUS, AND ACID

4. MASSAGE AMPULLA

ANIMAL	NUMBER OF FEMALES PER EJACULATION
BOAR	8-12
BULL	300-500
ROOSTER	8-12
RAM	40-100
STALLION	8-12

FIGURE 12

ARTIFICIAL VAGINA



"From Breeding and Improvement of Farm Animals by Rice et al. Copyright (c) 1957 by McGraw-Hill, Inc. Used with permission of McGraw-Hill Book Company."

TABLE XXIII

SEMEN DILUTION

DILUTORS:

1. EGG YOLK -- PRIMARY ONE -- CHEAP
   A. EGG YOLK CITRATE
   B. EGG YOLK PHOSPHATE
2. MILK
3. COCONUT MILK
4. BLOOD PLASMA
5. GLYCEROL -- PREVENTS ICE CRYSTAL FORMATION

HOW STORED:

1. AMPULE
2. PIPETTE
3. PELLET

FREEZING SEMEN:

1. DRY ICE: -79°C (-110°F)
2. LIQUID NITROGEN: -196°C (-320°F)
   A. CHEAPEST METHOD

TABLE XXIV

COSTS OF DIRECT A. I.

HERD SIZE	TOTAL YEARLY COST PER COW
26-35	11.04
36-45	9.61
46-55	9.29
56-65	9.10
66-75	7.71
76-85	6.09
86-95	7.40
96-OVER	6.93
ALL (27-220)	8.69

TABLE XXV

A. I. AND HERD LEVEL

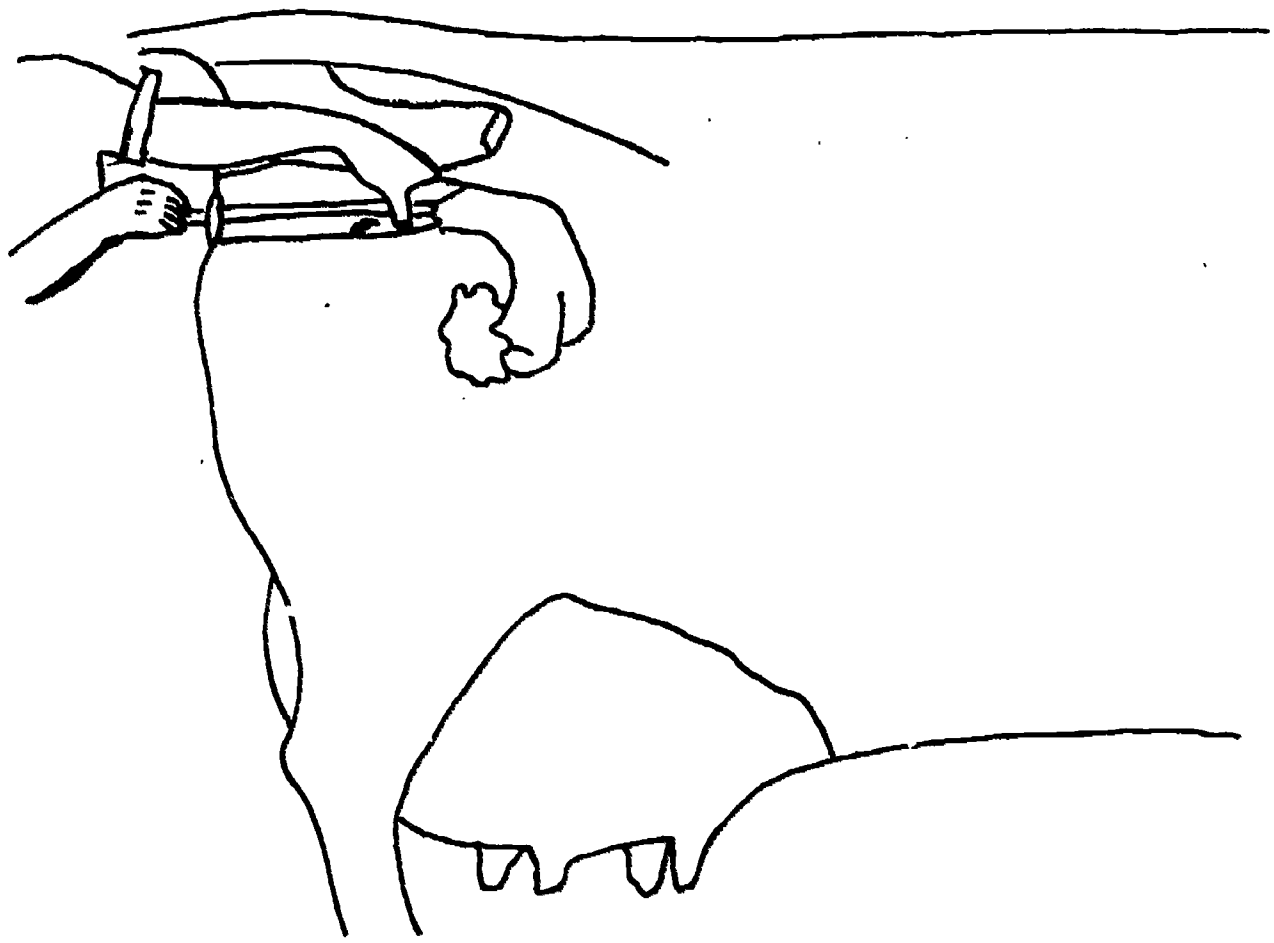
HERDMATE AVERAGE GROUPING (BUTTERFAT)	A. I. DAUGHTERS OVER HERDMATES	
	MILK	FAT
600 OR OVER	+811	+39
HIGH HERDS 500-599	+841	+45
GOOD HERDS 400-499	+438	+35
FAIR HERDS 300-399	+1980	+88
AVERAGE	+645	+42

EXAMPLE: HOLSTEINS

EXPERIMENTALISTS PICKED A SIRE THAT AVERAGED 900 LBS. OF MILK ACTUAL INCREASE WITH THE BREED AVERAGE TEST (3.5%) AT $5 PER CWT. OF MILK. THIS WOULD BE $45 MORE GROSS INCOME PER YEAR. FOLLOWING A PROGRAM LIKE THIS FOR FIVE YEARS WOULD MEAN $2.000 MORE GROSS INCOME FOR A 50-COW HERD PER YEAR.

FIGURE 13

METHOD OF ARTIFICIAL INSIMINATION



Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Genetics

Job XX: Inheritance of Traits

Objective: To develop an understanding of the principles of genetics

Motivation: "If I dock the sheep in my flock year after year, will I soon have naturally docked lambs?"

References:

1. Introduction to Breeding Farm Animals, Winters
2. Breeding and Improvement of Farm Animals, Rice and Andrews
3. "Improvement of Swine Through Breeding" Bulletin, Lasley, Day, and Tribble
4. Film: "Heredity," Communication Department, 119 Whitten Hall, Columbia, Missouri 65201
5. "Fundamentals of Inheritance," M.U. Guide (p. 3000)

Teaching Outline:

I. Basic cell

II. Mitosis and meiosis

III. Genes and chromosomes

IV. Mendel's Laws

V. Sex determination

Teaching Procedure:

I. Introduce unit.

II. Discuss how bodies are made up of cells and the make-up of an individual cell.

III. Explain cell division, both mitosis and meiosis and discuss their implications as related to heredity and genetics

IV. If possible, obtain a microscope and examine a cell, and compare these with sperm earlier examined.

V. Discuss genes and chromosomes and their function as carriers of traits.

VI. Discuss how cells occur in pairs in body cells and singularly in gametes.

VII. Discuss how cells are divided as by meiosis, above.

VIII. Discuss and explain Mendel's Laws.

IX. Work up sample problems for the students to calculate.

X. Explain how the sex of an individual is determined.

XI. Summarize and evaluate.

FIGURE 14

DIAGRAM OF A CELL

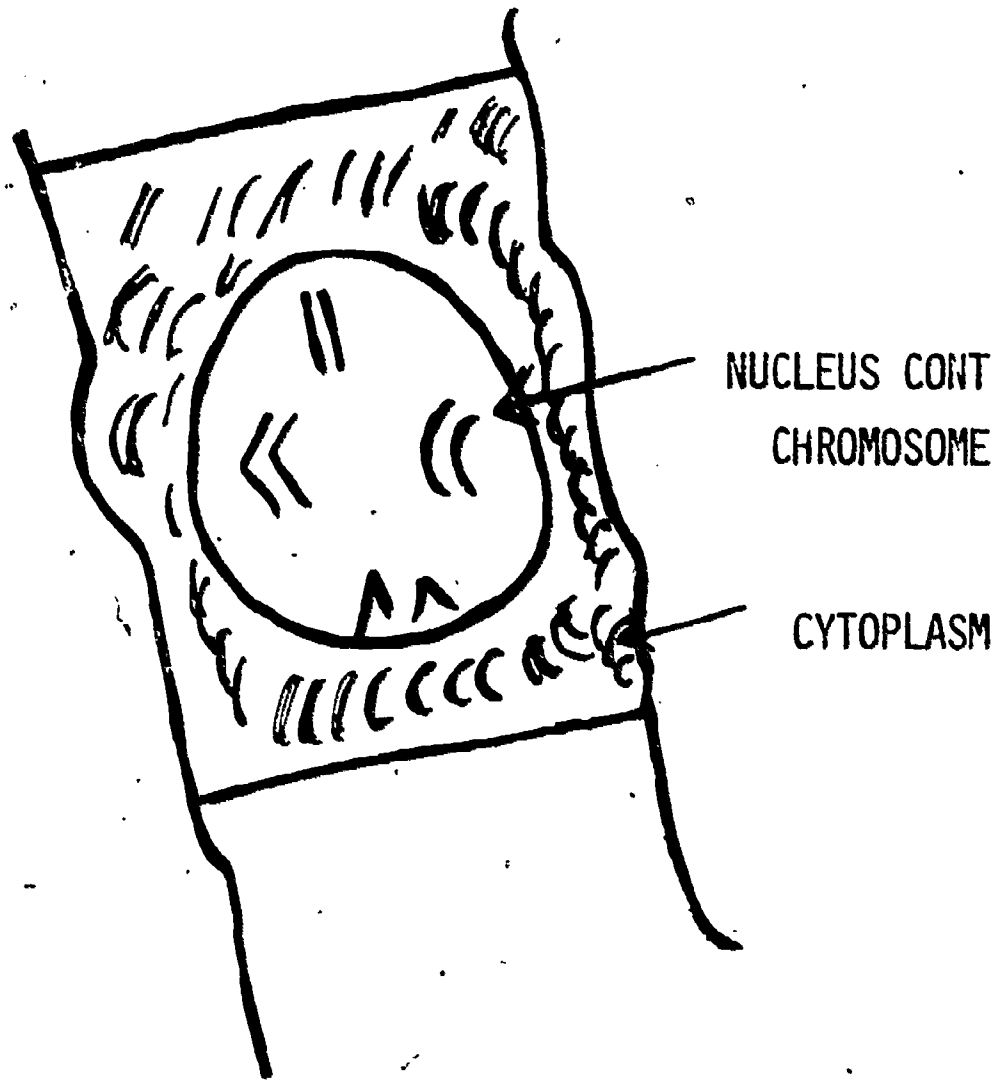
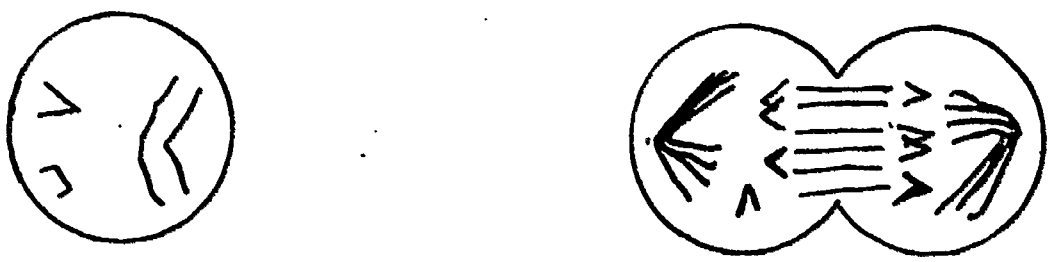


FIGURE 15

REPRODUCTION OF ANIMAL CELLS--MITOSIS

X CHROMOSOMES



X CHROMOSOMES

X CHROMOSOMES

FIGURE 16

SCHEMATIC SEMINIFEROUS TUBULE

SHOWING SPERMATOGENESIS --MEIOSIS

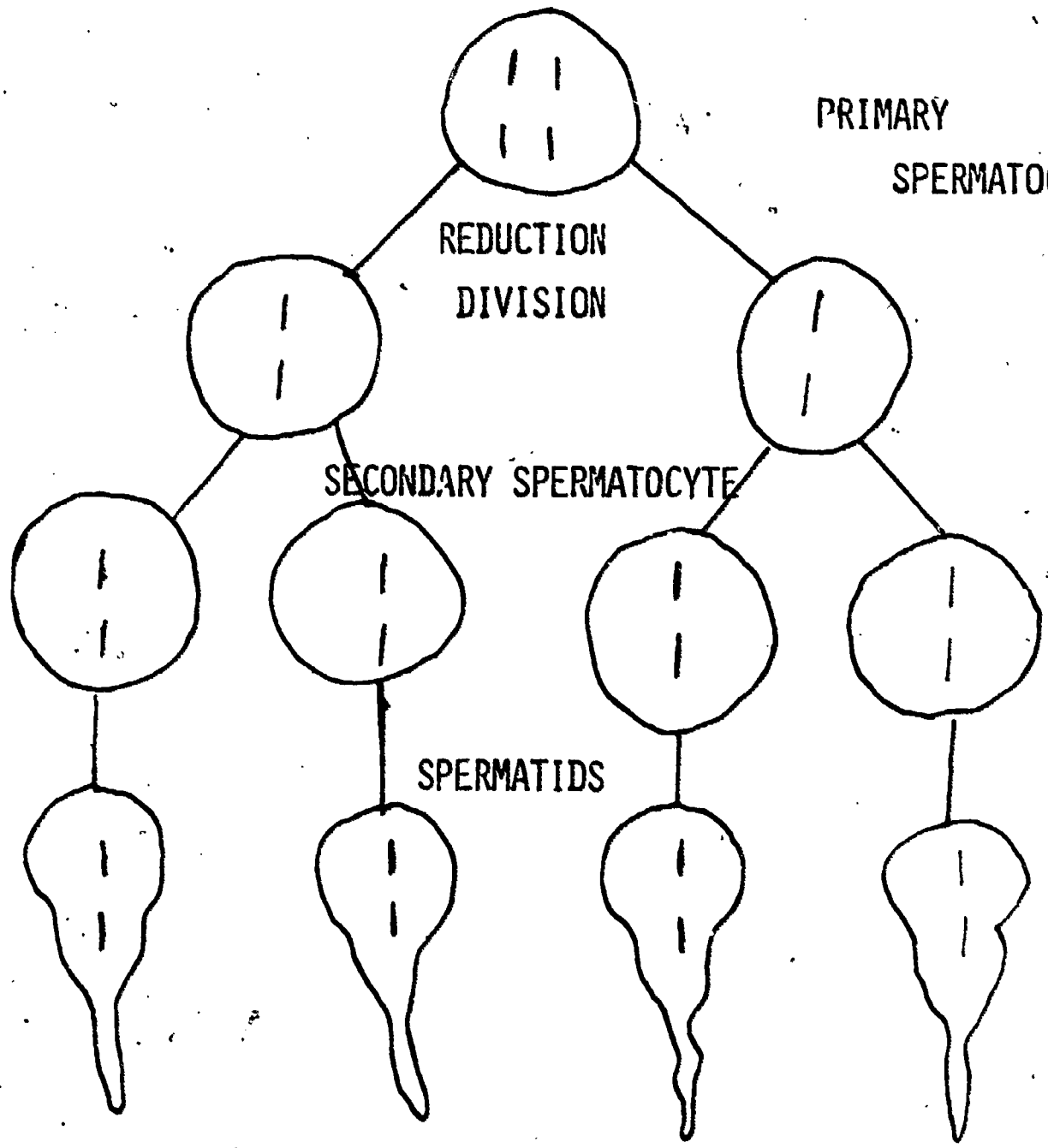


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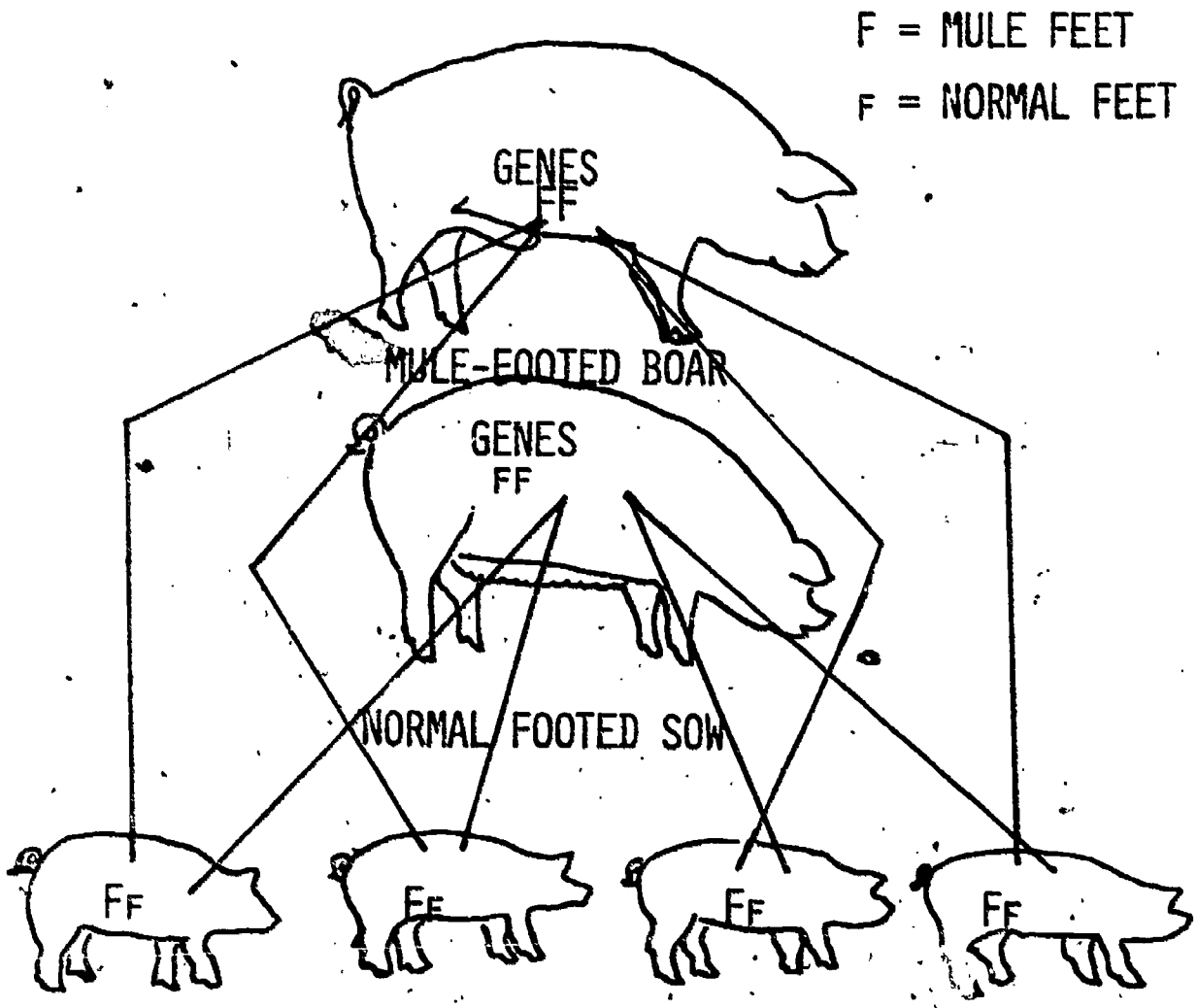
FIGURE 17

CROSSES



ALL MULE FOOTED

DIAGRAM SHOWING THE KIND OF OFFSPRING PRODUCED BY MATING PURE MULE-FOOTED BOAR WITH A PURE NORMAL -FOOTED SOW.

FIGURE 18

CROSSES

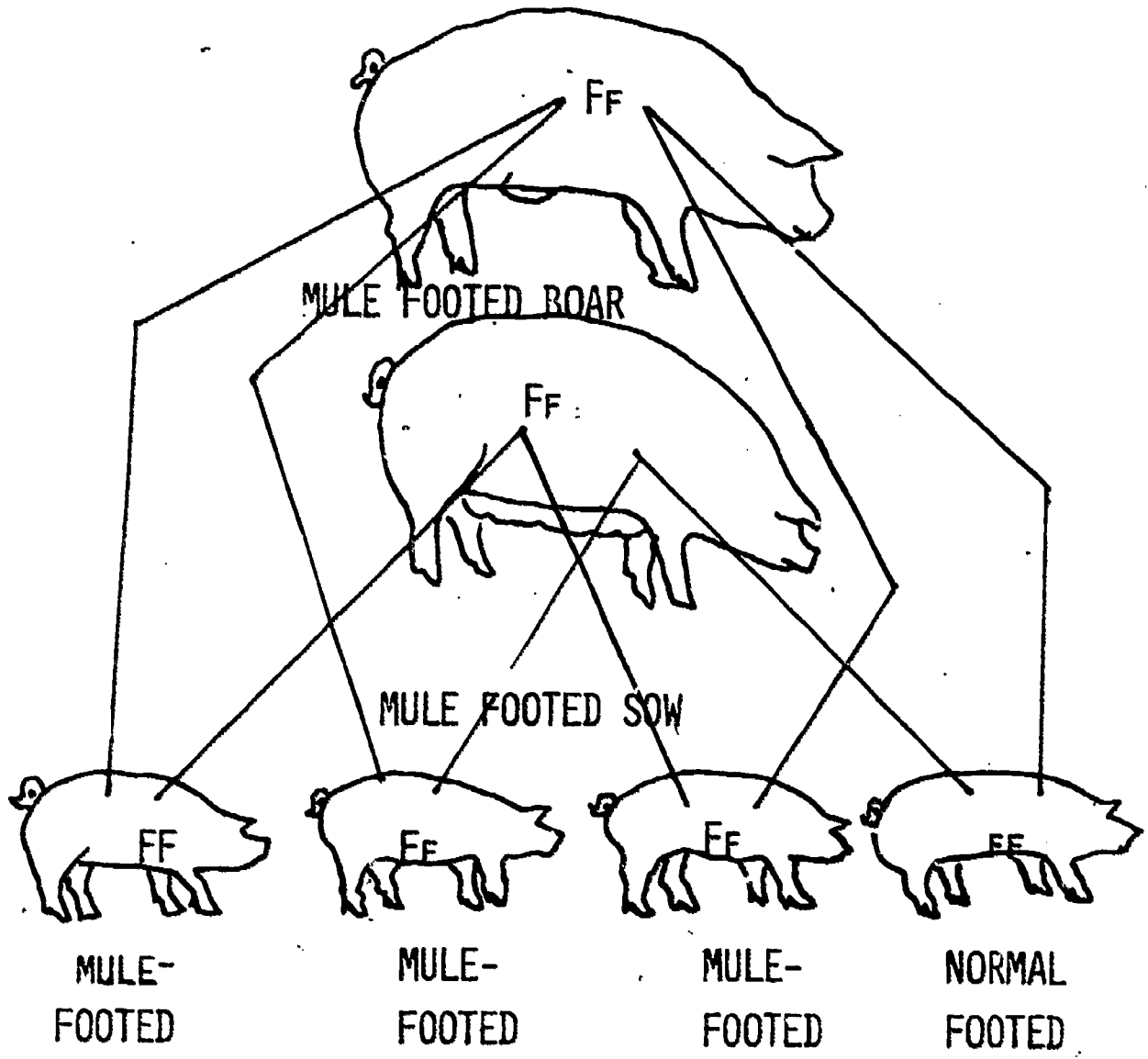


DIAGRAM SHOWING THE KIND OF OFFSPRING PRODUCED BY MATING AN IMPURE (HETEROZYGOUS) BOAR WITH AN IMPURE (HETEROZYGOUS) SOW.

TABLE XXVI

GENETIC VOCABULARY

Mitosis--Production of two cells identical to the parent cell

Meiosis--Production of two cells with half the chromosome number of the parent cell

Spermatogenesis--Production of sperm

Spermiogenesis--Growth and maturation of sperm to a mature cell

Genotype--Genetic make-up of the individual

Phenotype--Physical make-up of the individual

Homozygous--Identical in genotype and phenotype with reference to chromosomes and individuals

Heterozygous--Not identical in genotype and phenotype with reference to chromosomes and individuals

Dominance--The ability of a gene to cover up a recessive gene that is homozygous to it

Recessive--Nonapparent unless it is homozygous

Allele--A pair of genes that occur in the same place on a homozygous chromosome but affect the same trait in a different manner

Prepotency--Ability of an individual to stamp its characteristics on its offspring

Progeny--Offspring of an individual

Heterosis--Hybrid vigor resulting from a cross

Fertility--Degree of reproductive ability an individual possesses

Prolificness--Ability to produce large numbers of offspring

Fecundity--Ability to produce large numbers of eggs or sperm

TABLE XXVII

CHROMOSOMES BY SPECIES

ANIMAL	TOTAL	PAIRS
DONKEY	66	33
HORSE	60	30
MULE	63	30 + 3
COW	60	30
SHEEP	54	27
HOG	38	19
MAN	46	23

TABLE XXVIII

MENDEL'S LAWS

WHEN TWO DIVISIONS TAKE PLACE INDEPENDENTLY. THE PRODUCT IS THE PROBABILITY OF EACH INDEPENDENT EVENT.

B = BLACK b = RED

Bb x Bb

↓

BB Bb Bb bb

1/4 1/4 1/4 1/4

BLACK BLACK RED

2/4

GENOTYPE RATIO: 1:2:1

PHENOTYPE RATIO: 3:1

1. Bb x BB = BB
2. Bb x Bb = 1 BB : 1 Bb
3. BB x bb = Bb
4. Bb x Bb = NEVER BREED TRUE
5. Bb x bb = 1 Bb : 1 bb
6. bb x bb = bb

TABLE XXIX

MENDEL'S SECOND LAW

INDEPENDENT ASSORTMENT

OF CHARACTERS

P = POLLED p = HORNED

B = BLACK b = RED

P_1-- BBPP X bbPP

BLACK POLLED RED HORNED

F_1-- BbPp

BLACK POLLED

F_2-- BbPp x BbPp

1 BB — 1 PP -- 1 BBPP
2 Pp -- 2 BBPp
1 pp -- 1 BBpp

2 Bb — 1 PP -- 2 BbPP
2 Pp -- 4 BbPp
1 pp -- 2 Bbpp

1 bb — 1 PP -- 1 bbPP
2 Pp -- 2 bbPp
1 pp -- 1 bbpp

PHENOTYPE RATIO:

BLACK POLLED --- 9

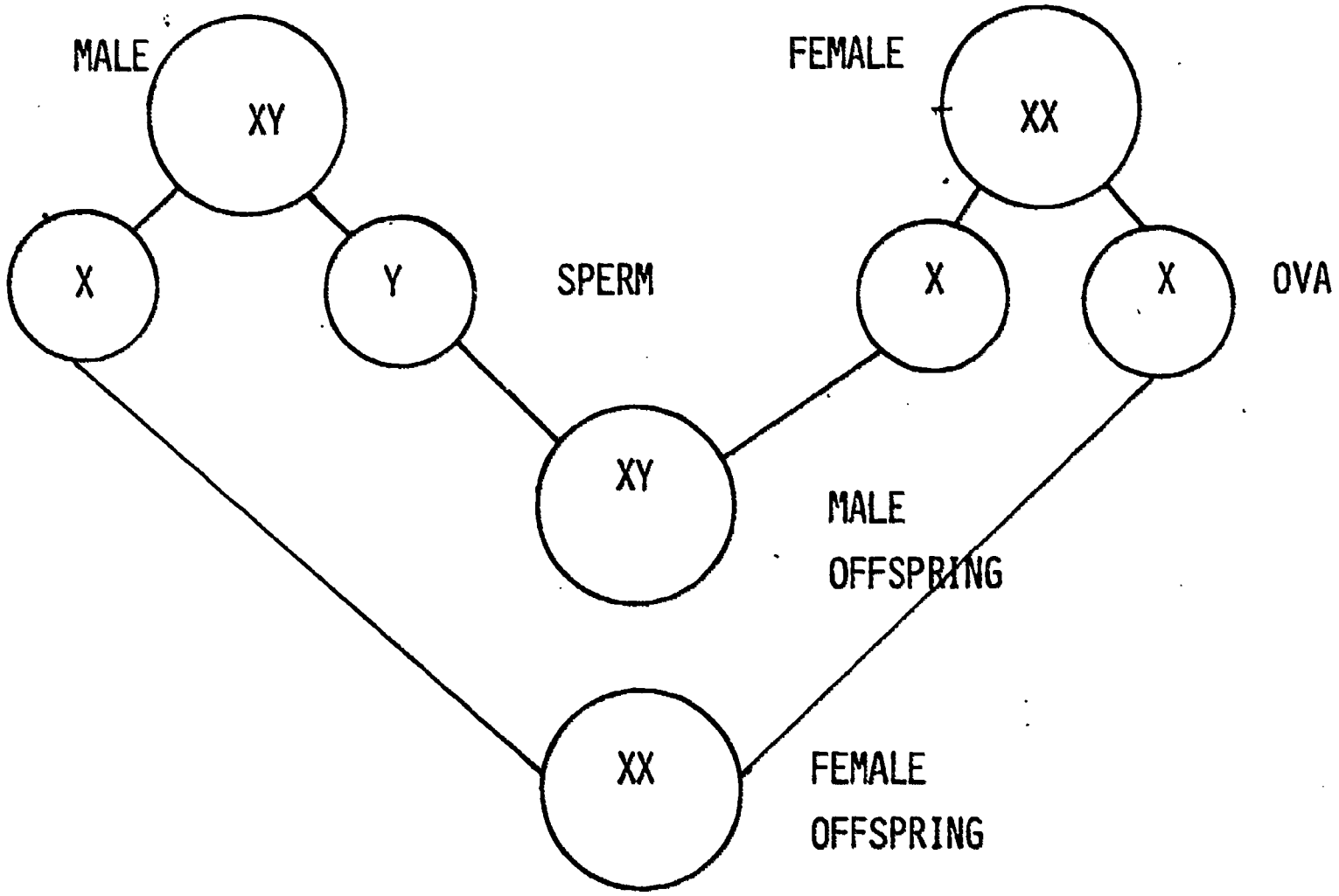
BLACK HORNED --- 3

RED POLLED --- 3

RED HORNED --- 1

FIGURE 19

SEX DETERMINATION



Course: Advanced Livestock Production

Area: Livestock Breeding

Unit: Genetics

Job XXI: Heritability Estimates

Objective: To instruct students in heritability estimation and the practicality of heritability estimate's application to farm use

Motivation: "Which trait in swine can you change the quickest by selective breeding--number of pigs farrowed or rate of gain?"

References: 1. "Improvement of Swine Through Breeding," Lasley, Day, Tribble, B775

2. Animal Breeding, Winters (p. 150)

3. Breeding and Improvement of Farm Animals, Rice and Andrews (p. 270)

4. "Animal Science" Slide (number 75)

Teaching Outline:

I. Principles of heritability estimation

II. Heritability estimates of livestock

III. Application to farm situation

Teaching Procedure :

I. Introduce unit.

II. Assign reading from one of the references and discuss the principles.

III. Discuss actual heritability estimates that apply to livestock.

IV. Discuss how heritability estimates can be applied to the student's livestock.

V. Summarize and evaluate.

TABLE XXX

HERITABILITY ESTIMATES FOR SWINE

PERFORMANCE CHARACTER	PER CENT HERITABLE
NUMBER OF PIGS FARROWED	15
NUMBER OF PIGS WEANED	20
WEIGHT OF LITTER AT WEANING	15
GROWTH RATE, WEANING TO 200 POUNDS	30
ECONOMY OF GAIN, WEANING TO 200 POUNDS	40
BODY CONFORMATION	
NIPPLE NUMBERS	60
LENGTH OF LEGS	65
LENGTH OF BODY	60
SCORE FOR CONFORMATION	30
CARCASS ITEMS	
CARCASS LENGTH	60
LOIN-EYE AREA	50
BACKFAT THICKNESS	50

PER CENT OF HAM	60
PER CENT OF FAT CUTS	60
PER CENT OF SHOULDER	50
PER CENT OF LEAN CUTS	50
BELLY THICKNESS	60

TABLE XXXI

EXAMPLE OF HOW SELECTION ON HERITABILITY WORKS

TRAIT

	140 DAY WT.	BACKFAT, INCHES	FEED PER 100 LBS.	% LEAN CUTS	LEAN EYE AREA
HEAD AVERAGE	180	1.40	290	37	4.00
BEST RECORD	235	.80	230	40	6.50
DIFFERENCE	50	.60	60	3	2.50
HERITABILITY	30%	50%	40%	50%	50%
PREDICTED CHANGE	7.5 LBS.	.15 INS.	12.1 LBS.	.75%	.62 SQ. INS.

TABLE XXXII

DAIRY

TRAIT	PER CENT HERITABILITY
SPEED OF MILKING	27-37
MILK PRODUCTION	25-35
SPEED OF FEEDING	12-15
BREEDING PROBLEMS	8-14
MILK LEAK	5-10

LIVESTOCK NUTRITION

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Digestive Systems of Livestock

Job XXII: The Monogastric System

Objective: To develop an understanding of the monogastric digestive system

Motivation: "Why doesn't a pig chew a cud?" "What is different about a hog that allows it to digest food without chewing a cud?"

References: 1. Feeds and Feeding, Morrison

2. "Animal Science" Slides, Iowa State (numbers 1-3, 35)

Teaching Outline:

I. Parts of monogastric digestive system

II. Function of parts of digestive system

Teaching Procedure:

I. Introduce unit.

III. Integrate the animal science slides from Iowa State into the discussion.

IV. Obtain the digestive system of a hog and compare pictures to actual system.

V. Summarize and evaluate.

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Digestive Systems of Livestock

Job XXIII: Ruminant Digestive System

Objective: To develop an understanding of the ruminant digestive system

Motivation: "Why do ruminants suffer from 'hardware' disease when other animals don't?"

References:
1. Feeds and Feeding, Morrison
2. Animal Nutrition, Maynard and Loosli
3. Film: "The Rumen Story," Ralston Purina Company
4.
5. "Animal Science" Slides, Iowa State (numbers 4-10, 32-34)

Teaching Outline:

I. Parts of a ruminant's stomach

II. Function of each portion

III. Pathways of food through ruminant's stomach

IV. Rumination and its implications

Teaching Procedure:

I. Introduce unit.

III. Integrate the Iowa State slides into the discussion of the function, parts, and movement within the ruminant's stomach.

IV. Obtain the digestive system from a cow and examine it in class and point out the various parts.

V. Point out the esophageal groove and the linings within the stomachs and intestines.

VI. Show the movie "The Rumen Story".

VII. Summarize and evaluate.

TABLE XXXIII

COMPARISON OF DIGESTIVE SYSTEMS

1. RUMINANTS HAVE A RELATIVELY LARGE DIGESTIVE SYSTEM (LARGE RUMEN PLUS OTHER COMPARTMENTS), WHICH ENABLES THEM TO USE ENORMOUS AMOUNTS OF ROUGHAGE-TYPE FEEDS IN COMPARISON WITH MONOGASTRIC ANIMALS.

2. RUMINANT ANIMALS HAVE A MUCH GREATER ABILITY THAN NON-RUMINANTS TO DIGEST ROUGHAGE BEFORE IT ENTERS THE INTESTINAL TRACT.

3. THE ALIMENTARY TRACT IN THE RUMINANT ANIMAL IS FAR MORE EFFICIENT THAN THAT OF THE MONOGASTRIC ANIMAL IN THE UTILIZATION OF CRUDE FIBER.

ALFALFA HAY CRUDE FIBER DIGESTION

	PER CENT DIGESTION
CATTLE	44
SHEEP	45
HORSES	39[A]
SWINE	22

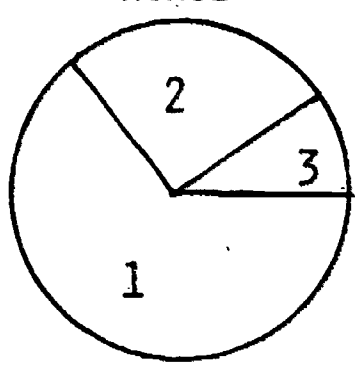
[A]MAINLY IN THE CAECUM

TABLE XXXIV

RELATIVE CAPACITIES OF

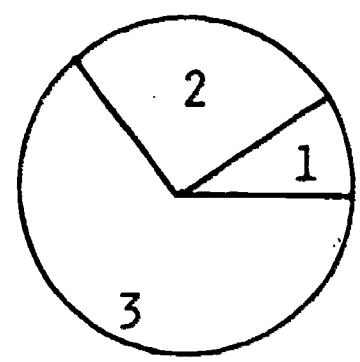
DIGESTIVE TRACTS

HORSE



1 LG. INTESTINE

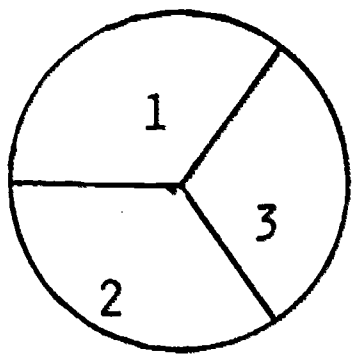
COW



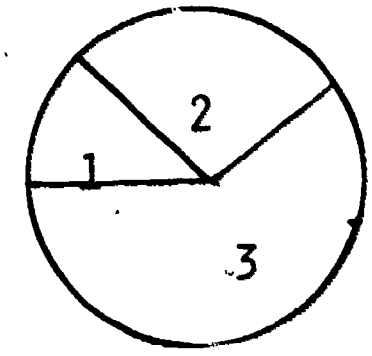
2 SM. INTESTINE

3 STOMACH

PIG



SHEEP



Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Nutrients

Job XXIV: The Basic Nutrients

Objective: To develop a general knowledge on the part of the student of the basics of nutrients

Motivation: "Is it true that livestock need fuel just like a motor?" "What nutrients are required?" "How can they be provided?"

References:

1. Feeds and Feeding, Morrison
2. "Animal Science" Slides (numbers 12-19)
3. "Nutrient Requirements of Beef Cattle," No. 4, publication 1137, National Academy of Sciences
4. "Nutrient Requirements of Horses", No. 6, publication 1401, National Academy of Sciences
5. "Nutrient Requirements of Dairy Cattle," No. 3, publication 1349, National Academy of Sciences
6. "Nutrient Requirements of Swine," No. II, publication 1192, National Academy of Sciences
7. "Life Cycle Swine Nutrition", AS-90, Iowa State University.

Teaching Outline:

I. The kinds of nutrients.

Teaching Procedure:

I. Introduce unit.

II. Assign students to construct a chart of the food nutrients showing the different kinds, compositions, sources, and uses by the animal.

III. Review the unit on feed nutrients, using handout, and integrating the Iowa State slides.

IV. Summarize and evaluate.

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Nutrients

Job XXV: The Proteins

Objective: To develop an understanding of the structure of protein and amino acids and the use of non-proteinous-nitrogen

Motivation: "Why is it that of the proteins we have studied, no two proteins are alike?"

References:

1. Feeds and Feeding, Morrison
2. "Buying Protein Supplement," Doanes Agricultural Report (p. 218.1)
3. "Supplementing Summer Pasture", Doanes Agricultural Report (p. 261)
4. "Urea and Limestone for Corn Silage," Doanes Agricultural Report (p. 276.1)
5. "Evaluating Protein Supplements for Beef Cows," M. U. Guide (p. 2063)
6. "Urea Supplements for Beef Cattle," M. U. Guide (p. 2071)
7. "Urea for Dairy Cattle," M. U. Guide (p. 3109)

Teaching Outline:

I. Structure of proteins

II. Essential and nonessential amino acids

III. Non-proteinous-nitrogen sources

Teaching Procedure:

I. Introduce unit.

II. Described how proteins are made up of amino acids.

III. Discuss which amino acids are essential and which are nonessential.

IV. Discuss the use of non-protein-nitrogen in ruminant rations.

V. Summarize and evaluate.

TABLE XXXV

AMINO ACIDS

ESSENTIAL	NONESSENTIAL
PHENYLALANINE	ALANINE
HISTIDINE	ASPARTIC ACID
ISOLEUCINE	CYSTINE
LEUCINE	GLUTAMIC ACID
LYSINE	GLYCINE
METHIONINE	HYDROXYPROLINE
TRYPTOPHAN	PROLINE
VALINE	SERINE
ARGININE	TYROSINE
THREONINE	

TABLE XXXVI

UREA

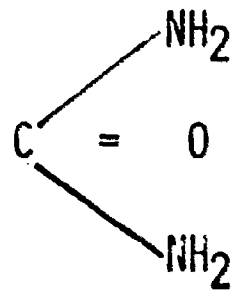
CRUDE PROTEIN = (% NITROGEN) (6.25)

CRUDE PROTEIN = (UREA 46% N) (6.25)

CRUDE PROTEIN = 262%

1. USE IN RATIONS LOW IN PROTEIN
2. ENERGY SOURCE
3. NECESSITY OF BEING WELL MIXED
4. POSSIBILITY OF SUPPLYING UP TO 1/3 TOTAL PROTEIN

   A. ABOUT 1% OF TOTAL RATION
   B. ABOUT 3% OF CONCENTRATE
   C. ABOUT 5% OF PROTEIN SUPPLEMENT



OTHER NPN SOURCES -- LESS BENEFICIAL THAN UREA

1. AMMONIATED MOLASSES
2. AMMONIATED CONDENSED DISTILLERS MOLASSES SOLUBLES
3. AMMONIATED CITRUS PULP
4. AMMONIATED BEET PULP
5. AMMONIATED FURFURAL RESIDUE
6. BIURET

"Adapted from Frank B. Morrison: Feeds and Feeding 22nd Edition, by special permission of The Morrison Publishing Company, R.R. #3, Claremont, Ontario, Canada."

TABLE XXXVII

UREA FEEDING RECOMMENDATIONS

(BY CLASS OF LIVESTOCK)

	LOW QUALITY ROUGHAGE* + PROTEIN SUPPLEMENT	GOOD OR HIGH QUALITY ROUGHAGE** + PROTEIN SUPPLEMENT	HIGH ROUGHAGE + SUPPLEMENTAL GRAIN AND PROTEIN	FULL FULL	HIGH CONCENTRATE
BEEF CATTLE					
WINTERING COWS	1/2 S	1/3 T			
GROWING CALVES					
200 + POUNDS	1/2 S	1/3 T	1/3 C		
FATTENING			1/3 C	1/3 T	1/2 T
SHEEP					
EWES	1/2 S	1/3 T	1/2 C		
LAMBS			1/2 C	1/2 T	
DAIRY CATTLE					
MILKING COWS			1/3 C	1/3 C	
DRY COWS	1/2 S	1/3 T	1/3 C		
GROWING STOCK	1/2 S	1/3 T	1/3 C		

* LOW QUALITY ROUGHAGE - - CONTAINING LESS THAN 6% PROTEIN

** GOOD QUALITY ROUGHAGE - -CONTAINING MORE THAN 6% PROTEIN

S AMOUNT OF SUPPLEMENTAL PROTEIN UREA MAY REPLACE

C AMOUNT OF CONCENTRATE PROTEIN UREA MAY REPLACE

T AMOUNT OF TOTAL RATION PROTEIN UREA MAY REPLACE

TABLE XXXVIII

PROTEIN UTILIZATION IN RUMINANTS

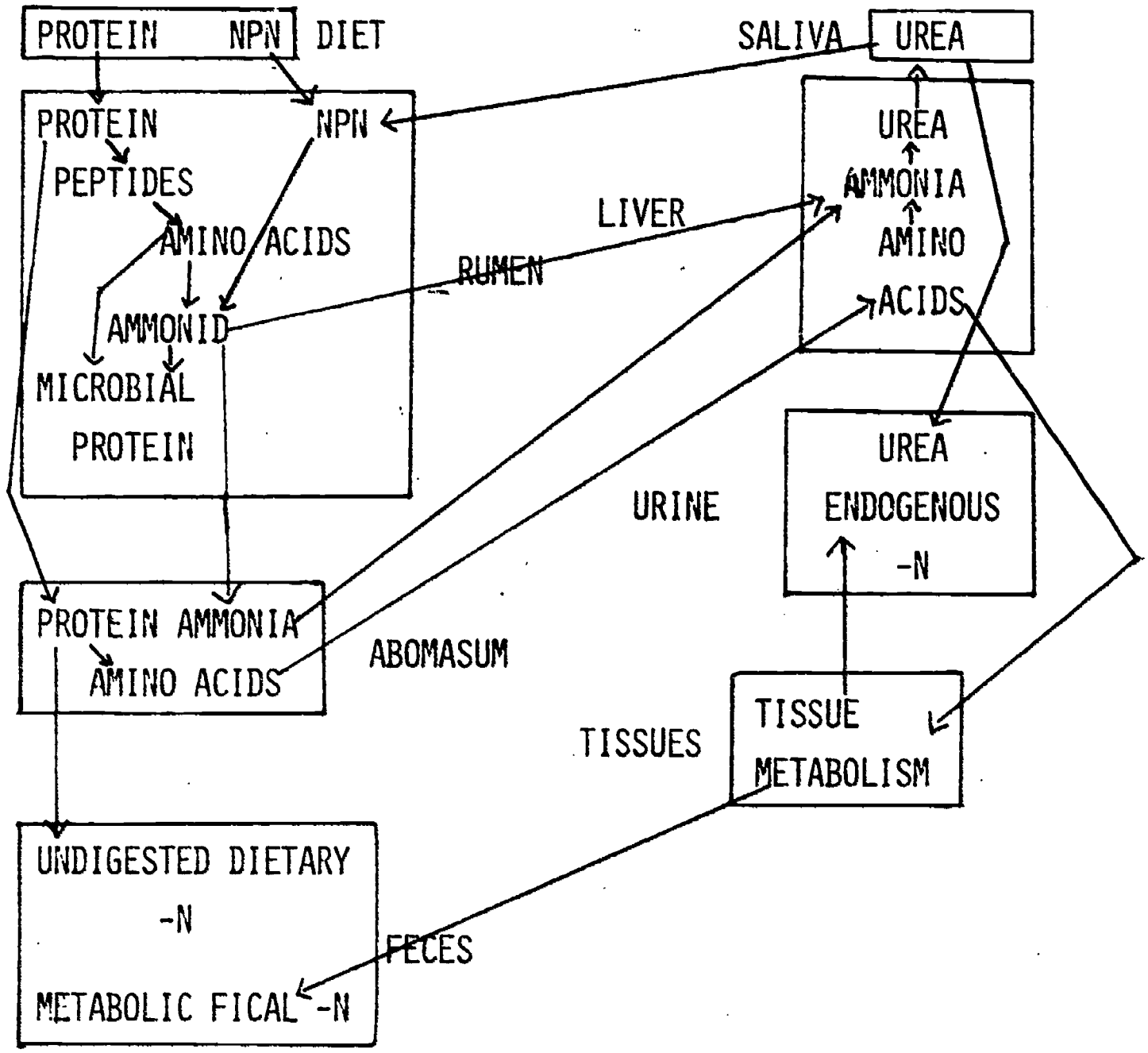
Procedure

1. Bacterial breakdown of protein and non-protein-nitrogen in the ration, which produces ammonia
2. Synthesis of this ammonia into bacterial protein
3. Digestion of the bacterial protein in the lower digestive tract of the ruminant, which supplies both the essential and nonessential amino acids required

TABLE XXXIX

NITROGEN METABOLISM

IN THE RUMINANT



Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Nutrients

Job XXVI: The Energy Sources

Objective: To develop a basic understanding of how an animal secures energy

Motivation: "Can a cow actually receive some nutritional value from straw?"

Reference:

1. Feeds and Feeding, Morrison
2. "Animal Science" Slides (number 19)
3. "Nutrient Requirements of Beef Cattle," No. 4, publication 1137, National Academy of Sciences, National Research Council, 2101 Constitution Avenue, Washington, D. C. 20418
4. "Nutrient Requirements of Horses," No. 6, publication 1401, National Academy of Sciences
5. "Nutrient Requirements of Dairy Cattle," No. 3, publication 1349, National Academy of Sciences
6. "Nutrient Requirements of Swine," No. II, publication 1192, National Academy of Sciences
7. "Life Cycle Swine Nutrition," AS-90, Iowa State University, Ames, Iowa.

Teaching Outline:

I. Sources of energy

II. Supplying of energy through feeds

III. Measures of energy

Teaching Procedure:

I. Introduce unit.

II. Discuss how energy sources are broken down.

III. Assign students to make a list of sources of high energy levels.

IV. Discuss how energy is measured in regard to ration calculation.

V. Summarize and evaluate.

TABLE XL

ENERGY SOURCES

YIELD ENERGY:

(1) FAT

(2) NITROGEN-FREE EXTRACT

(3) PROTEIN

(4) CRUDE FIBER

CARBOHYDRATES

I. MONOSACCHARIDES

A. PENTOSES

B. HEXTOSES

1. GLUCOSE
2. GALACTOSE
3. FRUCTOSE

II. DISACCHARIDES

A. LACTOSE (MILK SUGAR)

B. MALTOSE

C. SUCROSE (TABLE SUGAR)

III. POLYSACCHARIDES

A. STARCH

B. CELLULOSE

IV. LIGNIN

A. NOT DIGESTIBLE

EAIS_

SATURATED:

ACETIC, PROPIONIC, BUTYRIC — VOLATILE FATTY ACIDS FROM RUMEN

CAPROIC, CAPRYLIC, CAPRIC — FOUND IN BUTTERFAT

OLEIC -- UNSATURATED:

LINOLEIC*

LINOLENIC*

ARACHADONIC -- UNSATURATED*

- - - - - - - - - - - - - - -

* ESSENTIAL FATTY ACIDS TO NUTRITION

REST USED FOR ENERGY SUPPLY

TABLE XLI

MEASUREMENTS OF ENERGY

TDN (TOTAL DIGESTIBLE NUTRIENTS)

1. TDN = (% PROTEIN) (PROTEIN DIGESTIBILITY COEFFICIENT) + (% FAT) (FAT DIGESTIBILITY COEFFICIENT) (2.25) + (% CRUDE FIBER) (C. F. DIGESTIBILITY COEFFICIENT) + (% NITROGEN-FREE EXTRACT) (NFE DIGESTIBILITY COEFFICIENT)

2. D. E. (DIGESTIBLE ENERGY)
   ASSUME ONE POUND TDN - 2.000
   KILOCALORIES OF DE

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Nutrients

Job XXVII: Minerals

Objective: To develop an understanding of the functions of minerals, their symptoms of deficiency and when and where a deficiency is likely to occur

Motivation: "If animals require such small amounts of minerals, why is it essential that we supply any minerals?"

References:

1. Feeds and Feeding, Morrison
2. "Nutrient Requirements of Beef Cattle," No. 4, publication 1137, National Academy of Sciences
3. "Nutrient Requirements of Horses," No. 6, publication 1401, National Academy of Sciences
4. "Nutrient Requirements of Dairy Cattle," No. 3 publication 1349, National Academy of Sciences
5. "Nutrient Requirements of Swine," No. II, publication 1192, National Academy of Sciences
6. "Life Cycle Swine Nutrition," AS-90, Iowa State University.
7. "Mineral Supplements for Livestock", Doanes Agricultural Report (p. 219)

Teaching Outline:

I. Minerals

II. Function of minerals

III. Deficiency symptoms of minerals

IV. Time and place mineral deficiencies are likely to occur

V. Mineral requirements

VI. Water as a nutrient

Teaching Procedure:

I. Introduce unit.

III. Distribute handouts and discuss the minerals and their functions, deficiencies, and when and where they are likely to occur.

IV. Obtain a guest speaker through a commercial feed company to discuss with the class the feeding of minerals.

V. Show samples of minerals and mineral supplements.

VI.. Collect pictures of animals exhibiting mineral deficiencies from various sources and exhibit and discuss them with the class.

VII. Review in Feeds and Feeding or NRC bulletins the nutrients required by the various farm animals.

VIII. Review the amount of minerals in feeds.

IX. Discuss the function, metabolism, and elimination of water.

X. Summarize and evaluate.

TABLE XLII

THE GENERAL FUNCTIONS OF MINERALS

1. STRUCTURAL -- CALCIUM AND PHOSPHORUS IN THE SKELETON

2. OSMOTIC PRESSURE -- SODIUM, POTASSIUM, CHLORINE AND PHOSPHATES

3. pH REGULATION
   A. BUFFERS
   B. BLOOD pH 7.35

4. MUSCLE FUNCTION AND NERVE TRANSMISSION -- CALCIUM, POTASSIUM AND SODIUM

5. ENZYME REACTIONS

TABLE XLIII

MINERALS

MINERAL	FUNCTIONS	SYMPTOM OF DEFICIENCY
K POTASSIUM	REGULATES OSMOTIC PRESSURE; REGULATES pH; REGULATES ENZYMATIC REACTIONS	LOSS IN WEIGHT, REDUCED FEED INTAKE, POOR WOOL GROWTH, STIFFNESS
P PHOSPHORUS	AIDS STRUCTURAL GROWTH	LOWERED BLOOD PLASMA P; DEPRAVED APPETITE (PICA), RICKETS, POOR GAINS, ROUGH HAIR COAT
Ca CALCIUM	AIDS STRUCTURAL GROWTH	RICKETS IN YOUNG ANIMALS, FRAGILE BONES OR OSTEOMALACIA IN MATURE ANIMALS, ESPECIALLY LACTATING

WHEN IS DEFICIENCY LIKELY?

WHEN RUMINANTS ARE FED RATION WITH NO ROUGHAGE

WHEN CATTLE ARE ON LOW GRADE ROUGHAGE OR ON UNFERTILIZED PASTURE; WHEN POULTRY ARE ON PLANT RATIONS; WHEN HOGS ARE ON PASTURE WITH NO PROTEIN SUPPLEMENT

WHEN CATTLE AND SHEEP ARE ON LOW GRADE HAY; WHEN HOGS ARE ON DRY LOT AND VEGETABLE RATIONS; WHEN POULTRY ARE FED UNSUPPLEMENTED RATIONS

		FEMALES AND LAYING HENS
MG MAGNESIUM	AIDS STRUCTURAL GROWTH; REGULATES ENZYMATIC REACTIONS	HYPERIRRITIBILITY, MUSCULAR TWITCHING, WEAK PASTERNS, TETANY AND EXCESS SALIVATION
FE IRON	ABETS BLOOD FORMATION; AIDS RESPIRATION; REGULATES ENZYMATIC REACTIONS	ANEMIA AND THUMPS IN PIGS
CU COPPER	AIDS IRON USAGE; INFLUENCES HAIR PIGMENTATION	DIARRHEA, BLEACHED HAIR COAT, STEELY WOOL, SWELLING ABOUT PASTERNS, FRAGILE BONES, ANEMIA
CO COBALT	REGULATES VITAMIN B_{12} USAGE	LOSS OF APPETITE, ANEMIA, POOR GROWTH

WHEN ON LUSH PASTURES WITH HIGH NITROGEN APPLICATIONS

WHEN BABY PIGS ARE ON CONCRETE OR BOARD FLOORS

NOT LIKELY TO OCCUR .

WHEN CORN COBS OR LOW GRADE ROUGHAGE ARE FED WITH CORN

MN MANGANESE	AIDS CARBOHYDRATE METABOLISM; AIDS FERTILITY	SLIPPED TENDONS IN POULTRY, LOWERED HATCHABILITY
ZN ZINC	REGULATES INSULIN PRODUCTION ; INFLUENCES SKIN ENZYME PRODUCTION	PARAKERATOSIS, POOR GROWTH IN POULTRY
SE SELENIUM	REGULATES VITAMIN E USAGE	WHITE MUSCLE DISEASE, STIFF LAMB DISEASE, CHRONIC ALKALI DISEASE, ACUTE BLIND STAGGERS
S SULPHUR	AIDS FORMATION OF PROTEINS	REDUCED GROWTH, ESPECIALLY OF WOOL IN SHEEP
I IODINE	REGULATES THYROID GLAND	GOITER, HAIRLESS PIGS, ENLARGED NECKS

IF POULTRY RATIONS ARE USED: NEVER FOR OTHER FARM ANIMALS

WHEN LARGE AMOUNTS OF Ca ARE ADDED TO SWINE RATIONS

NOT LIKELY TO OCCUR ; EASILY CORRECTED BY LARGE DOSE OF VITAMIN E

WHEN LOW GRADE ROUGHAGE SUPPLEMENTED WITH UREA ARE USED

WHEN PREGNANT ANIMALS DRINK RAIN OR RIVER WATER IN SOME AREAS

NA Cl SALT	REGULATES OSMOTIC PRESSURE	SALT HUNGER, REDUCED APPETITE, ROUGH HAIR, LOSS OF WEIGHT, DECLINE IN PRODUCTION

IN ALL ANIMALS, IF NOT ALLOWED SALT

TABLE XLIV

WATER

FUNCTIONS --

1. TAKES UP HEAT -- HIGH SPECIFIC HEAT AND HEAT OF VAPORIZATION
2. ABETS NERVE TRANSMISSION -- HIGH DIELECTRIC CONSTANT
3. PRODUCES CATALYTIC CHEMICAL REACTION IN DIGESTION AND HYDROLYSIS OF FOODS

METABOLISM --

1. INTAKE
   - A. DRINKING WATER
   - B. WATER IN THE FEED
   - C. METABOLIC WATER

     $C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O$
2. ELIMINATION
   - A. URINE
   - B. FECES
   - C. PERSPIRATION -- THROUGH PORES
   - D. INSENSIBLE PERSPIRATION
     - (1) LOST FROM LUNGS
     - (2) LOST DIRECTLY THROUGH SKIN

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Nutrients

Job XXVIII: Vitamins

Objective: To develop an understanding of the functions of the various vitamins, the symptoms of their deficiencies, their sources, and their requirements.

Motivation: Show examples of animals with vitamin deficiencies and ask what could have caused these conditions.

References:

1. Feeds and Feeding, Morrison.
2. "Nutrient Requirements of Beef Cattle," No. 4, publication 1137, National Academy of Sciences.
3. "Nutrient Requirements of Horses," No. 6, publication 1401, National Academy of Sciences
4. "Nutrient Requirements of Dairy Cattle," No. 3, publication 1349, National Academy of Sciences.
5. "Nutrient Requirements of Swine," No. II, publication 1192, National Academy of Sciences
6. "Life Cycle Swine Nutrition," AS-90, Iowa State University.
7. "Animal Science" Slides, Iowa State (number 43).
8. "Vitamin A in Beef Cattle Feeding," M.U. Guide (p. 2058).

Teaching Outline:

I. The vitamins--fat and water soluble

II. The functions of the vitamins

III. The symptoms of deficiency of vitamins

IV. The sources of vitamins

V. The vitamin requirements

Teaching Procedure:

I. Introduce unit.

III. Distribute handouts and discuss the vitamins, their functions, deficiency symptoms, sources and requirements.

IV. Collect pictures of animals exhibiting vitamin deficiencies and discuss them with the class.

V. Review the NRC and Feeds and Feeding as they apply to the amounts of vitamins needed by the different classes of livestock.

VI. Review the amounts of vitamins found in feedstuffs and have the students compile a list of vitamin contents of commonly used feeds.

VII.. Summarize and evaluate.

TABLE XLV

VITAMINS

VITAMIN	FUNCTION	SYMPTOM OF DEFICIENCY
FAT SOLUBLE		
A	MAINTAIN EIPTHELIAL TISSUE AND FORM CARTILEGE	NIGHT BLINDNESS; XEROPHTHALMIA; REPRODUCTIVE PROBLEMS; POOR GROWTH
D	FORMS BONE AND ACTIVATES PARATHYROID	RICKETS IN YOUNG; OSTEOMALACIA IN MATURE ; WEAK EGG SHELLS IN POULTRY
E	ACTS AS ANTIOXIDANT, STIMULATES PROTEIN SYNTHESIS, AIDS REPRODUCTION	REPRODUCTIVE FAILURES; ENCHEPALOMALACIA-- CRAZY CHICKEN DISEASE, WATER ON THE BRAIN; STIFF LAMB AND WHITE MUSCLE DISEASE OF SHEEP

K	COAGULATES BLOOD (PROTHOMBIN)	INTERNAL HEMMORHAGING
WATER SOLUBLE		
C	NONE	NONE
B_1 THIAMIN	METABOLIZES PYRUVIC ACID	BERI-BERI IN MAN; POLYNEURITIS IN POULTRY
B_2 RIBOFLAVIN	ENCOURAGES PHOSPHORYLATION AND AMINO ACID OXIDATION	POOR GROWTH; CURLED TOE PARALYSIS; DIARRHEA; POOR HATCHABILITY
B NIACIN	ENCOURAGES PHOSPHORYLATION	PELLAGRA

SOURCES	MISCELLANEOUS INFORMATION AND REQUIREMENTS
ANIMAL SOURCE -- A; PLANT SOURCE -- CAROTENE	MAINTENANCE -- 1,000 IU PER CWT., GROWTH -- 3,000 IU PER CWT.
PLANT -- D_2; ANIMAL -- D_3; SUNLIGHT	400 IU PER CWT.
GERM OF GRAIN; GREEN FORAGES	UNKNOWN

ANTIBIOTICS, ALFALFA	NONE
NONE	NEEDED ONLY BY MAN, MONKEY AND GUINEA PIGS
SYNTHESIZED IN RUMEN	.5 MG PER DAY
YEAST, WHEY, GREEN PLANTS	1-2 MG PER POUND FEED, DESTROYED BY LIGHT
YEAST, MEAT SCRAPS, GRAIN	5-10 MG PER POUND FEED

B_{12}	ENCOURAGES NUCLIC ACID METABOLISM AND RED BLOOD CELL FORMATION; AIDS IN THE CARBOLIC EXCHANGE	POOR GROWTH.ANEMIA

TANKAGE, FISH MEAL, FERMENTATION RESIDUES	5 MG PER POUND FEED

OTHER VITAMINS:

1. PYRIDOXINE
2. PANTOTHENIC ACID
3. BIOTIN
4. CHOLIN
5. INISTOL
6. FOLIC ACID

TABLE XLVI

DIGESTION--THE PROCESS

OF PREPARING FOOD FOR ABSORPTION

I. MECHANICAL
   A. MASTICATE (TEETH)
   B. CRUSH (GIZZARD)
   C. EMULSIFY (LIVER)
   D. REGURGETATE (RUMINANT)

II. CHEMICAL
   A. STOMACH -- HYDROCHLORIC ACID
   B. SMALL INTESTINE -- ALKALI

III. ENZYMATIC -- NEURAL AND HORMONAL SECRETION

SOURCE	NAME	ACTS UPON
MOUTH (SALIVA)	PTYALIN	CARBOHYDRATES
STOMACH (GASTRIC JUICE)	PEPSIN	PROTEIN
PANCREAS (PANCREATIC JUICE)	TRYPSIN	PROTEIN
	CHYMOTRYPSIN	PROTEIN
	AMYLASE	CARBOHYDRATES
	LIPASE	FATS
SMALL INTESTINE (INTESTINAL JUICE)	PEPTIDASE	PROTEIN
	CARBOHYDASES	CARBOHYDRATES

IV. BACTERIAL -- ALL ACTION IN RUMEN BACTERIAL

A. CONDITIONS IN RUMEN DESIRABLE FOR BACTERIA

(1) WARM (39°C)

(2) MOIST

(3) pH CONTROLLED

(4) DARK

(5) CONTINUOUS FEEDING

TABLE XLVII

CARBOHYDRATE DIGESTION

---

1. SALIVA -- PIG SALIVORY -- AMYLASE
2. STOMACH -- HYDROCHLORIC ACID
3. SMALL INTESTINE
   - A. MALTOSE $\xrightarrow{\text{MALTOSE}}$ 2 GLUCOSE MOLECULES
   - B. SUCROSE $\xrightarrow{\text{SUCROSE}}$ 1 GLUCOSE + 1 FRUCTOSE MOLECULE
   - C. LACTOSE $\xrightarrow{\text{LACTOSE}}$ 1 GLUCOSE + 1 GALACTOSE MOLECULE

TABLE XLVIII

FAT DIGESTION

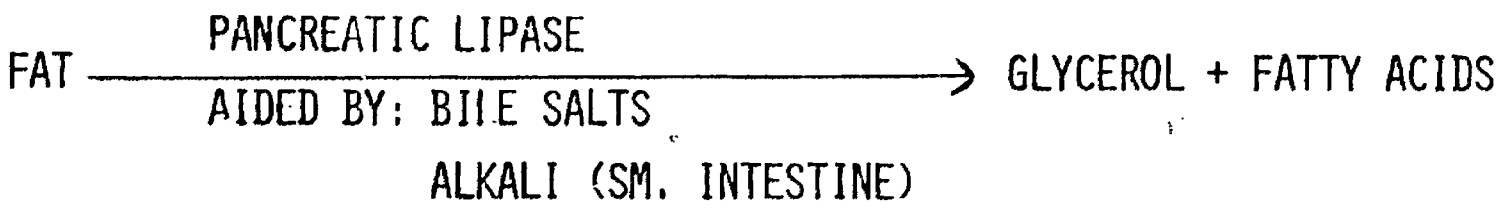


TABLE XLIX

PROTEIN DIGESTION

1. STOMACH -- PEPSIN (SCI OR HCL)

2. PANCREAS
   A. TRYPSIN
   B. CHYMOTRYPSIN

3. SMALL INTESTINE
   A. CARBOXY PEPTIDASE
   B. AMINO PEPTIDASE
   C. DIPEPTIDASE

THESE SEPARATE SPECIFIC AMINO ACIDS.

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Physiology of Digestion

Job XXIX: Digestive Process

Objective: To develop an understanding of the processes, both physically and enzymatically, in digestion

Motivation: "Food taken into the animal must undergo certain changes before it can be used by the animal."

References: 1. Feeds and Feeding, Morrison.

2. "Animal Science" Slides, Iowa State (numbers 20-31 and 36-42)

Teaching Outline:

I. Digestive Process

A. Mechanical

1. Masticate (teeth)

2. Crush (gizzard)

3. Emulsify (liver)

4. Regurgetate (ruminent)

B. Chemical

C. Enzymatic

D. Bacterial

Teaching Procedure:

I. Introduce unit.

II. Discuss the digestive process and integrate the slides from Iowa State.

III. Summarize and evaluate.

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Physiology of Digestion

Job XXX: Metabolism and Absorption of Nutrients

Objective: To instruct students in how the body takes the nutrients it needs from feedstuff

Motivation: Liken the body to a pipe which closes around its food and takes out what it needs. "How is this accomplished?"

References: 1. Feeds and Feeding, Morrison

2. "Animal Science" Slides, Iowa State (numbers 20-31 and 36-42)

Teaching Outline:

I. Absorption

A. Carbohydrates

B. Fats

C. Proteins

II. Metabolism of nutrients

Teaching Procedure:

I. Introduce unit.

II. Integrate the appropriate slides into the discussion.

III. Discuss how carbohydrates, fats, and proteins are absorbed and metabolized.

IV. Summarize and evaluate.

TABLE L

CARBOHYDRATE ABSORPTION

VILLI OF SMALL INTESTINE

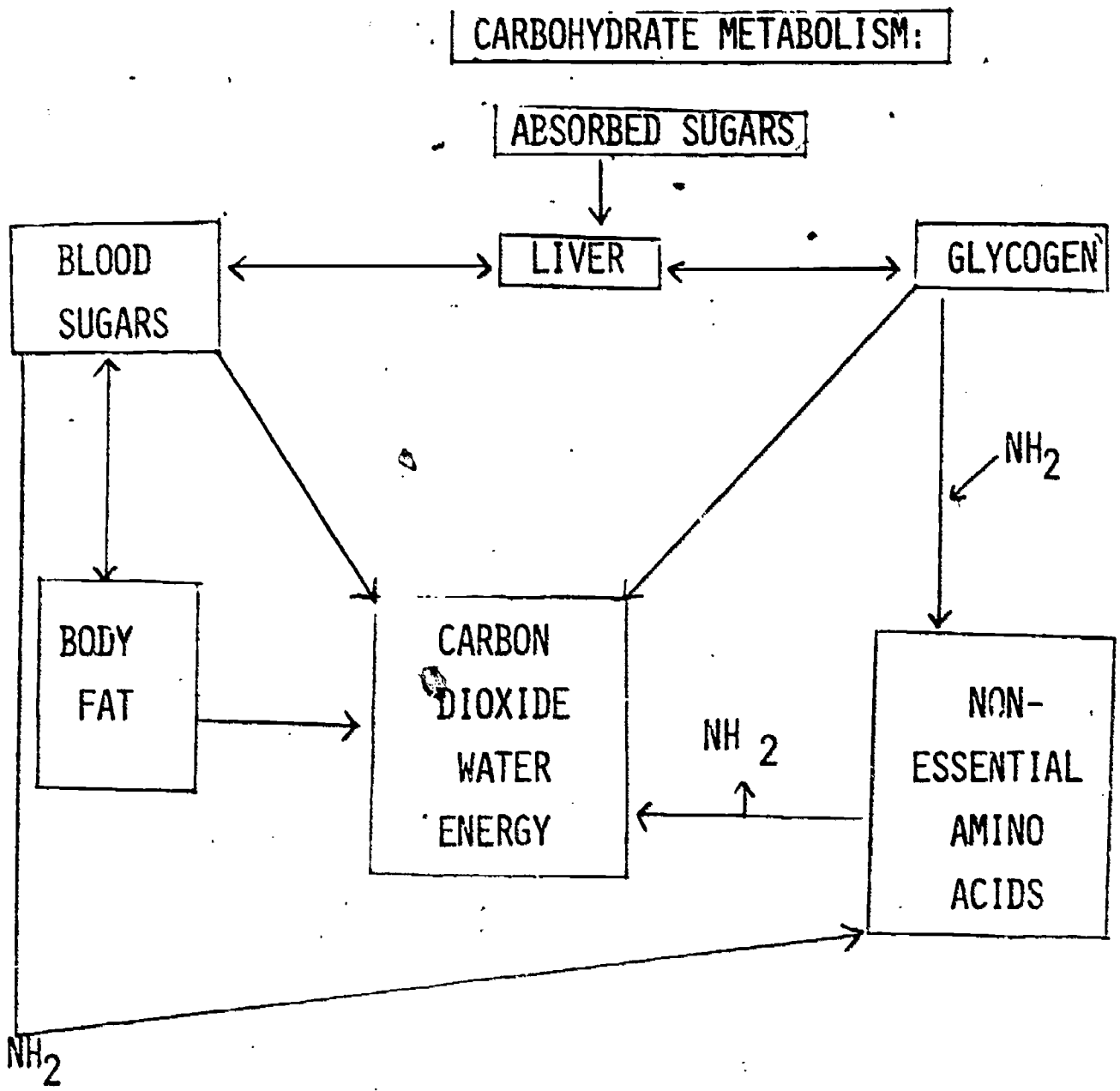
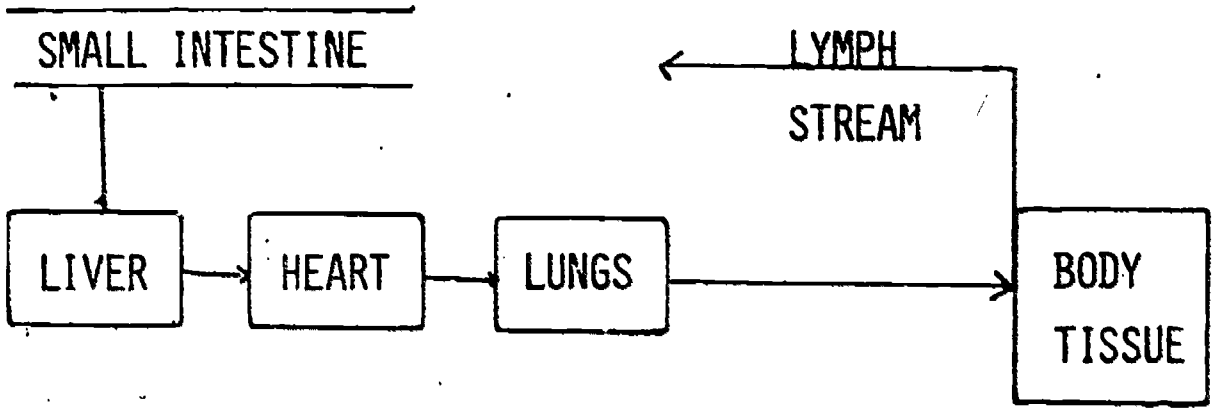


TABLE LI

FAT ABSORPTION

VILLI OF SMALL INTESTINE

FAT METABOLISM:



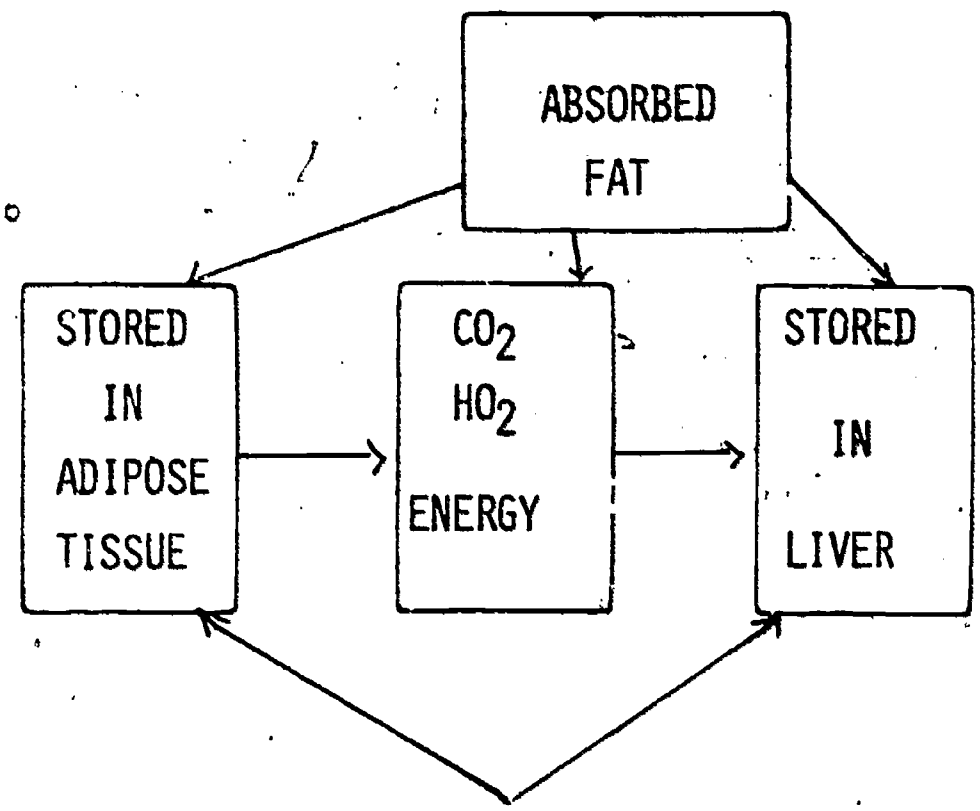


TABLE LII

PROTEIN ABSORPTION

VILLI OF SMALL INTESTINE

PROTEIN METABOLISM:

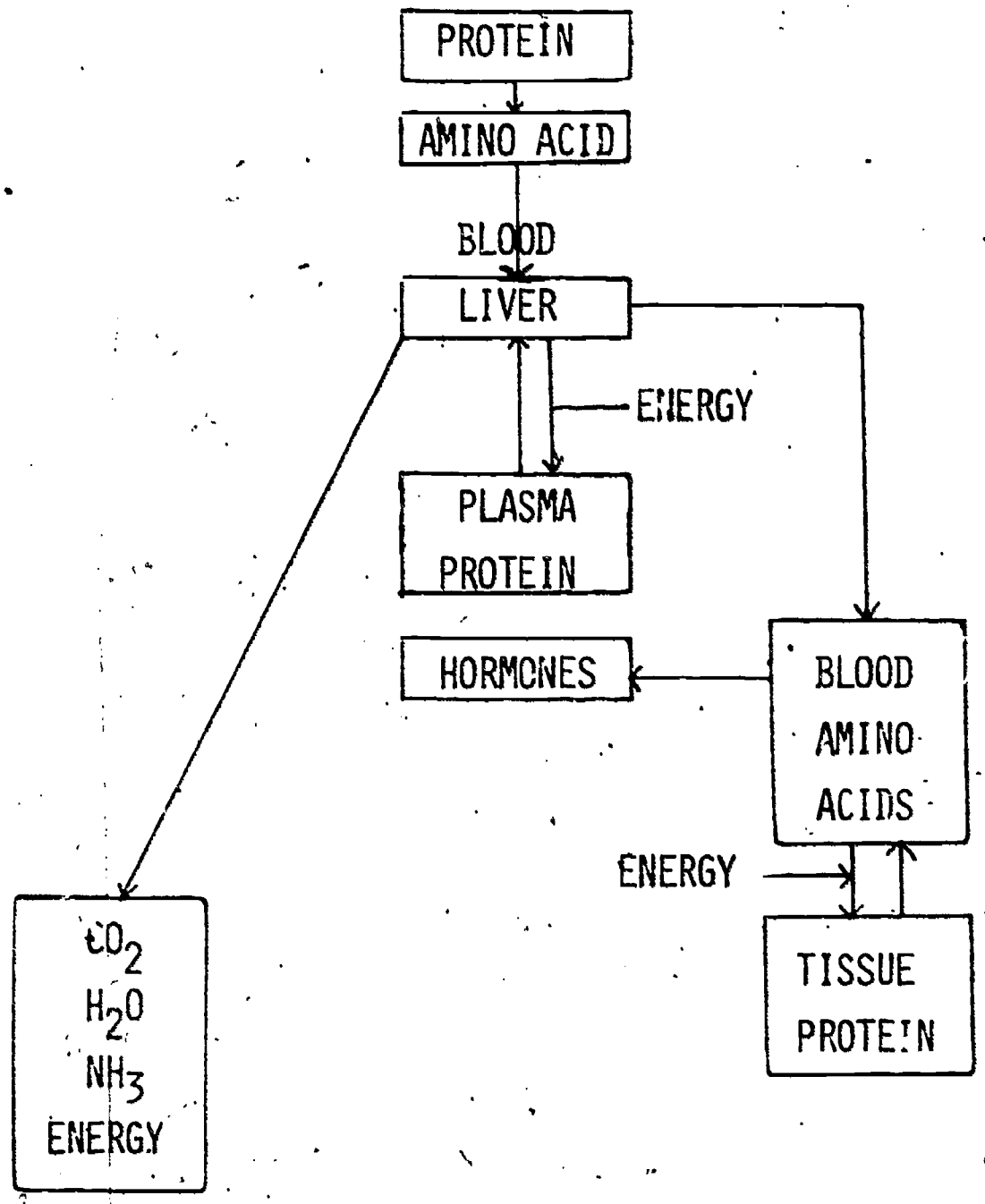


TABLE LIII

METABOLISM

ANY CHANGE THAT TAKES PLACE IN AN ANIMAL'S BODY

WASTE REMOVAL

1. LIVER -- REGULATOR -- WATER INSOLUBLE WASTE PRODUCTS
2. KIDNEY -- REGULATOR -- WATER SOLUBLE WASTE PRODUCTS
3. LUNGS -- OXYGEN UPTAKE AND CARBON DIOXIDE REMOVAL

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Rations

Job XXXI: Analysis of Feedstuffs

Objectives: To instruct students in how an analysis of feedstuffs is made and how it can be used

To understand the digestibility of feeds

Motivation: "What is the difference between a concentrate and a roughage?"

References:

1. Feeds and Feeding, Morrison
2. "Nutrient Requirements of Beef Cattle," No. 4, publication 1137, National Academy of Sciences
3. "Nutrient Requirements of Horses," No. 6, publication 1401, National Academy of Sciences
4. "Nutrient Requirements of Dairy Cattle," No. 3, publication 1349, National Academy of Sciences
5. "Nutrient Requirements of Swine," No. II, publication 1192, National Academy of Sciences
6. "Life Cycle Swine Nutrition", AS-90, Iowa State University
7. "Animal Science" Slides, Iowa State (numbers 16-18)

Teaching Outline:

I. Proximate analysis

II. Digestibility of feeds

Teaching Procedure:

I. Introduce unit.

II. Review the routine analysis of feedstuffs and discuss how it is made.

III. Burn some dry leaves to illustrate ash content.

IV. Review Table I in the appendix of Feeds and Feeding and illustrate the calculation of the digestibility of feedstuff.

V. Calculate a problem on TDN as illustrated in Table SLI to illustrate the digestibility of feedstuff.

A. Digestibility Coefficient = $\frac{\text{Amount of feed digested}}{\text{Amount of feed consumed}}$

VI. Summarize and evaluate.

TABLE LIV

ROUTINE ANALYSIS OF FEEDSTUFFS

1. DRY MATTER. HEAT SAMPLE TO A CONSTANT WEIGHT. THIS REMOVES THE WATER, SO LOSS IN WEIGHT EQUALS WATER -- 24 HRS. USUALLY REQUIRED.

2. ETHER EXTRACT (FAT). EXTRACT DRY SAMPLE WITH ANHYDROUS ETHYL ETHER FOR 16 HOURS. THIS REMOVES THE FAT SO AGAIN THE LOSS IN WEIGHT AFTER DRYING (EVAPORATION OF ETHER) EQUALS THE FAT. (WILL CONTAIN PIGMENTS, WAXES, AND OILS.)

3. ASH. BURN SAMPLE BY PLACING A WEIGHED AMOUNT IN A MUFFLE FURNACE FOR 2 HOURS AT 600°C. ASH IS CONSIDERED AT THE DRY RESIDUE REMAINING. THE WATER, FAT, PROTEIN, CARBOHYDRATES HAVE BEEN REMOVED BY THE PROCESS.

4. PROTEIN (KJELDAHL PROCESS). DIGEST SMALL DRIED SAMPLE IN CONCENTRATED SULPHURIC ACID UNTIL ALL ORGANIC MATTER IS DESTROYED. NITROGEN IN FEED IS NOW IN FORM OF AMMONIUM SULPHATE. THE DIGEST IS DISTILLED WITH SODIUM HYDROXIDE AND THE AMMONIA IS DRIVEN OVER INTO STANDARD ACID AND TITRATED. THIS DETERMINES THE AMOUNT OF NITROGEN IN THE SAMPLE.

5. THE PERCENTAGE OF NITROGEN FREE EXTRACT (N.F.E.) IS FOUND BY DIFFERENCE -- NOT BY ACTUAL ANALYSIS. THE PERCENTAGE OF WATER, ASH, PROTEIN, FIBER, AND FAT ARE MERELY ADDED TOGETHER AND SUBTRACTED FROM 100.

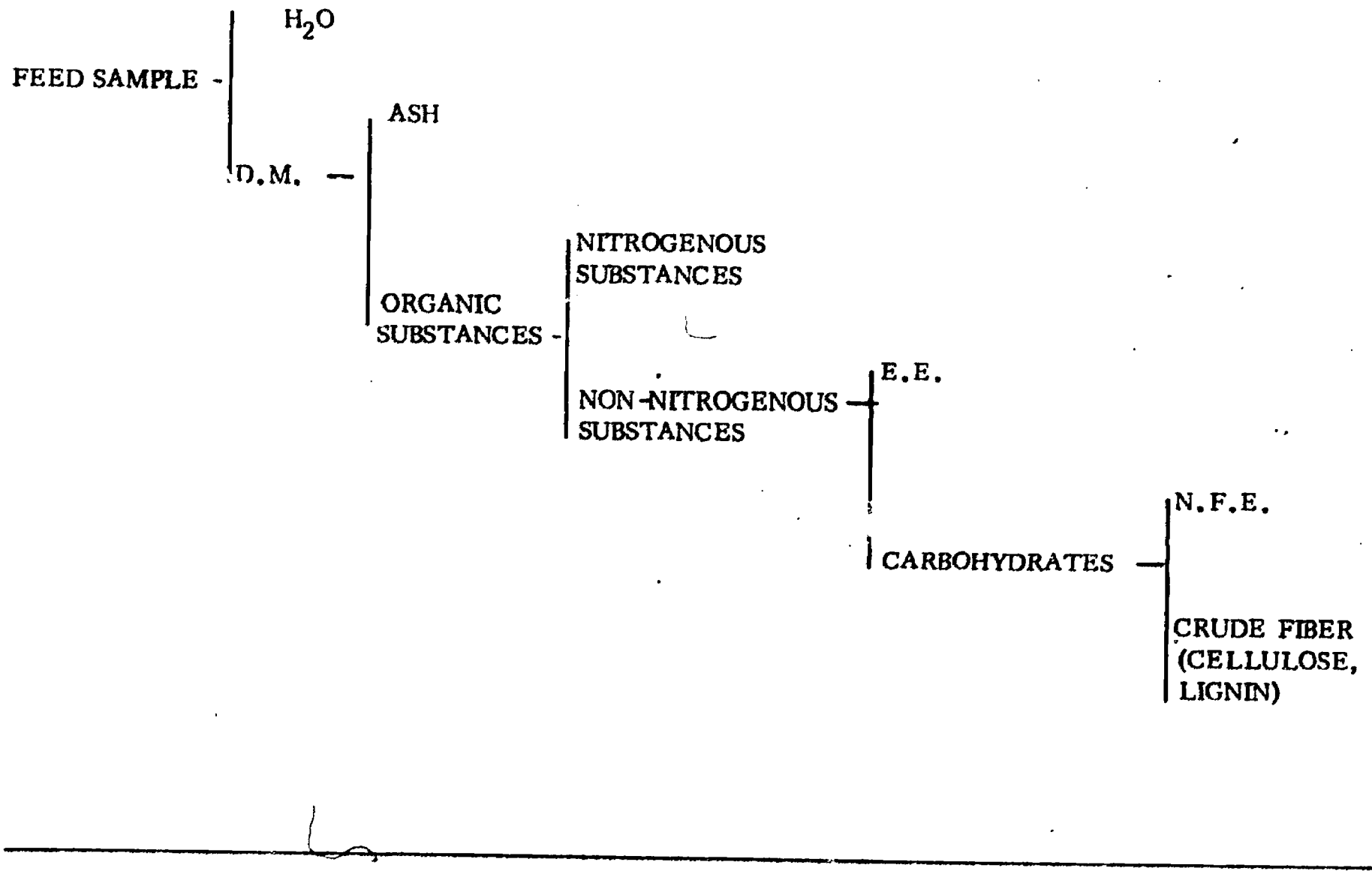
6. CRUDE FIBER. AFTER REMOVAL OF WATER AND E.E. FROM A SAMPLE OF FEED, THE SAMPLE IS BOILED FOR THIRTY MINUTES IN WEAK ACID (o.255N.H_2SO_4), THEN IN WEAK ALKALI, (0.312 N. NaOH). THIS REMOVED THE PROTEINS, SUGARS, AND STARCHES, WHICH ARE DISCARDED. CELLULOSE AND MINERAL MATTER ARE LEFT IN THE FEED RESIDUE. THIS MATERIAL IS DRIED AND WEIGHED, THEN BURNED IN MUFFLE FURNACE AT 600°C. LOSS IN WEIGHT IS REPORTED AS CRUDE FIBER.

7. CARBOHYDRATES (CHO). NOT DETERMINED BY ANALYSIS. CHO = N.F.E. PLUS CRUDE FIBER, 100 - H_2O + FAT + PROTEIN + CRUDE FIBER + MIN. = N.F.E.

TABLE LV

ROUTINE ANALYSIS OF FEEDSTUFFS CHART[73]

OUTLINE



Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Rations

Job XXXII: Economics of Ration Selection

Objective: To instruct students in the method of feedstuff evaluation for economics purposes

Motivation: "If corn is available for $1.15 per bushel and milo, for $1.05 per 100 pounds, which would be the best buy in terms of TDN?"

References: 1. Feeds and Feeding, Morrison (Table II)

2. "Buying Dairy Feeds Wisely," M. U. Guide (p. 3100)

Teaching Outline:

I. Evaluation on TDN basis

II. Evaluation in terms of Peterson Constants

Teaching Procedure:

I. Introduce unit .

II. Illustrate, by use of a problem, how feedstuffs can be evaluated on a TDN basis and discuss the procedure.

III. Assign additional problems.

IV. Illustrate and discuss the use of the Peterson Constants of feed evaluation.

V. Assign additional problems for the students to calculate.

VI. Summarize and evaluate.

TABLE LVI

PROBLEM: EVALUATION ON TDN BASIS

WHICH OF THE FOLLOWING WOULD BE THE BEST BUY? (ON TDN BASIS)

SHELLED CORN AT $1.10 PER BUSHEL
BARLEY AT 1.05 PER BUSHEL
MILO AT 1.95 PER CWT.

CHANGE PRICES TO CWT. BASIS.

SHELLED CORN = $1.96 PER CWT.
BARLEY = 2.18 PER CWT.
MILO = 1.95 PER CWT.

CHANGE TO POUNDS OF TDN (% TDN X 100 LI .)

SHELLED CORN = $1.96 PER 80.1 LBS. TDN
BARLEY = 2.18 PER 73.2 LBS. TDN
MILO = 1.95 PER 77.8 LBS. TDN

CHANGE TO VALUE PER POUND TDN (PRICE/NO. OF POUNDS)

SHELLED CORN = 2.45¢ PER POUND TDN
BARLEY = 2.98¢ PER POUND TDN
MILO = 2.50¢ PER POUND TDN

THEREFORE, SHELLED CORN IS THE BEST BUY.

TABLE LVII

PROBLEM: PETERSON CONSTANTS

IF THE FOLLOWING PRICES WERE IN EFFECT, WHICH WOULD BE THE BEST BUY?

44% SOLVENT SOYBEAN MEAL = $82.50 PER TON

41% COTTONSEED MEAL = $80.70 PER TON

36% LINSEED MEAL = $73.80 PER TON

17% DEHYDRATED ALFALFA MEAL = $53.00 PER TON

AND CORN IS SELLING FOR $39.20 PER TON.

PETERSON CONSTANTS

(TABLE II, FEEDS AND FEEDING)

FEED	CORN CONSTANT	SOYBEAN MEAL CONSTANT
SOYBEAN MEAL	.000	1.000
COTTONSEED MEAL	.025	.770
LINSEED MEAL	.258	.709
ALFALFA MEAL	.325	.241
CORN	1.000	.000

CSM PRICE = (.025) (39.20) + (.770) (82.30)

= .99 + 63.40

LSM PRICE = $64.39 PER TON
(.258) (39.20) + (.709) (82.30)

= 10.11 + 58.30

ALFALFA PRICE = $68.41 PER TON
(.325) (39.20) +
(.241) (82.30)

= 12.71 + 19.80

SBM PRICE = $32.52 PER TON
(.000) (39.20) + (1.000) (82.30)

= 0 + 82.30

= $82.30 PER TON

THEREFORE, BUY SOYBEAN MEAL.

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Rations

Job XXXIII: Balancing Rations

Objective: To instruct students in the methods of ration balancing.

Motivation: "How can a farmer calculate his own rations without getting professional assistance?"

References:

1. Feeds and Feeding, Morrison
2. "Nutrient Requirements of Beef Cattle," No. 4, publication 1137, National Academy of Sciences
3. "Nutrient Requirements of Horses," No. 6, publication 1401, National Academy of Sciences
4. "Nutrient Requirements of Dairy Cattle," No. 3, publication 1349, National Academy of Sciences
5. "Nutrient Requirements of Swine," No. II, publication 1192, National Academy of Sciences
6. "Life Cycle Swine Nutrition," AS-90, Iowa State University.
7. "Calculating Rations for Dairy," M.U. Guide (p. 3104)
8. "Ration Work Sheet With Example," M. U. Guide (p. 3108)

Teaching Outline:

I. Methods of balancing rations

A. Trial and error

B. Simultaneous equations

C. Square method

Teaching Procedure:

I. Introduce unit.

II. Illustrate and discuss the use of the square method of calculating rations.

III. Assign additional problems for students to calculate.

IV. Illustrate and discuss the use of simultaneous equations to calculate rations.

V. Assign additional problems for the students to calculate.

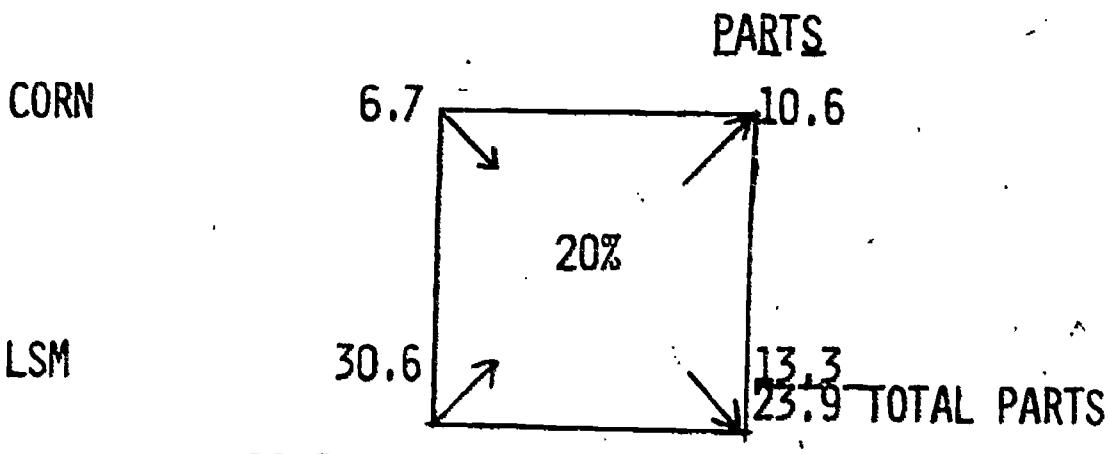
VI. After students have worked problems, check and discuss them.

VII. Summarize and evaluate.

TABLE LVIII

SQUARE METHOD

ASSUME THAT WE REQUIRE 20% PROTEIN (DIG.) FOR OUR SOW'S RATION AND THAT WE HAVE CORN (6.7% DP) AND LINSEED MEAL (30.6% DP) ON HAND. HOW MUCH OF EACH WOULD WE MIX TO MAKE A 20% DP RATION?



$$\% \text{ CORN} = \frac{10.6}{23.9} = 44.4\% = 44.4 \times 20 = 888\#/\text{TON}$$

$$\% \text{ LSM} = \frac{13.3}{23.6} = 55.6\% = \frac{55.6}{100} \text{ LBS.} = 1112\#/\text{TON}$$

BY_ALGEBRA:

LET X = % CORN 100 - X = % LSM

.067X + .306 (100 - X) = 20

X = 44.4

100 - X = 55.6

TABLE LIX

SQUARE METHOD PROBLEM

I have a lactating gilt. According to the Iowa State University "Life Cycle Swine Nutrition," she requires 16 per cent protein. Using barley at 12 per cent protein and cottonseed meal at 41 per cent protein, how much of each would you mix, to achieve the 16 per cent protein ration, in a ton of feed?

TABLE LX

SIMULTANEOUS EQUATION

USING ALFALFA HAY AND CORN, BALANCE A RATION FOR A 400-POUND DAIRY HEIFER.

RULES:

1. FEEDS THAT INCLUDE ROUGHAGE SATISFY FOR DM AND TDN.
2. FOR MOST CONCENTRATE RATIONS, BALANCE FOR DP AND TDN.

1. OBTAIN THE REQUIREMENTS FOR THE HEIFER:

HEIFER 400# $\frac{\#DM}{9.1 -- 11.4}$ $\frac{\#D.P.}{.76 -- .87}$

$\frac{\#TDN}{6. -- 7.}$

USE UPPER LIMITS

2. OBTAIN PER CENT COMPOSTION OF FEEDSTUFFS.

	%D.M.	%D.P.	%TDN
ALFALFA HAY (Y)	90.5	10.9	50.7
CORN (X)	85	6.7	80.1

CHANGE % TO DECIMAL EQUIVALENTS.

3. SET UP SIMULTANEOUS EQUATIONS.
IN THIS CASE, FOR DM AND TDN.
LET X = AMOUNT OF CORN
LET Y = AMOUNT OF ALFALFA HAY

DM

$.85X + .905Y = 11.4$

$$X = \frac{11.4}{.85} - \frac{.905Y}{.85}$$

$X = 13.4 - 1.06Y$

$X = 13.4 - 1.06\ (10.8) = 13.4 - 11.5$

$X = 1.9$ POUNDS OF CORN

4. SUBSTITUTE (X) IN TDN EQUATION
5. SUBSTITUTE (Y) BACK INTO DM EQUATION.

TDN

$.801X + .507 = 7.$

$.801\ (13.4 - 1.06Y) + .507Y = 7.$

$10.7 - .85Y + .507Y = 7$

$-.343Y = -3.7$

$$Y = -\frac{3.7}{.343} -$$

Y = 10.8 POUNDS OF ALFALFA HAY

6. SEE IF REQUIREMENTS HAVE BEEN MET.

		CM		DP		TDN	
		COMP.	AMT.	COMP.	AMT.	COMP.	AMT.
ALFALFA HAY	10.8#	.905	9.8	.109	1.17	.507	5.48
CORN	1.9#	.85	1.6	.067	.13	.801	1.52
TOTAL PRODUCED		XXX	11.4	XXX	1.30	XXX	7.00
REQUIRED AMOUNT			11.4		.87		7.00
EXCESS OR DEFICIT		±0		+.43		±0	

EXCESS IS PERMISSIBLE.

TABLE LXI

SIMULTANEOUS EQUATION PROBLEM

	T.D.N. LBS.	D.P. LBS.
100-Pound Shoat Requirements	4.4	.65
Feed Stuffs--Percent:		
	T.D.N.	D.P.
Corn:	80.1	6.7
Soybean Meal:	78.1	42.0

Let X = Corn

Let Y = S.B.M.

TABLE LXII

KEY -- SIMULTANEOUS EQUATION PROBLEM

	TDN LBS.	D.P. LBS.
100- POUND SHOAT REQUIREMENTS:	4.4	.65
FEEDSTUFFS -- PERCENT :		
CORN :	80.1	6.7
SOYBEAN MEAL :	78.1	42.0

LET X = CORN

LET Y = S.B.M.

TDN

$(.801)\ (X) + (.781)\ (Y) = 4.4\#$

$.801X + .781Y = 4.4$

$$X = \frac{4.4 - .781Y}{.801}$$

$X = 5.5 - .97Y$

D.P.

$(.067)\ (X) + (.42)\ (Y) = .65$

$.067X + .42Y = .65$

$.067\ (5.5 - .97Y) + .42Y = .65$

$.37 - .06Y + .42Y = .65$

$$.42Y - .06Y = .65 - .37$$

$$.36Y = .28$$

$$Y = \frac{.28}{.36}$$

$Y = .77$ POUNDS OF S.B.M.

$X = 5.5 - .97\ (.77)$

$X = 5.5 - .75$

$X = 4.75$ POUNDS OF CORN

TABLE LXIII

RATION PROBLEM FOR STUDENTS

The basic principles of balancing a ration are illustrated in this problem; however, the problem is made easy because of the limited number of feeds used and the limited nutrient requirements to be satisfied. The ration may or may not be adequate in other nutrients not considered in this problem.

Given:

% TDN=(% Protein in feed) (Protein Digestibility Coefficient)

+(% Fat in feed) (Fat Digestibility Coefficient) (2.25)

+(% Crude Fiber) (CF Digestibility Coefficient)

+(% NFE) (NFE Digestibility Coefficient)

NFE = 100 - (% water + % protein + % ash + % fat + % crude fiber)

% Protein = % Nitrogen X 6.25

A. Using oat hay, how much of this feed would be required to supply enough dry matter for a 600-pound dairy heifer?

B. Using the amount of hay calculated in A, determine whether her digestible protein and TDN requirements will be met. (Make calculations and show your results, using upper requirement figures.)

C. Using milo grain and soybean meal (solvent analysis), how much of the feed is required to make up the deficit indicated in B?

D. Readjust the amount of the feed in A. Show final ration.

(DM, TDN, and DP should be within the upper requirements range.

Course: Advanced Livestock Production

Area: Livestock Nutrition

Unit: Rations

Job XXXIV: Feed Additives

Objective: To familiarize the students with compounds added to a ration for non-nutritional purposes

Motivation: "You are all familiar with the tags on feeds. What are the meanings of the other numerous items listed which we haven't studied? What are their functions?"

References:
1. Feeds and Feeding, Morrison
2. "Additives for Beef Cattle Rations," M. U. Guide (p. 2070)

Teaching Outline:

I. Growth stimulants

II. Medicants

III. Adjuncts

Teaching Procedure:

I. Introduce unit.

II. Discuss and describe the feed additives.

III. Obtain current information, with student aid, concerning new developments in the feed additive field such as polo-xolene, M. G. A., etc.

IV. Obtain an outside speaker, perhaps a commercial feed salesman or a veterinarian, to further discuss the safe use of feed additives.

V. Summarize and evaluate.

TABLE LXIV

FEED ADDITIVES

I. GROWTH STIMULANTS
   A. HORMONES
      (1) DIETHYLSTILBESTROL
      (2) SYNOVEX
      (3) IODINATED CASEIN -- DAIRY CATTLE
      (4) DIENESTROLDIACETATE
   B. ANTIBIOTICS
      (1) TYLAN
      (2) AUREA -- SP 250
   C. ARSONIC ACIDS
   D. TRANQUILIZERS
      (1) TRAN-Q
      (2) SERPASIL -- CAGED LAYERS
      (3) TRIFLUOMEPRAZINE
   E. ENZYMES -- LIMITED USE
      (1) TAKAMINE
      (2) AGROZYME

II. MEDICANTS
   A. BACTERIOSTATS
   B. ANTIBIOTICS

C. COCCIDIOSTATS -- POULTRY

D. PARASITICIDES

E. ANTHELMENTICS -- WORMERS

(1) HYGRAMYCINE

(2) CADMIUM OXIDE

(3) PHENOTHIAZINE

(4) PIPERAZINE

(5) THIBENZOL

F. SYSTEMICS -- GRUBICIDES

(1) RONNEL

(2) CO-RAL

G. SULFACANTS -- PREVENT FEEDLOT BLOAT

(1) DYNAFAC

III. ADJUNCTS

A. ANTIOXIDANTS -- FOR GUARANTEED VITAMIN CONTENT

(1) SANTAQUIN

(2) B. H. T.

(3) M. H. T.

B. ANTIMYCOTICS -- PREVENT MOLDS

C. HUMECANTS -- ADD MOISTURE

D. FLAVORS

E. PELLET BINDERS

(1) STAPEL (LIGNIN MATERIAL FROM WOOD)

(2) SODIUM BENTONITE