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AG. 530 – ZOOLOGY/ANIMAL SCIENCE

AG 530

ZOOLOGY/ANIMAL SCIENCE

FOR

IDAHO

SECONDARY AGRICULTURE INSTRUCTORS

Developed and written by:
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Provided through a grant from the
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Administered through the
Department of Agricultural and Extension Education
University of Idaho
By
Douglas A. Pals, Project Director

FOREWORD

The Agricultural Science and Technology Curriculum Guides are the product of many years of careful planning and development. In 1987, an Agricultural Education Technical Committee was assembled to determine the competencies necessary to prepare students for careers in agriculture. In 1989, a committee of secondary agriculture instructors, state supervisory staff and University of Idaho Agricultural and Extension Education faculty arranged the competencies into an outline of courses appropriate for secondary agriculture programs in Idaho. These curriculum guides have been written to provide the secondary agriculture instructor with up-to-date instructional materials to be used in developing lessons for the student interested in pursuing a career in agriculture.

The arrangement of the guide follows the courses outlined in the Agricultural Science and Technology Curriculum Outline - The Guide to the 90's (Vo. Ed. #240) published in 1989. The format used in this guide was adapted from the curriculum guides developed for Idaho secondary agriculture instructors during the period of 1981-1985.

The original Idaho Agricultural Curriculum Guides used in the development of these materials were:

1981 - Livestock Production
1981 - Agricultural Mechanics
1982 - Farm Business Management
1985 - Crop and Soil Science

Many individuals made the original guides possible. The format used was adapted from curriculum developed by the Curriculum and Instructional Materials Center of the Oklahoma State Department of Vocational and Technical Education. Selected information and many of the transparency masters used in the guides were provided by the Vocational Instructional Services, Texas A & M University. Additional information and transparency masters were provided by the Department of Agricultural Communications and Education, College of Agriculture, University of Illinois and the Agricultural Education Program, Department of Applied Behavioral Sciences, University of California, Davis.

Laboratory exercises incorporated into the units of instruction were used from the Holt, Rinehart and Winston, Inc. book, Modern Biology, Biology Investigations and the Scott, Foresman, and Company Lab Manual for Biology. Credit appears on the first page of the materials used from these two sources.

Without the following individuals' dedication and commitment, this project would not have been completed.

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USE OF THIS PUBLICATION

Introduction

This material must be taught. It does not replace the teacher, nor the teacher's expertise. The teacher needs to adapt the material to the local area and individual students. The teacher must also provide the necessary motivating techniques to help the students learn the material.

The pages in the guide are color coded to assist in identifying and locating the desired pages. The colors used are:

Table of Contents	Ivory
Semester Course Title Page	Green
Foreword	Yellow
Use of Publication	Salmon
Divider Page Between Units	Tan
Refer to Another Unit Page	Grey
Unit Objectives/Specific Competencies	White
Suggested Activities	Blue
Information Sheets	White
Transparency Masters	White
Assignment Sheets	White
Answers to Assignment Sheets	Gold
Instructors Notes for Laboratory Exercises	Blue
Laboratory Exercises	White
Answers to Laboratory Exercises	Gold
Unit Test	White
Answers to Test	Gold

Instructional Units

These units are not geared to a particular age level and must be adapted for the students with whom they are used. Units include objectives and competencies, suggested activities for the instructor and students, information sheet, transparency masters, assignment sheets, laboratory exercises, instructor notes for laboratory exercises, answers to assignment sheets and laboratory exercises, test and answers to test. Units are planned for more than one lesson or class period.

The teacher should carefully study each instructional unit to determine:

A. The appropriateness of the material for the age level

B. The amount of material that can be covered during a class period

C. Additional objectives and/or assignments, which could be developed

D. The skills that must be demonstrated

1. Supplies needed
2. Equipment needed
3. Amount of practice needed
4. Amount of class time needed for demonstrations

E. Supplementary materials, such as pamphlets, filmstrips and slides that must be ordered

F. Resource people who must be contacted

Objectives and Competencies

Each unit of instruction is based on stated objectives. These objectives state the goals of the unit, thus providing a sense of direction and accomplishment for the student.

The objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performances necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Following is a list of performance terms and their synonyms that may have been used in this material:

Name	Identify	State a Rule	Apply a Rule
Label	Select	Calculate	
List in writing	Mark		
List orally	Point out		
Letter	Pick out		
Record	Choose		
Repeat	Locate		
Give	Match		

Describe	Order	Distinguish
Define	Arrange	Discriminate
Discuss in writing	Sequence	
Discuss orally	List in order	
Interpret	Classify	
Tell how	Divide	
Tell what	Isolate	
Explain	Sort	

Construct		Demonstrate	
Draw	Transcribe	Show your work	Replace
Make	Reduce	Show procedure	Turn on/off
Build	Increase	Perform an experiment	(Dis) assemble
Design	Figure	Perform the steps	(Dis) connect
Formulate	Conduct	Operate	
Reproduce	Compare	Remove	

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives, which will fit the material to the needs of the students and community. When a teacher adds objectives, he/she should remember to supply the needed information, assignment sheets and/or laboratory exercises and criterion tests.

Suggested Activities

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of the instructor will vary according to the particular unit. However, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and laboratory exercises; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Information Sheet

The information sheet provides content essential for meeting the cognitive (knowledge) requirements of the unit. The teacher will find that the information sheet serves as an excellent guide for presenting the background knowledge necessary to develop the skills specified in the unit objective.

Students should read the information sheet before the information is discussed in class. Students may take additional notes on the information sheet.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheet. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion. (NOTE: Stand away from the overhead projector when discussing transparency material. The noise of the projector may cause the teacher to speak too loudly.)

<u>Assignment Sheets</u>

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

<u>Laboratory Exercises</u>

Laboratory exercises are found in selected units. The laboratory exercises include both science and agricultural mechanics activities. The science laboratory exercises often have instructions to the instructor prior to the actual laboratory. Procedures outlined in the laboratory exercise for agricultural mechanics give direction to the skill being taught and allow both student and teacher to check student program toward the accomplishment of the skill.

<u>Test and Evaluation</u>

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and can help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teachers should be constructed and added to the test.

<u>Test Answers</u>

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

<u>Care of Materials</u>

The cost of reproduction of this guide prohibits the replacement of these materials. Therefore, please be extremely careful in handling originals. Make the necessary copies of the information sheets, transparencies, assignments and tests and replace originals in the curriculum guide notebook. Take extra care in keeping originals clear for future reproduction.

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

UNIT OBJECTIVE

After completion of this unit, students will be able to identify the importance and scope of the livestock industry in the United States, Idaho and the community. This knowledge will be demonstrated by completion of assignment sheets and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with an introduction to the livestock industry to their correct definitions.
2. Name the types of livestock.
3. Name products and services livestock provide.
4. Identify the sources of Idaho cash farm receipts.
5. Identify Idaho's rank in the nation's agriculture for crops, livestock and livestock products.
6. Distinguish between primary and secondary food sources.
7. Describe reasons for and against using livestock as a food source.
8. List three specific careers in each of the seven areas of livestock industry employment.
9. Develop an opinion on the future of livestock production.
10. Conduct a community survey on the types of livestock raised in the area.
11. Be familiar with current employment information in the livestock industry.
12. Explain general laboratory procedures, equipment and report writing.
13. Demonstrate the use of a compound microscope.

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Make transparencies and necessary copies of materials.

   B. Provide students with objective sheet and discuss.

   C. Provide students with information sheet and discuss.

   D. Provide students with assignment and laboratory sheets.

   E. Discuss and demonstrate the laboratory exercises.

   F. Obtain background information on the local livestock industry.

   G. Invite a local rancher to come in and talk about the livestock industry in the local community.

   H. Have students collect articles on the livestock industry and share them in class.

   I. Divide class into groups to conduct the community survey and have them report their results in class.

   J. Review and give test.

   K. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Food Chains

      2. TM 2--Manure as a Fertilizer

   E. Assignment sheets

      1. AS 1--Develop an Opinion on the Future of Livestock Production

      2. AS 2--Conduct a Community Survey on the Types of Livestock Raised in the Area

F. Instructor notes for laboratory exercises

G. Laboratory exercises

1. LE 1--General Laboratory Procedures, Equipment and Report Writing

2. LE 2--Using a Compound Microscope

H. Answers to laboratory exercises

I. I. Test

J. Answers to Test

III. Unit references

A. Badger, Daniel D., *Economics of Substitution and the Demand for Beef Feedlot Wastes: One Alternative for Solving Environmental Quality Problems*. Managing Livestock Wastes: The Proceedings of the 3rd International Symposium on Livestock Wastes, American Society of Agricultural Engineers, 1975.

B. Ensminger, M.E., *Animal Science*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1977.

C. Harper, Judson M., and Seckler, David, *Engineering and Economic Overview of Alternative Livestock and Waste Utilization Techniques*. Managing Livestock Wastes: The Proceedings of the 3rd International Symposium on Livestock Wastes, American Society of Agricultural Engineers, 1975.

D. *Idaho Agricultural Statistics*. United States Department of Agriculture, Washington D.C., 1989.

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

INFORMATION SHEET

I. Terms and definitions

A. Product--An actual material provided by an animal that can be eaten, worn or used

B. Service--A benefit provided by an animal

C. Receipt--Money coming in or received for a product or service

D. Concentrate--Feed high in energy and low in fiber

Example: grain

E. Roughage--Feed that is bulky, contains more than 18% crude fiber and is low in energy

Example: pasture

F. Cultivate--Working land to produce a crop

G. By-products--Products left after the main products have been extracted

H. Flexibility--Capacity for change

I. Elasticity--Ability of a farm operation to withstand changes in the supply or demand

II. Types of livestock

A. Beef

B. Dairy

C. Sheep

D. Swine

E. Dairy goats

F. Horses

G. Rabbits

H. Fish

I. Fur-bearing animals

J. Poultry

III. Products and services livestock provide

A. Products

1. Meat

2. Eggs

3. Milk

4. Clothing

5. Medicine

6. Fertilizer

7. Miscellaneous products

Example: Shoe polish, photographic film, soap, glue, lubricants

B. Services

1. Power

(Note: Animals used for power are found primarily in developing nations.)

2. Recreation

a. Horseback riding

b. Racing

c. Rodeos

d. Back-packing

3. Transportation--mainly used for large range operations in the west

IV. Sources of Idaho cash farm receipts - 1987

A. Cattle and calves -- 27.8%

B. Dairy products -- 13.1%

C. Hogs -- .6%

D. Sheep, lambs and wool -- 1.2%

E. Other livestock -- 2.1%

F. Total livestock -- 45.2%

G. Total crops -- 54.8%

V. Idaho's rank in the nation's agriculture - 1988

A. Livestock and livestock products

1. American cheese - 5
2. Honey - 11
3. Sheep, lambs and wool - 11
4. Milk production - 13
5. Milk cows - 18
6. All cattle and calves - 22

B. Crops

1. Potatoes - 1
2. Barley - 1
3. Sugarbeets - 3
4. Hops - 3
5. Mint (all) - 3
6. Onions (summer storage) - 3
7. Prunes and plums (fresh) - 4
8. Dry edible beans - 5
9. Sweet corn (for processing) - 5
10. Sweet cherries - 6
11. Alfalfa hay - 6
12. Wheat (all) - 8
13. Apples - 10

VI. Primary and secondary food sources (Transparency 1)

A. Primary -- Food source deriving energy directly from sun

B. Secondary -- Food source deriving energy from plants or animals

(Note: A secondary food source requires energy from the primary source for maintenance. Therefore, energy is lost as it is transferred through secondary sources.)

VII. Livestock as a food source

A. Factors against using livestock--Livestock provide a secondary food source and therefore use more energy to produce the same amount of food

Example: 400 pounds of grain will feed one man for one year; 2,000 pounds of concentrates are needed to produce enough meat and livestock products to feed one man for one year

B. Factors for using livestock

1. Usable plant energy would otherwise be wasted

a. Much of the world's land is not cultivated -- 46.8% of the land in the United States is pasture or grazing land, not including Alaska or Hawaii

b. Forages provide a high percentage of animal food

c. 95% of all energy fixed by plants is unusable by man, but can be used by ruminants

d. Animals can use otherwise wasted by-products

Example: Cottonseed hulls, corncobs, beet pulp, rice bran and hulls, wood by-products

2. Animals provide higher quality food

a. Higher in protein content

b. Better quality protein -- more amino acids

c. More digestible protein

d. More preferred by consumers

3. Animals provide other needed products such as medicine, power and fertilizer (Transparency 2)

Example: Medicine -- Twenty-six steer pancreas are needed to produce enough insulin to keep one diabetic alive for one year. There are 1.25 million people in the United States who require insulin regularly

Fertilizer -- One ton of manure contains 500 pounds of organic matter, 10-30 pounds of nitrogen, 5-20 pounds of phosphoric acid and 10-30 pounds of potassium. The United States' livestock industry currently produces 1.6 billion tons of manure annually

4. Animals increase flexibility of farm operations

   a. Stimulate grain production

   b. Provide elasticity to grain production

      Example: In high grain production years the excess can be fed to livestock, while in low production years forage can be substituted and grain can be marketed as cash crop

VIII. Careers in the livestock industry

A. Farming/Ranching

1. Manager
2. Foreman
3. Herdsman

B. Research

1. Production
2. Processing
3. Marketing
4. New equipment and use

C. Industry

1. Food processing
2. Pesticides and herbicides
3. Feed manufacturing
4. Dairy processing

D. Business

1. Agricultural banking
2. Farm management
3. Grading and packaging
4. Marketing

E. Education

1. Agricultural extension specialist
2. Vocational agriculture instructor
3. College instructor
4. Governmental agencies

F. Communications

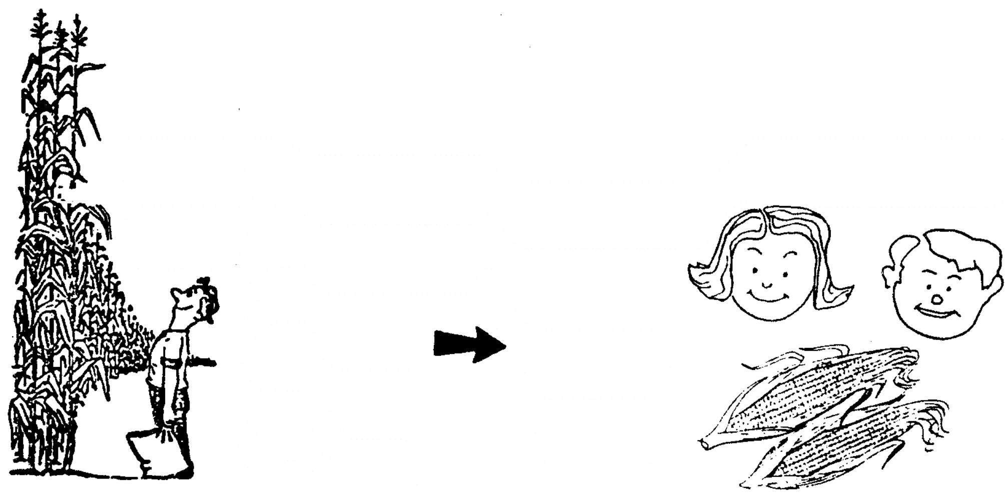
1. Farm reporting
2. Market reporting
3. Radio
4. Television

G. Service

1. Inspection and regulation
2. Plant and animal quarantine
3. Foreign service
4. Agricultural consultant
5. Veterinary

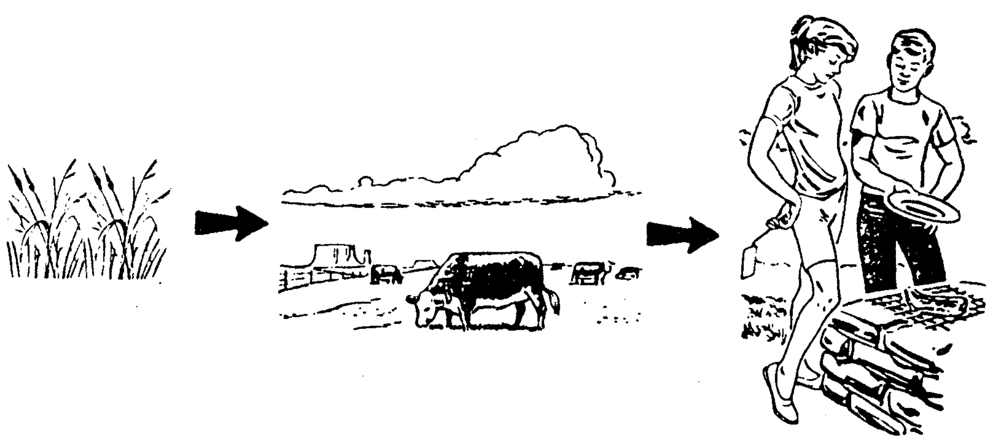
Food Chains

PRIMARY



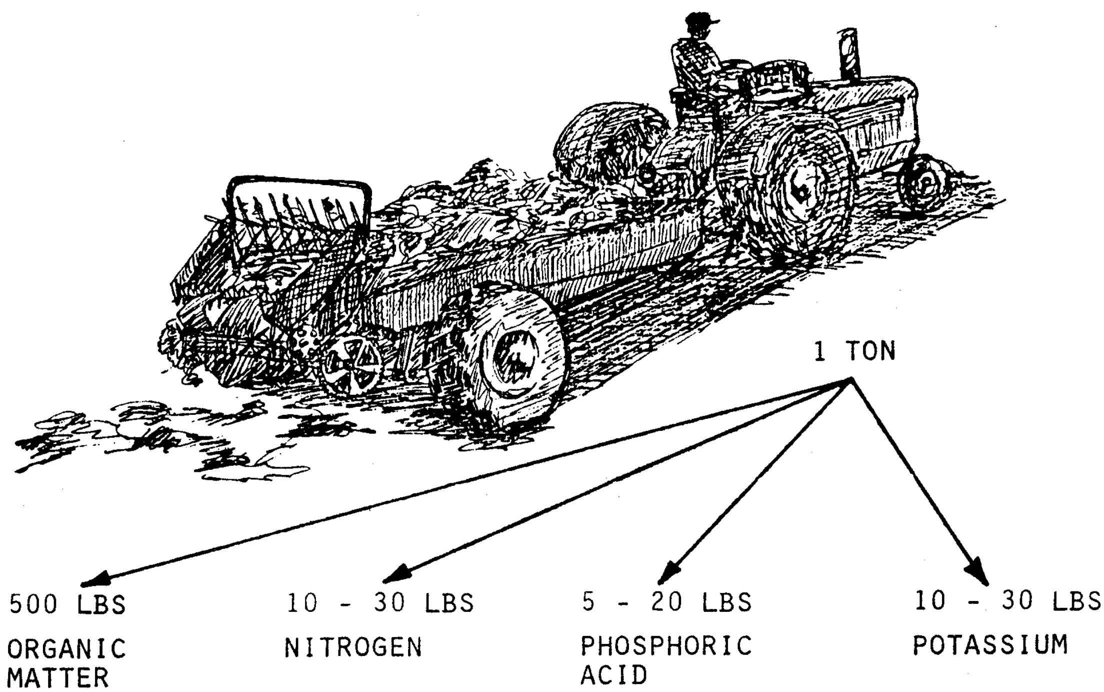
PLANT MAN

SECONDARY



PLANT ANIMAL MAN

Manure As A Fertilizer



1 TON = $6.00 - $11.33 FERTILIZER VALUE

1.6 BILLION TONS PRODUCED IN THE UNITED STATES

VALUE OF YEARLY MANURE CROP AT 1980 PRICES IS

9.6 - 18.1 BILLION DOLLARS

AG 530 - A

ASSIGNMENT SHEET #1--DEVELOP AN OPINION ON THE FUTURE OF LIVESTOCK PRODUCTION

Name ______________________________ Score ______________________________

The world food situation is getting more critical every day. The role livestock will play in providing the world's food supply will depend on public opinion and political decisions as well as technological developments.

Write a few paragraphs outlining your views on the future of livestock production and the role livestock should play in providing the world's food supply.

INTRODUCTION TO ANIMAL SCIENCE

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ASSIGNMENT SHEET #2--CONDUCT A COMMUNITY SURVEY ON THE TYPES OF LIVESTOCK RAISED IN THE AREA

Name ______________________________ Score ______________________________

You have looked at the livestock industry on a national and state level. This assignment is designed to help you get an idea of the type and importance of livestock in your community.

Take an informal survey of your community to find out the types and approximate numbers of different livestock raised in the area. People to ask would be farmers, ranchers, agribusiness people, bankers and state extension people. Use at least three sources.

Sources	Types	Numbers
1.		
2.		
3.		

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

INSTRUCTOR NOTES FOR LABORATORY EXERCISES

Lab #2

Allow approximately 80 minutes for activity
Have students read *Anatomy of the Microscope* before class, and then make the changes that are necessary to fit
the microscopes being used.

Part IV:

Demonstrate the procedure for high power focusing.

Remind students that fine adjustments should be approximately 1/4 of a turn.

Looking at the letter "a" under low power, image will be upside down.

Under high power, you cannot view the entire "a", only a small portion can be seen. It appears very rough and coarse.

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

LABORATORY EXERCISE #1--GENERAL LABORATORY PROCEDURES,
EQUIPMENT AND REPORT WRITING

Name ______________________________________ Score ___________________________________

Part I: General Laboratory Procedures

The following is a list of general laboratory procedures. You will be required to write at least ten of these on a quiz.

1. Never "horse around" in the laboratory.

2. Never play with laboratory equipment or materials.

3. Always follow instructions and wait until you are told to begin before starting any investigation.

4. Never carry out unassigned experiments.

5. Never eat or taste anything in the laboratory. This includes food, drinks and gum, as well as chemicals found in the laboratory.

6. Wash your hands after *every* experiment.

7. Keep all books and other nonessential items away from the work area.

8. Keep your work area clean. Dispose of waste materials in appropriate containers.

9. Turn off any gas jets or any electrically operated equipment when you have completed the laboratory investigation.

10. Report all injuries or accidents to your teacher immediately.

11. Never use broken or cracked glassware.

12. Always wear shoes in the laboratory. Sandals are not suggested.

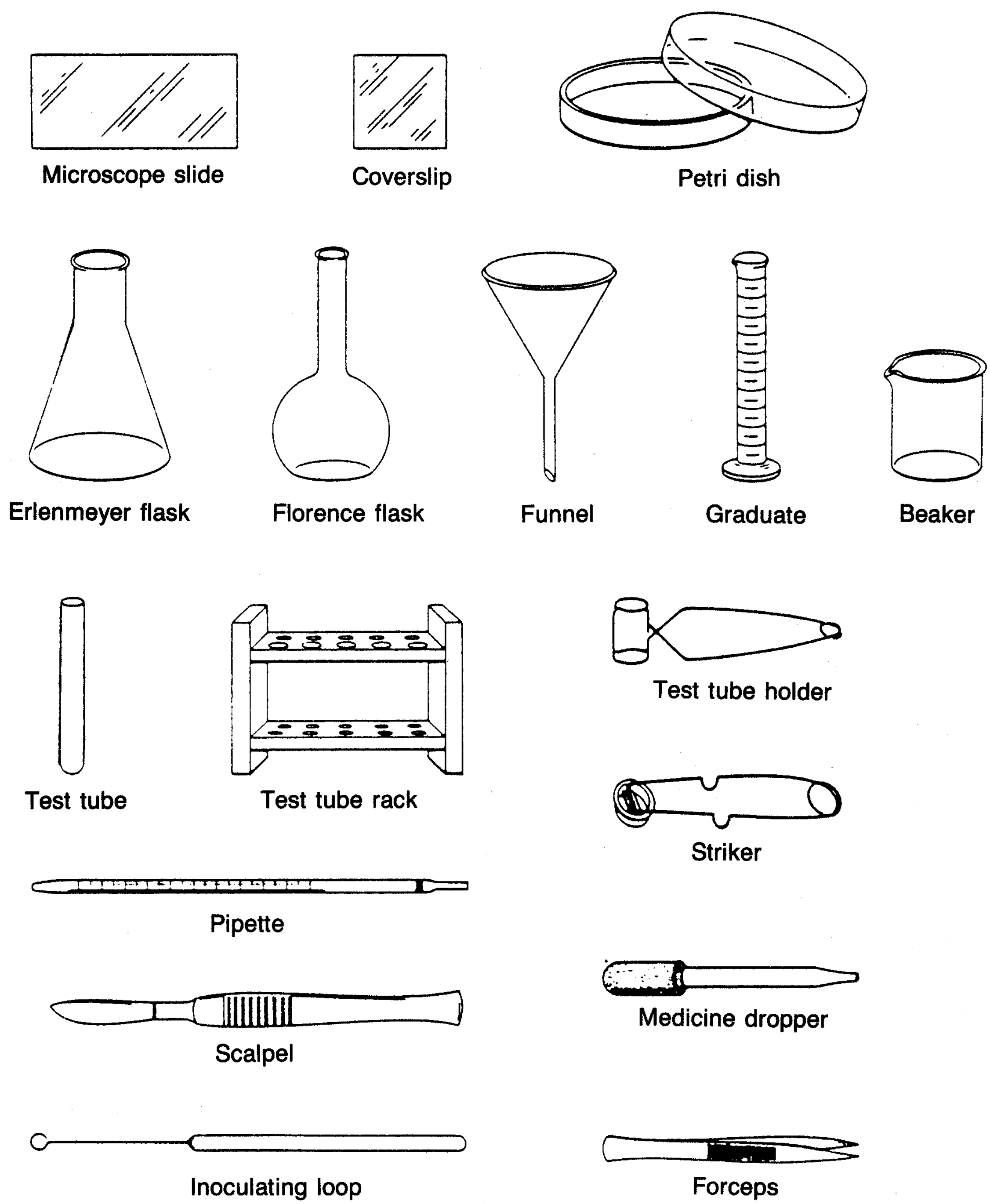
13. Tie back long hair and restrict any loose clothing.

14. Wear safety goggles, laboratory aprons and gloves when instructed to do so.

Part II: Laboratory Equipment

Various types of laboratory equipment are identified and illustrated below. Ask your teacher to show you examples of each. You will be required to identify all the illustrations on a quiz.

Laboratory Equipment



Part III: How to Write a Laboratory Report

The following information explains how to write laboratory reports. You will be asked to outline and explain these procedures on a quiz.

There are two different types of laboratory reports that you may be asked to write. The first is a report of a laboratory investigation in which the results and your interpretation of the results are the most important items required by your teacher. This type of investigation is usually found in a laboratory manual, where the procedure is already outlined for you. Such reports would contain the following parts.

Title — This is the name of the laboratory investigation you are doing. In an investigation from a laboratory manual, the title will be the same as the title of the investigation.

Hypothesis — The hypothesis is what you think will happen during the investigation. It is often posed as an "If...then" statement. For example: If sulfuric acid is added to sugar, then the sugar will be broken down into its chemical components.

Materials — This is a list of all the equipment and other supplies you will need to complete the investigation. In investigations taken from a laboratory manual, the materials are generally listed for you.

Procedure — The procedure is a step-by-step explanation of exactly what you did in the investigation. Investigations from laboratory manuals will have the procedure carefully written out for you, all you need to do is to read it very carefully. Often, in laboratory manuals, there will be questions in the procedure section that will help you understand what is happening in the investigation.

Data — Your data is what you have observed. It is often recorded in the form of tables, graphs and drawings.

Analyses and Conclusions — This is the most important and difficult part of the investigation. It explains what you have learned. You should include everything you have learned; you should explain any errors you made in the investigation; and you should evaluate your hypothesis. Keep in mind that not all hypotheses will be correct. That is normal. You just need to explain why things did not work out the way you thought they would. In laboratory manual investigations, there will be questions to guide you in analyzing your data. You should use these questions as a basis for your conclusions.

In some cases, you might be required to do an independent project. You may design your own investigation for a science fair project, or your teacher may have you design an investigation to perform in class.

The report for this type of investigation should include two sections not included in the previous type of report. In order for a laboratory report on an independently designed experiment to be complete, you must now include an introduction and a reference section. They should be included in your report in the following order:

Title

Introduction The introduction should include a clear, simple statement of your purpose. In addition, the introduction should include a discussion of the important ideas that led you to design and perform the experiment. For example, you could include such things as why you are doing this investigation, what is interesting about the topic to be investigated, and what information you have already gathered about the topic. In order to prepare a good introduction, you will need to do library research on the topic. Be sure to use proper citation methods when you use ideas from any reference source.

Hypothesis

Materials

Procedure

Data

Analyses and Conclusions

References List all the reference materials used to originate and to complete the project. Be sure to use complete citations, including author, title, date of publication and place of publication. Your teacher will give you the format preferred for the type of investigation you are doing.

Remember that a good laboratory report takes time. Do not wait until the night before the report is due to begin work on it.

<u>Part IV: Quiz</u>

1. List ten general laboratory procedures.

a.____________________

b.____________________

c.____________________

d.____________________

e.____________________

f.____________________

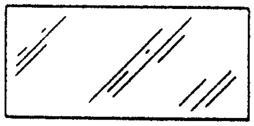
g.____________________

h.____________________

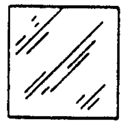
i.____________________

j.____________________

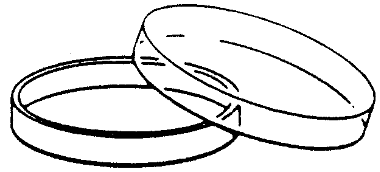
Identify the following types of laboratory equipment.



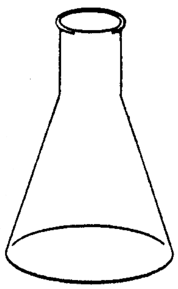
a. ____________



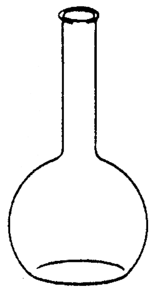
b. ____________



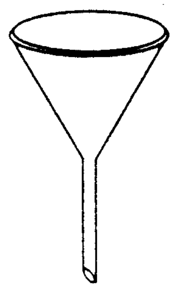
c. ____________



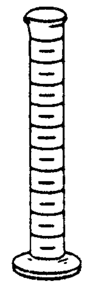
d. ____________



e. ____________

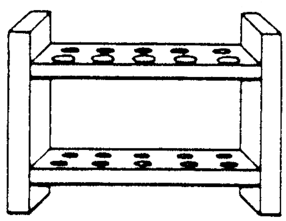


f. ____________

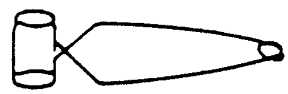


g. ____________

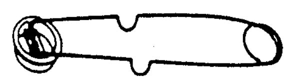
h. ____________



i. ____________



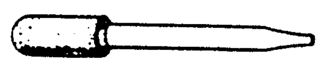
j. ____________



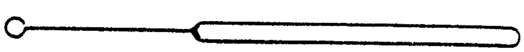
l. ____________

k. ____________

m. ____________



n. ____________



o. ____________

p. ____________

3. Outline and explain the procedures used in writing the two different types of laboratory reports.

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

LABORATORY EXERCISE #2--USING A COMPOUND MICROSCOPE

Name ____ Score __________________________________

Materials needed

Compound microscope
Lens paper
Microscope slides and coverslips
Newspaper
Scissors
Droppers
Thread of two different colors

Part I: Procedure--Anatomy of a Microscope

1. When removing a microscope from the cabinet, always hold one hand under the *base* and firmly grasp the *arm* with the other hand. Hold the microscope upright and treat it like the precision instrument it is. Place the microscope on your desk with the arm away from you so that you can observe the parts more easily.

   Using the diagram on the next page, identify the parts of the microscope starting at the top. As you read about each of the parts, memorize its name and function.

2. At the top of the microscope is the first lens that is called the eyepiece. Most compound microscopes have numbers, such as 5, 10, or 15 written near the eyepiece. The numbers refer to the total magnification of the lens. The symbol "X" means times or magnification power. For example, if you are looking at a piece of wool using only a 10X eyepiece, it would be seen ten times larger than its natural size.

3. The *body tube*, which extends below the eyepiece, helps in focusing the lenses properly.

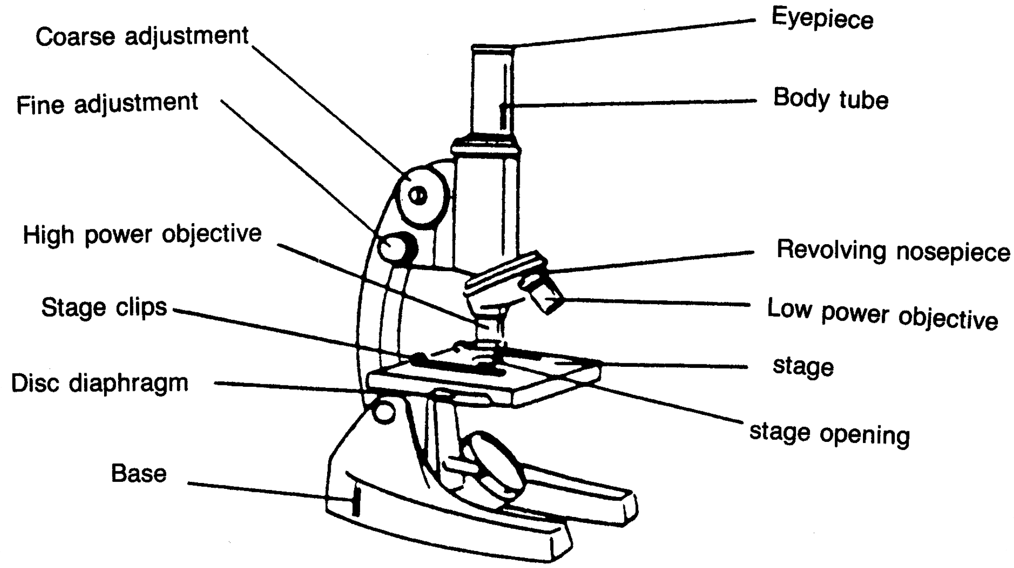
4. The body tube ends in a part known as the revolving nosepiece, under which are lenses called objectives. By turning the nosepiece, the objectives will turn and click into place. The objectives are low power or high power lenses. Low power usually consists of 5X or 10X, while high power consists of 43X to 100X magnification power.

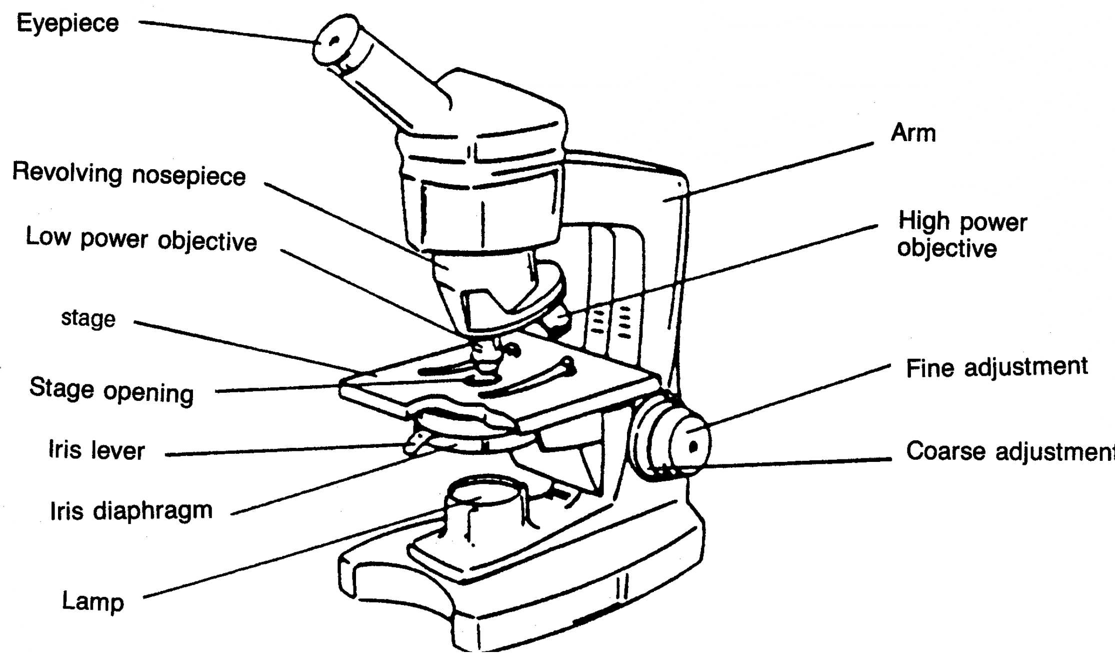
   Extreme care must be exercised when using these lenses; they must not hit the microscope slide when lowering the body tube. The objectives should be cleaned only with lens paper so that dirt and dust will not scratch them.

5. When a microscope has a double set of lenses (eyepiece and objective), it is called a compound microscope.

   If you multiply the number on the eyepiece by the number on the objective, the total magnification of the microscope will be known. For example, if the magnification of the eyepiece is 5X, and the magnification of the objective is 10X, then by multiplying, you get a total magnification of 50X.

6. The objectives overlook a flat platform called the *stage*. The stage has an opening in its center that allows light to enter the microscope. A slide is placed on this stage and kept from moving by the use of *stage clips*.


Coarse adjustment
Fine adjustment
High power objective
Stage clips
Disc diaphragm
Base
Eyepiece
Body tube
Revolving nosepiece
Low power objective
stage
stage opening


Eyepiece
Revolving nosepiece
Low power objective
stage
Stage opening
Iris lever
Iris diaphragm
Lamp
Arm
High power objective
Fine adjustment
Coarse adjustment

7. Underneath the stage is a diaphragm. The diaphragm regulates the amount of light entering the microscope. The diaphragm is adjustable for the type of lighting conditions used.

   On a microscope with an *iris diaphragm*, a lever controls the size of the opening through which light passes. A microscope with a *disc diaphragm* is operated by rotating a disc containing various sized openings. *Important: Adjusting the diaphragm is as important as correctly focusing a microscope.*

8. Your microscope may have a *lamp* or a *mirror* for a light source. If the microscope is equipped with a mirror, it can be turned toward the source of light so that the rays are diverted upwards through the body tube. *Caution:* Never use direct sunlight as a source of light; it can damage your eyes.

9. There are usually two pairs of adjustment wheels on a microscope. One large pair, when turned, move the body tube up or down rather rapidly. This will produce a *coarse adjustment* that is used for initial or first focusing. The second, smaller pair, is used to fine focus the image. This is called the *fine adjustment* and is for final focusing.

10. The bottom part of the microscope is the *base*. Make sure that the base is resting securely wherever it is placed for viewing.

11. Now place the microscope in its normal position for use, with the arm facing you. Before observing anything under the microscope, you should get it ready for viewing by following these simple steps:

    --Make sure the microscope is resting on a secure foundation.

    --Clean the eyepiece and all objectives by wiping them with a piece of lens paper.

    --Open the diaphragm all the way.

    --Turn the nosepiece until the low power objective (4X, 5X or 10X) clicks into place.

    --Look through the eyepiece with *both eyes open*. Doing this will reduce eyestrain.

    --Turn on the lamp or turn the mirror towards a light source until an evenly illuminated white light field is seen.

    --If the light is too bright or too dark, regulate it with the diaphragm.

    --If any tiny specks of dust appear, clean the lenses with fresh lens paper.

Part II: Analysis

1. Briefly describe the function of the following microscope parts:

   a. eyepiece ____

   ____

   b. objectives ____

   ____

   c. mirror or lamp ____

   ____

   d. revolving nosepiece ____

   ____

   e. stage ____

   f. stage clips ____

   g. diaphragm ____

   h. coarse adjustment ____

   ____

   i. fine adjustment ____

   ____

2. Why is the microscope called a compound microscope?

   ____

   ____

3. What would the magnification of your microscope be if you used:

   a. a 5X eyepiece and a 10X objective? ______________________________

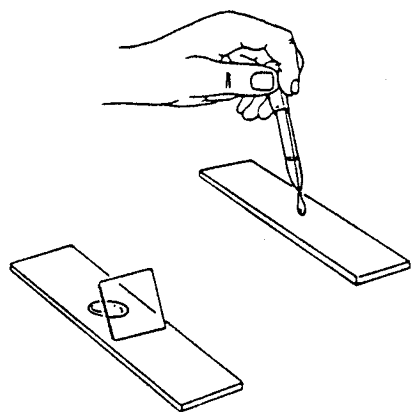
   b. a 10X eyepiece and a 40X objective? ______________________________

   c. a 10X eyepiece and a 100X objective? ______________________________

Part III: Making a Wet Mount

1. Cut out a small letter "a" from a newspaper column.

2. Carefully position it so that the letter "a" is in the center of a clean microscope slide and is right-side up. Using a dropper, place a drop or two of tap water over the specimen.



3. Holding a coverslip at a 45^{o} angle, slowly lower it into the drop of water containing the letter. Preparing a slide in this manner is known as a *wet mount*. If properly done, there should be no air bubbles trapped under the coverslip. If this is not the case, start over again.

   Why must all wet mount preparations be cut very thin?

   ____

   ____

Part IV: Low Power and High Power

When observing a specimen under *low power*, the following steps should be taken:

--Obtain a compound microscope and adjust the light as instructed at the beginning of this activity.

--Turn the nosepiece until the low power (10X) objective clicks into place. If the objective is not in place, the entire field will not be seen.

--Place the microscope slide on the stage under the stage clips with the letter "a" facing you in the center of the stage opening.

--Fasten the stage clips to the slide and lower the body tube until it stops. Most microscopes have an automatic stop on low power.

--Looking through the eyepiece, *slowly* raise the body tube with the coarse adjustment until the letter "a" comes into focus. Center the letter and use the fine adjustment to bring it into better focus. Look at the distance between the slide and the objective. This is called the *working distance*.

--At this point, adjust the diaphragm to control the amount of light.

While observing under low power, move the slide to the right and to the left. Then move it towards you and away from you. When you move the slide from left to right, in what direction does the letter move?

a.____

When you move the slide away from you, in what direction does the letter seem to move?

b.____

In order to see the entire field, the objective must be in place. (True or False)

c.____

The distance between the slide and the objective is called the d.______________________________

When observing a specimen under *high power*, these steps should be taken:

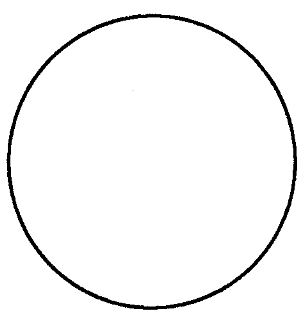
--Always position the specimen in the center of the field of view and fine focus under low power first.

--Open the diaphragm all the way. This is done because as you increase magnification, it becomes necessary for light rays to travel through additional lenses, producing a darker field.

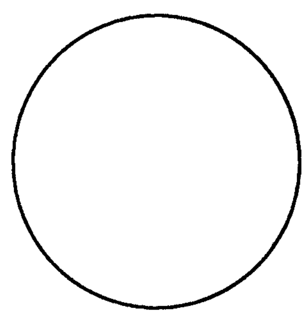
--Turn the nosepiece until the high power objective clicks into place. Most microscopes are *parfocal*. This means that an object focused under low power will be approximately focused under high power.

--All focusing is done *only* with the fine adjustment. Not more than one turn either way should be needed for a sharp focus. Look at how small the working distance is on high power. Using the coarse adjustment knob might crack the slide or damage the objective lens.

Sketch the "a" as you see it under low and high powers. Try to sketch your specimens as accurately as you can.



Low power



High power

When you changed from low to high power, how did the change affect the working distance of the lens?

e.____

____

brightness of the field of view?

f. ____

size of the field of view?

g. ____

Part V: Depth of Field and Resolution

Depth of field is the vertical amount of the specimen that will be in focus at one time while *resolution* is the ability of a microscope to show fine details clearly. Actually, resolution is just as important as magnification. To merely magnify a blur does not tell one anymore about it. The ability of a microscope to resolve very closely spaced objects depends on the quality of the lenses and the wavelength of the light being used.

1. Make a wet mount of two different colored threads that cross each other. Add a coverslip and observe under *low* and *high* power.

   a. Which diaphragm setting provides the clearest view on each power?

   ____

   b. How can the microscope be used to determine which thread is on the bottom?

   ____

   ____

   c. Are both threads in focus at once under low power? ____________________

   d. high power? ____

   e. Under which power is the depth of field greater?

   ____

Part VI: Analysis

1. Given a prepared slide of a one-cell organism, briefly list the steps from the beginning that must be taken to locate the organism under high power (430X).

   ____

   ____

   ____

2. You are searching a slide for an object that is in the lower right-hand side of the field of view. In which direction would you move the slide on the stage in order to center the object?

   ____

3. The largest opening on the diaphragm is always best. (True or False) ____________

   Explain. ____________

   ____

4. When searching a slide for a small object, with which objective is it best to begin?

   ____

5. Microscope A has a 20X eyepiece and a 30X objective; microscope B has a 5X eyepiece and a 40X objective.

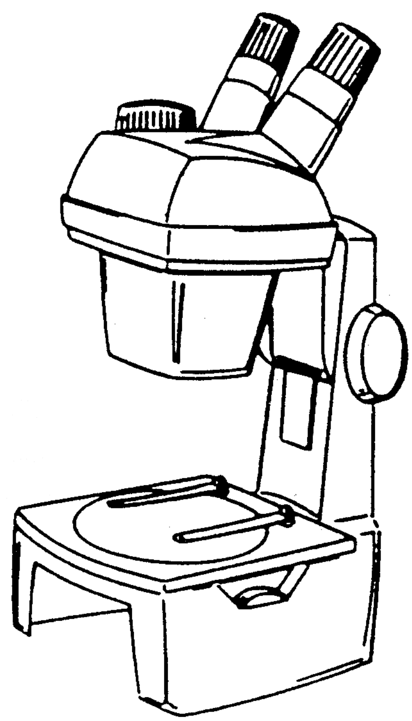
a. Which microscope has the greatest magnification? ____________

   ____

b. Which requires the most light? ____________

c. Which has the greatest depth of field? ____________

Part VII: The Stereoscopic Dissecting Microscope



In some cases, it is better to work with less magnification. This is true when the objects are opaque and too large to be seen whole under the lowest power of the compound microscope. Because the working distance is much greater, it is also possible to handle objects while they are being viewed with this microscope. Specimens are usually viewed by reflected light, and since there are two objectives and two eyepieces, a 3-dimensional effect is achieved.

1. Place the dissecting scope on a table and light its stage with a lamp. Adjust the eyepieces to fit the distance between your eyes. Use the focusing knob to move the objective as far down as it will go.

2. Focus on a plastic ruler by turning the focusing knob slowly toward you.

   a. What is the magnification with this objective?

   ____

   b. What is the field size in millimeters? ______________________

   c. in micrometers? ______________________

   d. How does the field size compare with the compound microscope low power field?

   ____

3. Magnification with this type of microscope can be increased by changing the eyepieces or objectives. If your microscope is so equipped, change to a higher magnification. What is the high power magnification?

   a. ____

   How does the field size compare with the low power field?

   b. ____

4. Select an object such as a leaf or insect to view. Focus the object under both low and high power. While looking through the microscope, move the specimen to the right. Which way did the image move?

   a. ____

   Move the specimen toward you. Which way did the image move?

   b. ____

   How does this movement compare with observation of movement when using the compound microscope?

   c. ____

   ____

5. Examine other objects under the dissecting microscope. If possible, practice moving the objects about with forceps or dissecting needles as you view them.

Part VIII: Analysis

1. List several advantages to using a stereoscopic dissecting microscope.

____

____

____

2. When searching a slide for even small objects, it is best to start with low power. Explain.

____

____

3. A microscope has a 10X field measuring 6 mm. What is the size of the field at 10X in

   micrometers? a. ____

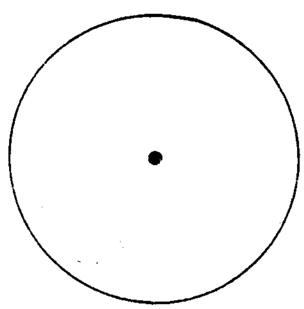
   b. at 20X?____

   c. at 45X?____

   d. What is the total magnification when using a 5X eyepiece with a 45X objective?

____

4. The circle below represents the field of view when using the 10X objective. Using the same center point, draw a circle that would approximate the field of view at 43X.



5. Why are objects frequently lost when switching to high power?

____

____

____

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

ANSWER SHEET TO LABORATORY EXERCISES

Lab #1

Part III--Quiz

1. Answer should include ten of the following:

Never "horse around" in the laboratory.
Never play with laboratory equipment or materials.
Always follow instructions and wait until you are told to begin before starting any investigation.
Never carry out unassigned experiments.
Never eat or taste anything in the laboratory. This includes food, drinks and gum, as well as chemicals found in the laboratory. Wash your hands after *every* experiment.
Keep all booksand other nonessential items away from the work area.
Keep your work area clean. Dispose of waste materials in appropriate containers.
Turn off any gas jets or any electrically operated equipment when you have completed the laboratory investigation.
Report all injuries or accidents to your teacher immediately.
Never use broken or cracked glassware.
Always wear shoes in the laboratory. Sandals are not suggested.
Tie back long hair and restrict any loose clothing.
Wear safety goggles, laboratory aprons, and gloves when instructed to do so.

2.

a.	Microscope slide	b.	Coverslip
c.	Petri dish	d.	Erlenmeyer flask
e.	Florence flask	f.	Funnel
g.	Graduate	h.	Test tube
i.	Test tube rack	j.	Test tube holder
k.	Pipette	l.	Striker
m.	Scalpel	n.	Medicine dropper
o.	Inoculating loop	p.	Forceps

3. Answer should include the following information:

<u>Laboratory Investigation Report:</u>

Title This is the name of the laboratory investigation you are doing. In an investigation from a laboratory manual, the title will be the same as the title of the investigation.

Hypothesis The hypothesis is what you think will happen during the investigation. It is often posed as an "If...then" statement. For example: If sulfuric acid is added to sugar, then the sugar will be broken down into its chemical components.

Materials This is a list of all the equipment and other supplies you will need to complete the investigation. In investigations taken from a laboratory manual, the materials are generally listed for you.

Procedure The procedure is a step-by-step explanation of exactly what you did in the investigation. Investigations from laboratory manuals will have the procedure carefully written out for you, all you need to do is to read it very carefully. Often, in laboratory manuals, there will be questions in the procedure section that will help you understand what is happening in the investigation.

Data Your data is what you have observed. It is often recorded in the form of tables, graphs and drawings.

Analyses and Conclusions This is the most important and difficult part of the investigation. It explains what you have learned. You should include everything you have learned; you should explain any errors you made in the investigation; and you should evaluate your hypothesis. Keep in mind that not all hypotheses will be correct. That is normal. You just need to explain why things did not work out the way you thought they would. In laboratory manual investigations, there will be questions to guide you in analyzing your data. You should use these questions as a basis for your conclusions.

Independent Project Report

Title

Introduction The introduction should include a clear, simple statement of your purpose. In addition, the introduction should include a discussion of the important ideas that led you to design and perform the experiment. For example, you could include such things as why you are doing this investigation, what is interesting about the topic to be investigated, and what information you have already gathered about the topic. In order to prepare a good introduction, you will need to do library research on the topic. Be sure to use proper citation methods when you use ideas from any reference source.

Hypothesis

Materials

Procedure

Data

Analyses and Conclusions

References List all the reference materials used to originate and to complete the project. Be sure to use complete citations, including author, title, date of publication and place of publication. Your teacher will give you the format preferred for the type of investigation you are doing.

Lab #2

Part II:

1.
  a. Lens closest to the eye that has 5X or 10X magnification power.
  b. Lens closest to the object being observed. These lenses usually have 5X, 10X, 43X or 100X magnification power.
  c. Provides an adequate light source for viewing.
  d. Allows observer to change from low (10X magnification) to high power (43X magnification).
  e. Supports the slide.
  f. Secures the slide.
  g. Regulates the amount of light entering the microscope.
  h. Brings objects into rapid but approximate focus.
  i. Brings objects into a more exact focus.

2. Because a double set of lenses (eyepiece and objective) is used

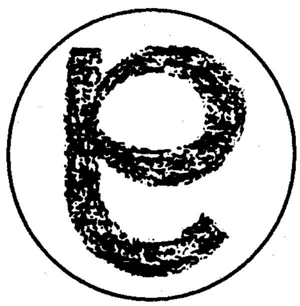
3. a. 50X b. 400X c. 1000X

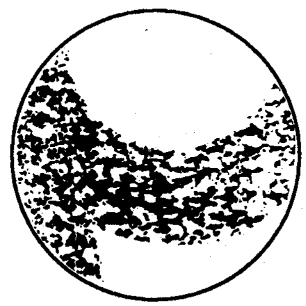
Part III:

3. So that light can be transmitted *through* the object for viewing.

Part IV:

a. The letter will move from right to left.
b. Toward you.
c. True
d. Working distance





e. Working distance is much smaller with the high power
f. Brightness is decreased on high power
g. Field of view is restricted on high power

Part V:

1. a. Less light is desirable on low power
   b. Use the fine adjustment to focus up and down. The bottom thread will come into view as the scope is focused down.
   c. Probably
   d. No
   e. Low power

Part VI:

1. See steps outlined in procedure under high power
2. Down and to the right
3. False. At low power the excessive light does not allow the eye to see detail.
4. Low power; a greater area can be seen at once
5. a. Microscope A b. Microscope A c. Microscope B

Part VII:

2. a. Answers variable
   b. Answers may vary
   c. Answers variable, should be 1000X answer above
   d. Field size is larger

3. a. Variable
   b. Field size is smaller

4. a. Movement of image is the same as movement of object
   b. The specimen moves toward you
   c. Not reversed as with compound microscope

5. Students can practice dissecting objects, such as insects, leaves or presoaked seeds, just to get the feel of working with a stereoscope.

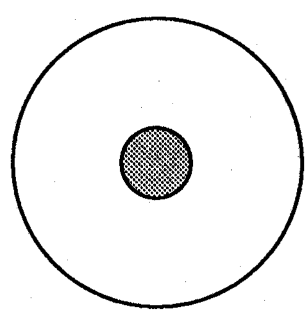
Part VIII:

1. Opaque objects can be viewed. Larger objects can be studied. Specimens can be dissected under the scope.

2. A larger field of view is available to find the objects.

3. a. 6000pm
   b. 3000pm
   c. approximately 1300pm+
   d. 225X

4. Students should draw a circle having an area approximately 1/4 the original circle



5. The object is not centered in the portion of the low power field that will be seen under high power.

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

UNIT TEST

Name ______________________________ Score ______________________________

1. Match the terms on the right with the correct definitions by placing the appropriate numbers in the blanks provided.

_____a. An actual material provided by an animal that can be eaten, worn or used		1. Product
_____b. Feed, such as pasture, that is bulky, contains more than 18% crude fiber and is low in energy		2. Cultivate
_____c. Capacity for change		3. By-products
_____d. Working land to produce a crop		4. Elasticity
_____e. Money coming in or received for a product or a service.		5. Concentrate
_____f. A benefit provided by an animal		6. Flexibility
_____g. Feed, such as grain, high in energy and low in fiber		7. Receipt
_____h. Ability of a farm operation to withstand changes in the supply or demand		8. Service
_____i. Products left after the main products have been extracted		9. Roughage

2. Name ten types of livestock.

______________________, ______________________, ______________________

______________________, ______________________, ______________________

______________________, ______________________, ______________________

____

3. Name four products and three services livestock provide.

Products

a.______________________ c.______________________

b.______________________ d.______________________

Services

a.______________________ c.______________________

b.______________________

4. Identify the sources of Idaho cash farm receipts by writing the source by the appropriate percentage:

a. 13.1% ______________________

b. 1.2% ______________________

c. .6% ______________________

d. 27.8% ______________________

e. 2.1% ______________________

f. 54.8% ______________________

g. 45.2% ______________________

5. Identify Idaho's rank in the nation's agriculture for the following crops, livestock and livestock products.

a. Honey ______________________

b. All cattle and calves ______________________

c. Milk production ______________________

d. American cheese ______________________

e. Milk cows ______________________

f. Sheep, lambs, wool ______________________

g. Barley ______________________

h. Potatoes ______________________

i. Sugarbeets ______________________

j. Hops ______________________

k. All mint ______________________________

l. Wheat ______________________________

m. Apples ______________________________

6. Distinguish between primary and secondary food sources by placing a one (1) by the primary source and a two (2) by the secondary source.

_____a. Food source deriving energy from plants or animals

_____b. Food source deriving energy directly from the sun

7. Describe reasons for and against using livestock as a food source.

a. Arguments for using livestock as a food source:

____

____

____

____

b. Arguments against using livestock as a food source:

____

____

____

____

8. List three specific careers in each of the following areas of livestock industry employment.

a. Farming/Ranching
(1) ______________________________
(2) ______________________________
(3) ______________________________

b. Research
(1) ______________________________
(2) ______________________________
(3) ______________________________

c. Industry
(1) ______________________________
(2) ______________________________
(3) ______________________________

d. Business (1) ______________________________
(2) ______________________________
(3) ______________________________

e. Education (1) ______________________________
(2) ______________________________
(3) ______________________________

f. Communications (1) ______________________________
(2) ______________________________
(3) ______________________________

g. Service (1) ______________________________
(2) ______________________________
(3) ______________________________

INTRODUCTION TO ANIMAL SCIENCE

AG 530 - A

ANSWERS TO TEST

1. a. 1   b. 9   c. 6   d. 2   e. 7   f. 8   g. 5   h. 4   i. 3

2. Beef, dairy, sheep, swine, dairy goats, horses, rabbits, fish, fur-bearing animals, poultry

3. Answers should include four products and three services from the following lists:

   Products -- Meat, eggs, milk, clothing, medicine, fertilizer, miscellaneous products
   Services -- Power, recreation, transportation

4. a. Dairy products
   b. Sheep, lambs, wool
   c. Hogs
   d. Cattle and calves
   e. Other livestock
   f. Total crops
   g. Total livestock

5. a. 11   b. 22   c. 13   d. 5   e. 18   f. 11   g. 1   h. 1   i. 3   j. 3   k. 3   l. 8   m. 10

6. a. 2   b. 1

7. a. Answers should include information from the following:

   Usable plant energy would otherwise be wasted: Much of the world's land is not cultivated; Forages provide a high percentage of livestock feed; 95% of all energy fixed by plants cannot be used by man, but can be used by ruminants; Animals use otherwise wasted by-products

   Animals provide higher quality food: Higher in protein content; Better quality protein (more amino acids); More digestible protein; More preferred by consumers

   Animals provide other needed products such as medicine, fertilizer and power

   Animals increase flexibility of farm operations: Stimulate grain production; Provide elasticity to grain production

   b. Livestock provide a secondary food source and therefore use more energy to produce the same amount of food

8. Answer should include three careers in each area:

   a. Farming/Ranching: Manager; Foreman; Herdsman

   b. Research : Production; Processing; Marketing; New equipment and use

   c. Industry: Food processing; Pesticides and herbicides; Feed manufacturing; Dairy processing

   d. Business: Agricultural banking; Farm management; Grading and packaging; Marketing

   e. Education: Agricultural extension specialist; Vocational agriculture instructor; College instructor; Governmental agencies

   f. Communications: Farm reporting; Market reporting; Radio; Television

   g. Service: Inspection and regulation; Plant and animal quarantine; Foreign service; Agricultural consultant; Veterinary

THE ORGANISMS

AG 530 - B

UNIT OBJECTIVE

After completion of this unit, students should be able to define terms related to organisms and list the categories of the classification system. Students should also be able to list traits that place an organism into a kingdom and define the five kingdoms in the classification system. This knowledge will be demonstrated by completion of laboratory exercises and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Define terms related to the organisms.
2. List the seven categories of the classification system in order from largest to smallest.
3. Outline the classification system for humans.
4. List three traits that help place an organism into a kingdom.
5. List and define the five kingdoms in the classification system.
6. State two biological principles for each of the categories that demonstrate commonness among organisms.
7. Outline the classification of the major livestock animals in the United States.
8. Examine cells from the five kingdoms.
9. Classify organisms.

THE ORGANISMS

AG 530 - B

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Make transparencies and necessary copies of materials.

   B. Provide students with objective sheet and discuss.

   C. Provide students with information sheet and discuss.

   D. Provide students with assignment and laboratory sheets.

   E. Discuss and demonstrate assignment sheets and laboratory exercises.

   F. Review and give test.

   G. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Classification System

      2. TM 2--Placing Organisms Into a Kingdom

      3. TM 3--Kingdoms

   E. Assignment sheet

      1. AS 1--Outline the Classification of the Major Livestock Animals in the United States

   F. Answer to assignment sheet

   G. Instructor notes for laboratory exercises

   H. Laboratory exercises

      1. LE 1--Examining Cells From the Five Kingdoms

      2. LE 2--Classifying Organisms

I. Answers to laboratory exercises

J. Test

K. Answers to test

III. Unit references

A. *Agricultural Education Curriculum*, College of Agriculture, University of Illinois, Urbana, Illinois, 1989.

B. Otto, James H., Towle, Albert, *Modern Biology*, Holt, Rinehart and Winston, Publishers, New York, 1985.

C. Slesnick, Irwin L.; Balzer, Leron; McCormack, Alan J.; Newton, David E.; Rasmussen, Fredrick A.; *Biology*, Scott, Foresman and Company, Glenview, Illinois, 1985.

THE ORGANISMS

AG 530 - B

INFORMATION SHEET

I. Terms and definitions

A. Binomial nomenclature--A system invented by Carolus Linnaeus for classifying organisms. Each organism is assigned a two-word Latin name
(Note: First word represents the genus; second word is descriptive.)

B. Prokaryote--Cell type that has a nucleus without a membrane around it. The nuclear material floats freely within the cell

C. Eukaryote--Cell type that has an organized nucleus surrounded by a membrane

D. Adaptation--A characteristic which enables the organism to survive in its environment

E. Autotrophs--Organisms that manufacture organic nutrients from inorganic raw materials

F. Biogenesis--The theory that all living things come only from preexisting living things

G. Biome--Large, easily differentiated community unit arising as a result of complex interactions of climate, other physical factors and biotic factors

H. Chordate--The phylum of animals characterized by the presence of a notochord at some stage of development

I. Colony--Association of unicellular or multicellular organisms of the same species

J. Community--An assemblage of populations that live in a defined habitat. The organisms constituting the community interact in various ways with one another

K. "Consumer" organisms--Those elements of an ecosystem that eat other plants or animals

L. Ecology--The study of the interrelations between living things and their environment

M. Ecosystem--All of the organisms of a given area

N. Epigenesis--The theory that development proceeds from a structureless cell by the successive formation and addition of new parts which do not preexist in the fertilized egg

O. Fossils--Any remains of an organism that have been preserved in the earth's crust

P. Genus--Taxonomic classification in which closely related species are grouped together

Q. Herbivore--A plant-eating animal

R. Heterotrophs--Organisms which cannot synthesize their own food from inorganic materials

S. Mammal--A member of a class of vertebrates characterized by having hair and mammary glands; includes such diverse types as shrews, bats, cats, whales, cattle and humans

T. Outbreeding--The mating of individuals of unrelated strains

U. Phenotype--The visible expression of the hereditary constitution of an organism

V. Phylogeny--The evolutionary history of a group of organisms

W. Polymorphism--Occurrence of several distinct phenotypes in a population

X. Population--The group of individuals of a given species inhabiting a specified geographic area

Y. Senescence--The gradual loss of vigor through the aging process

Z. Species--The unit of taxonomic classification, a population of similar individuals, alike in their structural and functional characteristics

AA. Taxonomy--The science of naming, describing and classifying organisms

BB. Territoriality--Behavior pattern or mold in which one organism (usually a male) delineates a territory of his own and defends it against intrusion by other members of the same species and sex

CC. Tissue--Specialized cells which together perform certain special functions

II. Classification system--Largest to smallest (Transparency 1)

A. Kingdom

B. Phylum

C. Class

D. Order

E. Family

F. Genus

G. Species

III. Classification system for humans

A. Kingdom -- Animalia

B. Phylum -- -- Chordata

C. Class -- Mammalia

D. Order -- Primates

E. Family -- Hominidae

F. Genus -- Homo

G. Species -- Homosapiens

IV. Traits that help place organism into kingdom (Transparency 2)

A. Kind of cells in organism: prokaryote or eukaryote

B. How organism obtains its food

C. How organism reproduces and develops

V. Five kingdoms (Transparency 3)

A. Animal kingdom (Animalia)

1. Eukaryotic cells

2. Multicellular organisms

3. Move about to obtain food

4. Digest food inside body

B. Plant kingdom (Plantae)

1. Eukaryotic cells

2. Multicellular organisms

3. Produce own food

4. Cannot move about

C. Fungi kingdom

1. Eukaryotic cells

2. Mostly multicellular organisms

3. Do not move about
4. Obtain food by absorbing it from living or dead organisms

D. Monera kingdom

1. Prokaryotic cells
2. Mostly one-celled organisms
3. Produce own food or obtain it from outside source

E. Protista kingdom

1. Eukaryotic cells
2. Many are one-celled
3. Produce own food or obtain it from outside source

VI. Biological principles that demonstrate commonness among organisms

A. Environmental interaction

1. Cells in organisms affect and interact with each other
2. Cells and organisms react and interact with their environment

B. Genes

1. All organisms pass on function and structure to their offspring
2. The combination of gene characteristics is variable
3. The DNA contains the genetic code in a linear arrangement
4. The RNA is the means of replicating and passing on the genetic code

C. Life

1. Life comes from life
2. Reproduction is required for life continuation

D. Physical and chemical reactions

1. Physical and chemical laws are obeyed by living creatures
2. All living organisms use the common molecular, biological and chemical reaction means
3. All living organisms must capture, store and release energy to sustain life

E. Evolution

1. All organisms arise from preexisting organisms. (The exception would be the assumption that the original living cell arose spontaneously. This assumption is commonly accepted but subject to serious question by some investigators)

2. Natural selection is responsible for organism evolution

3. The embryos of developing animals tend to resemble the embryos of their ancestors

4. Organisms adapt to their habitat through selection from environmental pressures

F. Cells

1. Cells are the fundamental units of life

2. Cells contain structures which are differentiated and interdependent

G. Development

1. All organisms exhibit characteristics of cell enlargement or cell division or both. This characteristic is termed growth

2. All organisms develop a characteristic body plan

CLASSIFICATION SYSTEM

Kingdom

Phylum

Class

Order

Family

Genus

Species

PLACING ORGANISMS INTO A KINGDOM

KIND OF CELL

METHOD OF OBTAINING FOOD

METHOD OF REPRODUCTION AND DEVELOPMENT

KINGDOMS

Animal

Plant

Fungi

Monera

Protista

THE ORGANISMS

AG 530 - B

ASSIGNMENT SHEET #1--OUTLINE THE CLASSIFICATION OF THE MAJOR LIVESTOCK ANIMALS IN THE UNITED STATES

Name ______________________________________ Score ___________________________________

Using resources in your library or agriculture classroom, outline the classification of the following animals:

	Cattle	Sheep	Horses	Goats	Chickens
Kingdom	Animal				
Phylum	Chordata				
Class	Mammalia				
Order	Artiodactyla				
Family	Bovidae				
Genus	Bos				
Species	Bostaurus				

THE ORGANISMS

AG 530 - B

INSTRUCTOR NOTES FOR LABORATORY EXERCISES

Lab #1

Background: The separate procedures do not have to be completed in any specific order. You may wish to set up five lab stations and divide the class into five groups. Have each group start at a different lab station doing a different procedure. This will minimize the amount of time that the students will need to wait for microscopes and prepared slides.

Solution preparation:

The following general instructions apply for the preparation of most solutions: Solvents should be added to solutes. Use distilled water, not tap water, for all reagents. When preparing an acid or base solution, *slowly* add the acid or base to the water. Never add water to a concentrated acid or base.

To make percentage solutions measure 1 ml of solute per percentage. Add the solute to enough solvent to make 100 ml of solution. When dissolving a solid in water, measure 1 g of solute per percentage and mix the solute with enough water to make 100 ml of the solution.

Iodine solution (also available ready-made)

Dissolve 5.0 g of potassium iodide [KI] and 1.5 g of iodine crystals in 500 ml of distilled water. Store in brown bottle or other glass container that shields the liquid from light. *CAUTION: Iodine dust and vapors are toxic and irritating. Avoid body contact and inhalation of fumes. Should body contact occur, flush immediately with water.* (Quantity needed: 500 ml)

Methyl cellulose solution (also available ready-made)

Dissolve 2 g of methyl cellulose in 38 ml of distilled water. Store in refrigerator. (Quantity needed: 40 ml)

Methyl blue stain (also available ready-made)

Dissolve 0.75 g of methylene blue in 50 ml of 95% ethyl alcohol. Dilute 5 ml of the alcohol and methylene blue solution with 45 ml of distilled water. This diluted solution is the stain. Bottle and store the remaining methylene blue and alcohol solution. *CAUTION: Ethyl alcohol is flammable. It is also irritating to the eyes. Flush spills with water. Do not ingest ethyl alcohol.* (Quantity needed: 50 ml)

Materials:

Prepared slides could include: Animal cells: human and frog blood cells, skeletal and cardiac muscle, nerve cells and epithelial cells

Plant cells: cross sections of leaves, stems and roots

Fungal cells: *Rhizopus, Lycogala* and mushroom cross sections

Protist cells: paramecia, diatoms, amebas and *Volvox*

Moneran cells: bacteria types and cyanobacteria, such as *Anabaena*

Part I:

Step 1: The tongue cells that students will observe are epithelial cells.

Part III:

To make yeast suspension, dissolve 0.1 g of yeast in 75 ml of warm (37^{o}C) water. Add 2-5 g of sugar.

Part IV:

Step 3. Cilia of paramecia are best seen under dim light or under a phase-contrast microscope

Part V:

You may suggest that students work on Table I as they do the laboratory. Students may need to use a textbook to complete Table I.

<u>Lab #2</u>

Inform the student that the construction and use of a classification key may be compared with solving a mystery or going on a treasure hunt, where each bit of information leads to another piece of information. Impress on them that one wrong choice somewhere along the way can cause them to take a wrong turn and end up in the wrong place with the wrong answer!

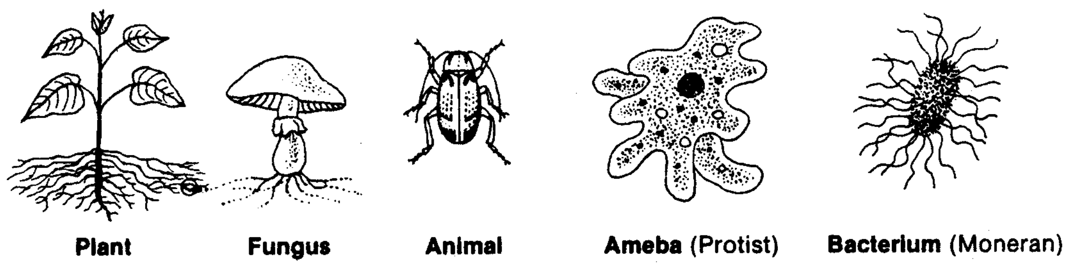
THE ORGANISMS

AG 530 - B

LABORATORY EXERCISE #1--EXAMINING CELLS FROM THE FIVE KINGDOMS

Name ______________________________ Score ______________________________

Slesnick, Irwin L., *Biology Laboratory Manual,* Scott, Foresman and Company, 1985. Reprinted by permission of Scott, Foresman and Company.



Introduction

A plant such as the one in the drawing above looks and behaves very differently from insects that might feed on it and from fungi that might grow on its roots. Likewise, different types of single-celled organisms, such as amebas and bacteria, vary in appearance. Differences in the cells of the organisms ultimately account for these variations. As the functional units of life, however, all cells have common characteristics. For example, every cell is made mainly of cytoplasm enclosed in some sort of membrane. All cells, at some point, also contain genetic material that directs the way the cell functions. In this laboratory you will examine cells representing organisms from each of the five kingdoms. You will observe similarities and differences in cell structure and function.

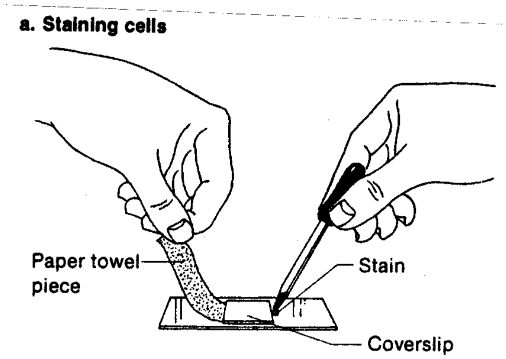
Materials needed:

5 microscope slides
Medicine dropper
Tap water
5 coverslips
Toothpick
Paper towels
Forceps
Compound microscope
Leaf
Yeast suspension
Paramecium culture
Nostoc or *Oscillatoria* culture
Methylene blue stain
Iodine solution
Methyl cellulose solution
Prepared slides of animal cells, plant cells, fungal cells, protist cells and moneran cells

Part I: Animal Cells

1. Prepare a wet mount slide of tongue cells using the following directions. Place a drop of water on the center of a clean slide. Use a clean toothpick to gently scrape the top surface of your tongue. Mix the tongue scrapings from the toothpick with the water on the slide. Gently lower a coverslip in place over the tongue cells and water mixture.

2. To make certain cell structures visible, stain the tongue cells with methylene blue stain by adding one drop of stain along one side of the coverslip. On the opposite side of the coverslip, place a small piece of paper towel, as shown in a. The paper towel draws the stain under the coverslip and across the slide.



3. Observe the stained tongue cells using the low power objective of your microscope. Estimate the length of a tongue cell, and record this figure in Table I in Part IV of this lab. Describe the general shape of the tongue cells in the space provided in the table. Also use the table to check off the cell structures that you observe.

4. Switch to high power, and bring the tongue cells into focus. CAUTION: Whenever you use a high power objective, very carefully lower the objective or raise the stage until the objective barely touches the slide. Then, look through the eyepiece and focus by slowly raising the objective or lowering the stage. Focusing this way will prevent damage to the lens and slide. Look for cell structures unobservable under low power. Check off these structures in the table.

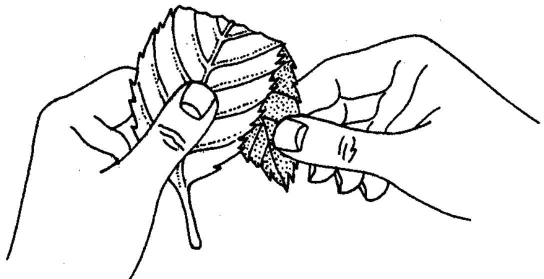
5. Draw several tongue cells in the circle below. Label all the structures you observed.

6. Remove the slide of your tongue cells from the stage. Obtain prepared slides of animal cells, and examine them under low and high power. In your table list the types of animal cells that you examined. Check off the cell structures you were able to observe in each cell.

7. In the circles below, draw the animal cells that you examined as they appeared under high power. Record the cell type on the line below the circle. Label the cell structures that you observed.

<u>Part II: Plant Cells</u>

1. Fold the leaf in half so that the underside of the leaf is on the outside, as shown in b. Use your forceps to pull a thin layer of tissue from the underside of the leaf.



b. Exposing layers of leaf tissue

2. Make a wet mount of the leaf tissue, and stain the plant cells with iodine solution, as in step 2 of Part I.

3. As in Part I, view the plant cells under low power. Estimate the length of a plant cell, and record your estimate in the table. Use the space provided in the table to describe the shape of the plant cell, and check off the cell structures that you observe in the plant cell.

4. Switch to high power, and adjust the focus on the microscope. As always, turn the adjustment knobs slowly to avoid damaging the slide and the objective. In the table check off additional cell structures that were unobservable under low power. Try to observe the different kinds of plastids in the plant cell.

5. Draw plant cells in the circle below, labeling all the cell structures you observed.

6. Remove your wet mount of the plant cells from your microscope. Obtain and examine prepared slides of plant cells. View these slides under low and high power. In the spaces provided in the table, list the plant cells that you examined. Check off cell structures that you observe.

7. In the circles above, draw the plant cells that you observed as they appeared under high power. Label the cell parts, as you did in Part I.

Part III: Fungal Cells

1. Put one drop of yeast suspension in the center of a clean slide. Add a coverslip. Stain the yeast cells with methylene blue stain, using the same method you used in Step 2 of Part I.

2. Observe the yeast cells under low power. Estimate the length of a yeast cell, and record your measurement in Table I. Also describe the shape of the cells in the space provided.

3. Examine the yeast cells under high power. As before, use the table to check off cell structures that you observe.

4. In the circle below, make a labeled drawing of yeast cells as they appear under high power.

5. Obtain prepared slides of fungal cells, and examine them under low and high power. Describe the general shapes of the fungal cells in the space in the table, and check off the structures you observe.

6. In the circles above, draw and label the cells you observed, as they appear under high power.

Part IV: Protist Cells

1. Make a wet mount slide of *Paramecium* cells by placing a drop of *Paramecium* culture on the center of a clean microscope slide. Add a drop of methyl cellulose. This material thickens the liquid, slowing the motion of the paramecia for easier viewing. Add a coverslip.

2. Examine the paramecia under low power. Locate one *Paramecium* that is swimming slowly enough for you to estimate its length. Record your estimate in the space provided in Table I.

3. Switch to high power, and observe the *Paramecium*. Look for the following structures: food vacuole, contractile vacuole and cilia. Use the table to check off the cell structures that you observe. Look for nuclei of different sizes. How many nuclei do you observe?

(a)____

4. In one of the circles below, draw and label a *Paramecium* cell as it appears under high power.

5. Remove the *Paramecium* slide, and examine prepared slides of other protists. Record the cell structures that you observe when viewing the different cells under high power, by checking the appropriate boxes in the table.

6. In the spaces below, draw and label the protist cells, as before.

________________ ________________ ________________

Part V: Moneran Cells

1. Remove several drops of *Nostoc* or *Oscillatoria* culture from a culture tube. Place one drop of the culture on a clean slide. Add a coverslip.

2. Examine the moneran cells under low power. Estimate the length of one cell, and record this measurement in Table I, as before. Look for a slimy substance that covers the outside of the cells. This substance may help the cells stick together to form long strands of organisms that you observe.

3. View the moneran cells under high power, checking off the cell structures you observe. Which structures observable in other cells, are absent in moneran cells?

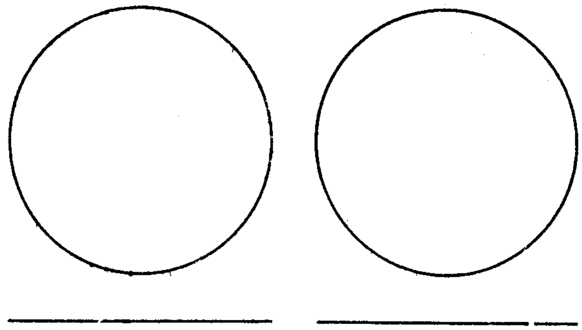
(b)____

4. In the circle below, draw and label a moneran cell under high power. Write the cell type on the line below the circle.

____

5. Obtain prepared slides of other moneran cells, and view these under low and high power. Record the cell structures that you observe by checking off the appropriate boxes in the table.

6. Make labeled drawings of these moneran cells in the circles below.



7. When you complete Parts I-IV, remove the coverslips from your wet mount slides. Put the coverslips in containers provided by your teacher. Wash your slides under running tap water. Dry them with paper towels, or allow them to air dry.

Table 1. Cells from the five kingdoms.

Cell type	Size	Shape	Cell structures: Cytoplasm	Cell wall	Genetic material	Nuclear membrane	Vacuole	Leucoplasts	Chloroplasts or chromoplasts	Other observations
Animal cells										
Plant cells										
Fungal cells										
Protist cells										
Moneran cells										

Part VI: Analysis

1. Using your laboratory data, list the cell structures that are common to all cells from the five kingdoms.

   ____

2. Can individual cell size alone be used to determine the kingdom to which a cell belongs? Explain.

   ____

   ____

3. Use your data from Table I and your textbook to summarize the features that differentiate the cells of one kingdom from the cells of other kingdoms. List these structures in Table II below.

Table II: Cell features of each kingdom

Cell types	Feature that differentiates cell
Animal cells	
Plant cells	
Fungal cells	
Protist cells	
Moneran cells	

4. Explain how certain cell structures are specialized for certain functions by filling in Table III below.

Table III: Function of certain cell structures

Cell type	Cell structure	Function for cell
Moneran cell: *Nostoc*	Slimy outer coating	
Paramecium		Allow organism to move; propel food into *Paramecium's* mouth
Fungal cell		Allows cytoplasm and other cellular material to move from cell to cell; aids transport within organism
Leaf cell	Chloroplast	
Tongue cell	Centromere	

THE ORGANISMS

AG 530 - B

LABORATORY EXERCISE #2--CLASSIFYING ORGANISMS

Name ____________________________ Score ____________________________

Selection from *Modern Biology*, Biology Investigations, Teacher's Edition, by James H. Otto, Albert Towle, W. David Otto, and Myra E. Madnick. Copyright 1977 by Holt, Rinehart and Winston, Inc. Printed by permission of the publisher.

Part I: A Study of Classification

The classification categories in biology are: kingdom, phylum, class, order, family, genus and species. A system of classification may be applied to any number of objects.

a. Examine the figures below and list some of the characteristics that you observe.________________

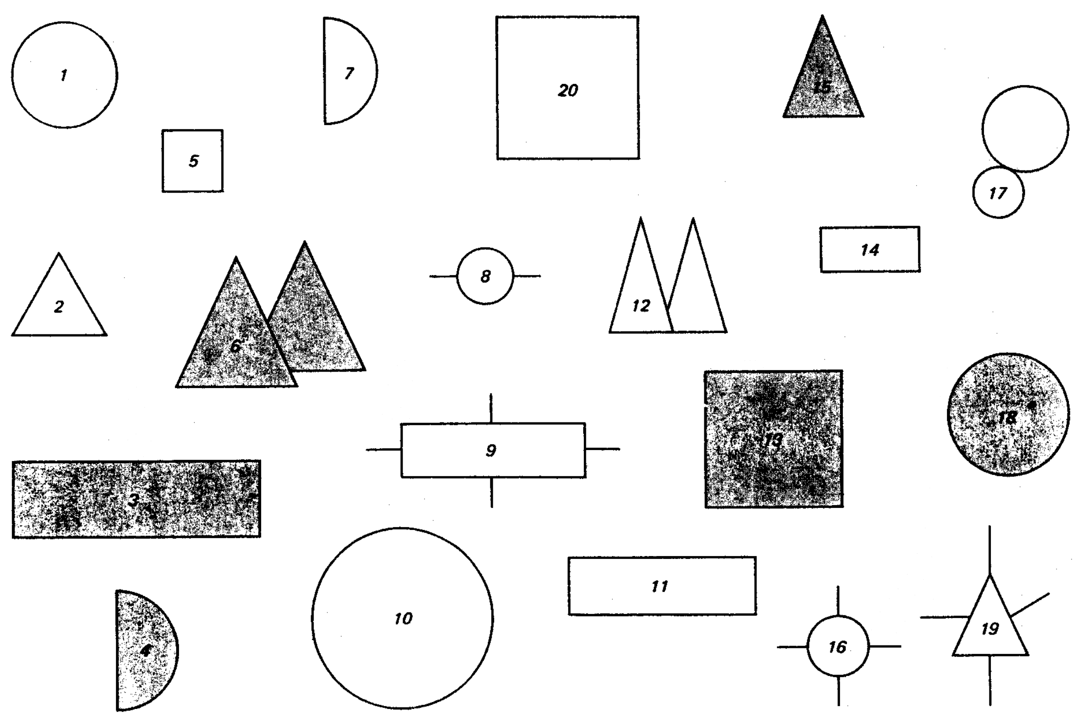
____

b. If considered in biological terms, what classification category would each individual figure

represent? ____

c. What classification category would the entire group of figures represent? ____________________

Cut the figures apart. Be sure that the identifying number stays with the figure. Assemble the figures into two groups based on a common characteristic. For instance, put all figures with curved lines into one group. The second group, then, will be figures with straight lines.



d. By thus separating the figures into two smaller groups, what classification category has been achieved? ______________________________

You should now have in the straight line group 12 straight-line figures: 1 rectangle and 1 triangle with lines projecting from them and 10 others being shaded or unshaded triangles, squares or rectangles. The group of figures with curved lines, representing the other phylum, will not be used further in this part of the investigation.

Using the characteristic of lines projecting from the figures, divide the 12 figures into two groups.

e. In this division, what classification category has been achieved?

____

f. What characterizes the remaining 10 figures? ______________________________

____

____

Separate the shaded figures from the unshaded figures. (Save the shaded figures for later use.)

g. What classification category has been achieved? ______________________________

h. What characterizes the remaining 6 figures? ______________________________

____

Separate the triangles from the other 4 figures. (Save the triangles for later use.)

i. What classification category does each group represent?

____

The remaining 4 figures can be divided into two smaller groups on the basis of being squares or rectangles. Make the separation and save the rectangles.

j. What classification category is represented by the group of squares and the group of rectangles?

____

The group of squares should now have in it a large square and a small square. Make the final separation on the basis of the size of the squares.

k. What classification category do you now have? ______________________________

In this classification, the genus category contains but two distinct species. In biological classifications of organisms, a genus contains several related but distinct species.

l. How are the figures (species) related? ______________________________

m. How are the figures different? ____

____

Part II: Completing a Key to Straight-Line Figures

Classification keys are usually based on pairs of opposing statements. Each pair of statements is increasingly specific in describing the item to be identified. Using the characteristics observed in Part I, fill in the blanks of the key with the characteristic needed to complete each pair of statements. The number in the column at the right refers you to the next pair of statements. When you come to "Fig.#_____," insert the number of the figure being described.

KEY TO KINGDOM OF FIGURES

1a. All figures have curved lines .... Curved figures

1b. All figures have ____________ lines 2

2a. All figures have projecting lines 3

2b. All figures have ______ projecting lines 4

3a. Figure is a triangle with lines .... Fig.#______________

3b. Figure is a ______________ with lines .... Fig.#______________

4a. Figures are shaded 5

4b. Figures are not _______________ 8

5a. Figures are triangles 6

5b. Figures are ___________ or ____________ 7

6a. Figure is ____________ triangle .... Fig.#______________

6b. Figure is _____________ triangles .... Fig.#______________

7a. Figure is a _____________ .... Fig.#______________

7b. Figure is a ______________ .... Fig.#______________

8a. Figures are triangles 9

8b. Figures are ___________ or ____________ 10

9a. Figure is __________ triangle .... Fig.#______________

9b. Figure is ___________ triangles .... Fig.#______________

10a. Figures are squares 11

10b. Figures are ___________________ 12

11a. _______________ square...Fig.# ______________

11b. _______________ square...Fig.# ______________

12a. Figure is _______________ rectangle..Fig.# ______________

12b. Figure is ________________ rectangle..Fig.# ______________

After completing the key, blacken the number of each figure and write the number on the back. Mix the figures and use the key to identify each of the 12 figures by number (species). If you can correctly identify each figure by number, you have accurately completed the key.

Part III: Using a Classification Key to Identify Certain Species of Fish

Study the terms defined below. All of these refer to structures of fish.

TERMS REFERRING TO THE STRUCTURE OF FISH

barbel--a fleshy projection from the lips or head

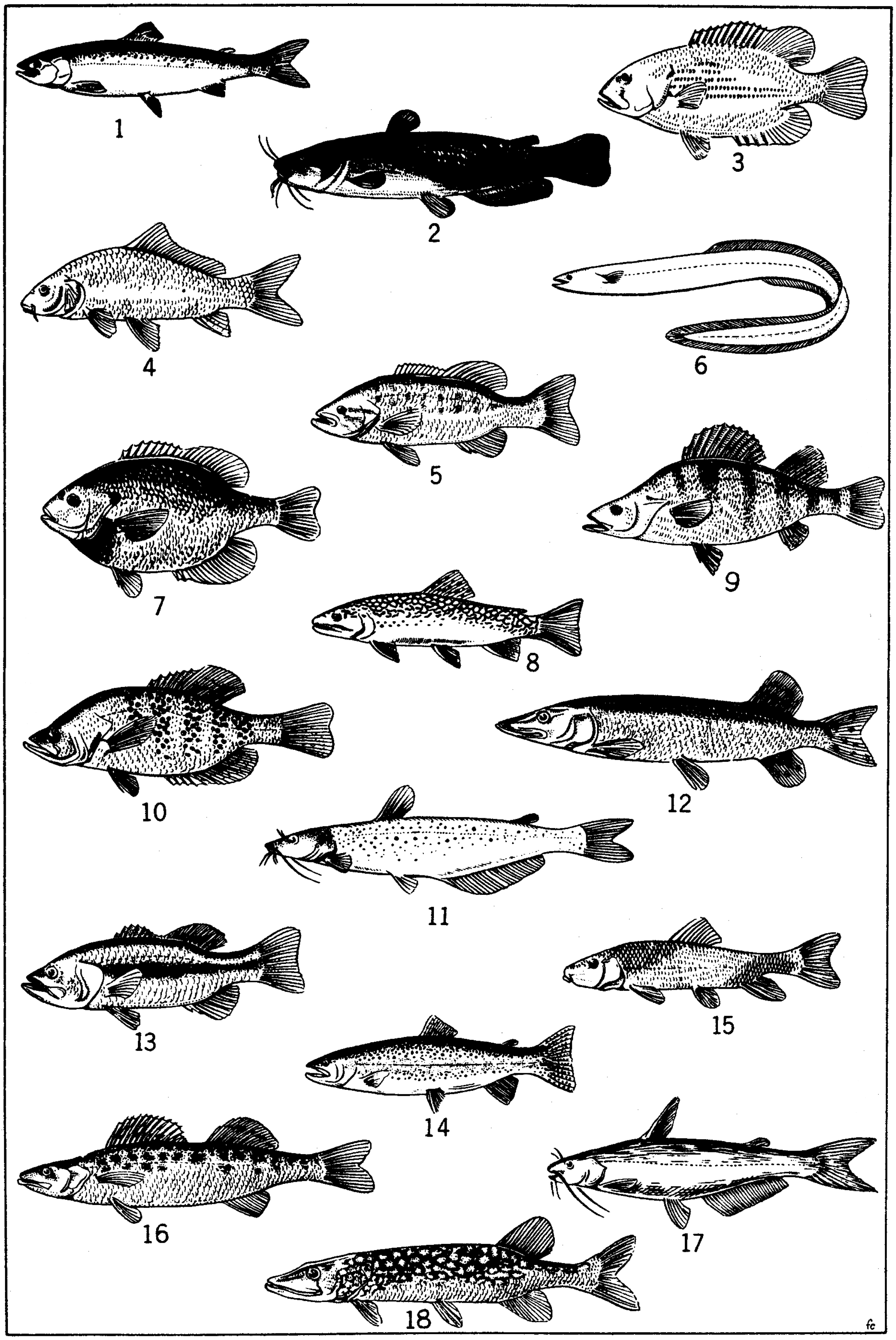
FINS

adipose--a small fin on the top mid-line of the body near the tail fin
anal--a fin along the lower mid-line of the body near the tail fin
caudal--tail fin
dorsal--the fin or fins along the top mid-line of the body
pectoral--the paired fins nearest the head, corresponding to front legs or arms
pelvic--the paired fins nearest the tail, corresponding to hind legs
scales--overlapping growths of the skin

Closely examine one of the drawings of a fish shown on the next page. Read both statements listed under number 1 in the classification key. One of these statements should describe the fish you have chosen; the other should not. Refer to the number after the statement that fits your fish and look for that number in the key. Again select the statement that describes the fish you picked. Continue through the key until you come to a name after one statement. This should be the name of the fish you picked. Practice using the key to identify several of the fish shown.

Example:

Suppose you want to find the name of fish number 2. Look at the classification key. Note that each numbered item presents two possibilities. We see that our fish has no scales, or at least we cannot see any. So we choose item 1b. This refers us to number 12. So we go down the page to number 12. Our fish is not elongated or snakelike (item 12b), so we go to number 13 of the key. The fish we are classifying has barbels growing from its lips and the top of its head (item 13a), so we go to number 14 of the key. Since our fish has a caudal fin that is rounded, and a blunt head, we see that it is the *Bullhead Cathead Catfish* (also known as *horn pout* in some parts of the country.)



Native Fish

CLASSIFICATION KEY TO CERTAIN FISH

1a.	Body noticeably covered with scales	2
1b.	Scales not covering body or too small to be seen	12
2a.	Dorsal fin single	3
2b.	Dorsal fins two or more, joined or separated	6
3a.	Body more than four times as long as broad (top to bottom); front edge of dorsal fin far back on body; mouth large, hinge back of eye	4
3b.	Body less than four times as long as broad; front edge of dorsal fin about midway between head and tail; mouth not large, hinge in front of eye	5
4a.	Dark lines forming netted design on body; fins not spotted	Pickerel
4b.	Body covered with yellow spots; fins spotted	Northern pike
5a.	Mouth turned downward; barbels absent; dorsal fin not elongated	White sucker
5b.	Mouth not turned downward; barbels present; dorsal fin elongated	Carp
6a.	Two dorsal fins separated, the anterial spiny and the posterior soft	7
6b.	Two dorsal fins united, forming an anterior spiny portion and a posterior soft portion	8
7a.	Top of head concave, forming a hump in front of dorsal fin; dark vertical bars on body	Yellow perch
7b.	Top of head not concave, body sloping to dorsal fin and not forming a hump; dark blotches on body	Wall-eyed pike
8a.	Body more than three times as long as broad	9
8b.	Body less than three times as long as broad	10
9a.	Hinge of jaws behind the eye; notch between spiny and soft dorsal fin deep and nearly separating into two fins	Large-mouth black bass
9b.	Hinge of jaws below the eye; notch between spiny and soft dorsal fin not nearly separating into two fins	Small-mouth black bass
10a.	Mouth large, hinge below or behind eye	11
10b.	Mouth small, hinge in front of eye	Bluegill
11a.	Five to seven spines in dorsal fin; dark spots forming broad vertical bars on sides	White crappie
11b.	Ten or more spines in dorsal fins; sides flecked with dark spots	Rock bass (Redeye)
12a.	Body much elongated and snakelike; dorsal, caudal and anal fins continuous	Eel
12b.	Body not elongated and snakelike; dorsal, caudal and anal fins separate; adipose fin present	13
13a.	Barbels growing from lips and top of head; head large and broad	14
13b.	Barbels lacking; head not large and broad	16
14a.	Caudal fin deeply forked; head tapering	15
14b.	Caudal fin rounded or slightly indented but not forked; head blunt	Bullhead catfish
15a.	Dorsal fin rounded at top; body silvery, speckled with black markings	Channel catfish
15b.	Dorsal fin long and pointed at top; body bluish-gray without speckles	Blue catfish
16a.	Caudal fin deeply forked; back not mottled and with few spots	Atlantic salmon
16b.	Caudal fin square or slightly indented; back mottled or spotted	17
17a.	Back and caudal fin spotted; broad horizontal band along sides	Rainbow trout
17b.	Back mottled with dark lines; caudal fin not spotted; fins edged with white	Brook trout

Part IV: Summary

a. Based on what you have learned in this investigation, discuss how classification is a useful tool for a biologist. ____

____

____

____

Fill in the blanks:

b. A group of closely related species is a ______________________________

c. A subdivision of a family is a ______________________________

d. The largest of the classification categories is the ______________________________

e. The most specific of the classification groupings is the ______________________________

f. A group of closely related classes is a ______________________________

g. The subdivision of an order is the ______________________________

h. A ____________________ is composed of several closely related orders.

Part V: Investigations On Your Own

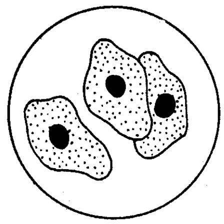
Select commonly seen groups of related objects (automobiles, canned goods, etc.) and classify them into the major classification categories. Construct a key to their identification. Try your classification key with some individuals in your class to see how well it works.

THE ORGANISMS

AG 530 - B

ANSWER SHEET TO LABORATORY EXERCISES

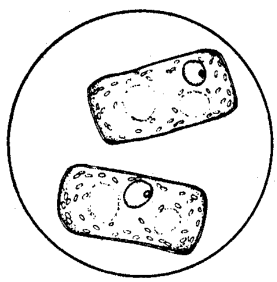
<u>Lab #1</u>
<u>Part I:</u>
Step 5:



Human tongue cells

Step 7: Drawings will very depending on slide available.

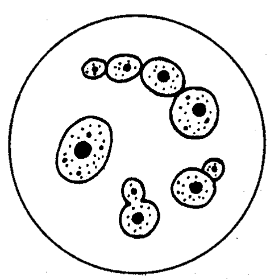
Part II:
Step 5:



Plant cells

Step 7: Drawing will vary depending on slides available.

Part III:
Step 4:



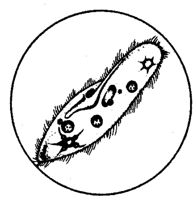
Yeast cells

Step 6: Drawings will very depends on slides available.

Part IV:

3. a. Students should see several

Step 4:



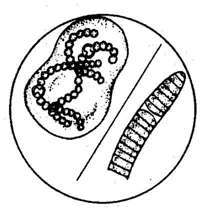
Paramecium

Step 6: Drawings will vary depending on slides available.

Part V:

3. b. Nuclei

Step 4:



Nostoc / Oscillatoria

Step 6: Drawing will vary depending on slides available.

Table I:

Animal cells:	Generally smaller than most other cells and irregular in shape. Animal cells lack cell walls and plastids. Some may have small vacuoles (vesicles) and cilia.
Plant cells:	Large, generally box-shaped cells with cell walls, larger vacuoles and plastids.
Fungal cells:	Single or multicellular organisms of variable size and shape. Lack plastids but may have vacuoles.
Protist cells:	Single cells of variable size and shape. Some may have cell walls, chloroplasts, cilia and more than one nucleus.
Moneran cells:	Single cells of variable size and shape with cell wall. Lack nuclear membrane. Some may have bacterial flagellum.

Part VI:

1. Cell membrane, genetic material, cytoplasm

2. No. Cells within the same kingdom vary in size; cells in different kingdoms are often similar in size.

3. Table II: Cell features of each kingdom

Cell Types	Features that differentiates cell
Animal Cells	Lack cell wall; have centromere
Plant Cells	Multicellular with chloroplasts
Fungal Cells	Gaps in cell walls of certain fungi
Protist Cells	More than one nucleus per cell
Moneran Cells	Lack nucleus

4. Table III: Function of certain cell structures

Cell Type	Cell Structure	Function for cell
Moneran cell: *Nostoc*	Slimy outer coating	Allows cells to adhere to one another in long strands
Paramecium	Cilia	Allow organism to move; propel food into *Paramecium's* mouth
Fungal cell	Discontinuous cell wall	Allows cytoplasm and other cellular material to move from cell to cell; aids transport within organism
Leaf cell	Chloroplast	Structure that manufactures glucose
Tongue cell	Centromere	Aids cell division

Lab #2

Part I:

a. Figures with straight lines, curved lines; some triangles, squares or rectangles; lines projecting from them; single or double figures; shaded or unshaded
b. Species
c. The kingdom of figures
d. Phylum
e. Class
f. Shaded or unshaded squares, rectangles, single or double triangles
g. Order
h. Triangles or squares and rectangles
i. Family
j. Genus
k. Species
l. Both figures (species) are squares.
m. One figure is larger than the other.

Part II:

1b. straight
2b. no
3a. 19
3b. rectangle, 9
4b. shaded
5b. squares, rectangles
6a. one, 15
6b. two, 6
7a. square, 13
7b. rectangle, 3
8b. squares, rectangles
9a. one, 2
9b. two, 12
10b. rectangles
11a. Large, 20
11b. Small, 5
12a. large, 11
12b. small, 14

Part III:

1. Atlantic salmon
2. Bullhead catfish
3. Rock bass (Redeye)
4. Carp
5. Small-mouth black bass
6. Eel
7. Bluegill
8. Brook trout
9. Yellow perch
10. White crappie
11. Channel catfish
12. Northern pike

13. Large-mouth black bass
14. Rainbow trout
15. White sucker
16. Wall-eyed pike
17. Blue catfish
18. Pickerel

Part IV:

a. The classifying of organisms enables biologists to organize and by grouping living organisms according to characteristics shared by the organisms, biologists are able to observe natural relationships and study characteristics of the group as a whole.
b. Genus
c. Genus
d. Kingdom
e. Species
f. Phylum
g. Family
h. Class

THE ORGANISMS

AG 530 - B

UNIT TEST

Name ______________________________ Score ______________________________

1. Match the terms on the right with the correct definitions by placing the appropriate numbers in the blanks provided.

_____a.	Cell type that has a nucleus without a membrane around it. The nuclear material floats freely within the cell	1. Binomial nomenclature
		2. Prokaryote
_____b.	The group of individuals of a given species inhabiting a specified geographic area	3. Eukaryote
_____c.	A member of a class of vertebrates characterized by having hair and mammary glands; includes such diverse types as shrews, bats, cats, whales, cattle and humans	4. Adaptation
		5. Autotrophs
		6. Biogenesis
_____d.	Organisms that manufacture organic nutrients from inorganic raw materials	7. Biome
_____e.	Association of unicellular or multicellular organisms of the same species	8. Chordate
		9. Colony
_____f.	Occurrence of several distinct phenotypes in a population	10. Community
_____g.	An assemblage of populations that live in a defined habitat and interact in various ways with one another organisms	11. "Consumer"
_____h.	Those elements of an ecosystem that eat other plants or animals	12. Ecology
_____i.	Organisms which cannot synthesize their own food from inorganic materials	13. Ecosystem
		14. Epigenesis
_____j.	The gradual loss of vigor through the aging process	15. Fossils
_____k.	The phylum of animals characterized by the presence of a notochord at some stage of development	16. Genus
_____l.	The theory that all living things come only from preexisting living things	17. Herbivore
		18. Heterotrophs
_____m.	Large, easily differentiated community unit arising as a result of complex interactions of climate, other physical factors and biotic factors	19. Mammal

______n. A system invented by Carolus Linnaeus for classifying organisms. Each organism is assigned a two-word Latin name

______o. The theory that development proceeds from a structureless cell by the successive formation and addition of new parts which do not preexist in the fertilized egg

______p. Taxonomic classification in which closely related species are grouped together

______q. A characteristic which enables the organism to survive in its environment

______r. Cell type that has an organized nucleus surrounded by a membrane

______s. Any remains of an organism that have been preserved in the earth's crust

______t. The mating of individuals of unrelated strains

______u. The study of the interrelations between living things and their environment

______v. The evolutionary history of a group of organisms

______w. The visible expression of the hereditary constitution of an organism

______x. Behavior pattern or mold in which one organism (usually a male) delineates a territory of his own and defends it against intrusion by other members of the same species and sex

______y. A plant-eating animal

______z. The unit of taxonomic classification, a population of similar individuals, alike in their structural and functional characteristics

______aa. The science of naming, describing and classifying organisms

______bb. All of the organisms of a given area

______cc. Specialized cells which together perform certain special functions

20. Outbreeding
21. Phenotype
22. Phylogeny
23. Polymorphism
24. Population
25. Senescence
26. Species
27. Taxonomy
28. Territoriality
29. Tissue

2. List the seven categories of the classification system in order from largest to smallest.

   a.______________________________

   b. ______________________________

   c.______________________________

   d. ______________________________

   e.______________________________

   f.______________________________

   g. ______________________________

3. Outline the classification system for humans.

   a.______________________________

   b. ______________________________

   c.______________________________

   d. ______________________________

   e.______________________________

   f.______________________________

   g. ______________________________

4. List three traits that help place an organism into a kingdom.

   a.______________________________

   b. ______________________________

   c.______________________________

5. List and define the five kingdoms in the classification system.

   a.______________________________

   ____

   ____

   b. ______________________________

   ____

   ____

   ____

c.____

____

____

d. ____

____

____

e.____

____

____

6. State two biological principles for each of the following categories that demonstrate commonness among organisms.

Environmental interaction

a.____

b. ____

Genes

a.____

b. ____

Life

a.____

b. ____

Physical and chemical reactions

a.____

b. ____

Evolution

a.____

b. ____

Cells

a.____

b. ____

Development

a.____

b. ____

THE ORGANISMS

AG 530 - B

ANSWERS TO TEST

1.

a.	2	k.	8	u.	12
b.	24	l.	6	v.	22
c.	19	m.	7	w.	21
d.	5	n.	1	x.	28
e.	9	o.	14	y.	17
f.	23	p.	16	z.	26
g.	10	q.	4	aa.	27
h.	11	r.	3	bb.	13
i.	18	s.	15	cc.	29
j.	25	t.	20		

2. Kingdom; Phylum; Class; Order; Family; Genus; Species

3.

a.	Kingdom	--	Animalia
b.	Phylum	--	Chordata
c.	Class	--	Mammalia
d.	Order	--	Primates
e.	Family	--	Hominidae
f.	Genus	--	Homo
g.	Species	--	Homosapiens

4. Kinds of cells in organism: prokaryote or eukaryote; How organism obtains its food; How organism reproduces and develops

5.
   a. Animal kingdom (Animalia): Eukaryotic cells; Multicellular organisms; Move about to obtain food; Digest food inside body
   b. Plant kingdom (Plantae): Eukaryotic cells; Multicellular organisms; Produce own food; Cannot move about
   c. Fungi kingdom: Eukaryotic cells; Mostly multicellular organisms; Do not move about; Obtain food by absorbing it from living or dead organisms
   d. Monera kingdom: Prokaryotic cells; Mostly one-celled organisms; Produce own food or obtain it from outside source
   e. Protista kingdom: Eukaryotic cells; Many are one-celled; Produce own food or obtain it from outside source

6. Answer should include two of the following for each category:

   Environmental interaction: Cells in organisms affect and interact with each other; Cells and organisms react and interact with their environment

   Genes: All organisms pass on function and structure to their offspring; The combination of gene characteristics is variable; The DNA contains the genetic code in a linear arrangement; The RNA is the means of replicating and passing on the genetic code

   Life: Life comes from life; Reproduction is required for life continuation

   Physical and chemical reactions: Physical and chemical laws are obeyed by living creatures; All living organisms use the common molecular, biological and chemical reaction means; All living organisms must capture, store and release energy to sustain life

Evolution: All organisms arise from preexisting organisms; Natural selection is responsible for organism evolution; The embryos of developing animals tend to resemble the embryos of their ancestors; Organisms adapt to their habitat through selection from environmental pressures

Cells: Cells are the fundamental units of life; Cells contain structures which are differentiated and interdependent

Development: All organisms exhibit characteristics of cell enlargement or cell division or both; This characteristic is termed growth; All organisms develop a characteristic body plan

CELL STRUCTURE

AG 530 - C

UNIT OBJECTIVE

After completion of this unit, students should be able to define terms associated with cell structure and state the basic ideas of the cell theory. Students should also be able to list and describe the cell components and functions and the differences between plant and animal cells. This knowledge will be demonstrated by completion of laboratory exercises and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with cell structure to their correct definitions..
2. List the three things which define a cell.
3. State the four basic ideas of the cell theory.
4. List the three ways that cells can differ from one another.
5. Label the correct parts of an animal cell.
6. List and describe the cell components and their functions.
7. Name and describe the functions of the cell organelles.
8. Describe the differences between plant and animal cells.
9. List and describe the functions of the major types of specialized animal cells.
10. Identify and describe cells.
11. Study cell parts.
12. Identify differences between plant and animal cells.

CELL STRUCTURE

AG 530 - C

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Make transparencies and necessary copies of materials.

   B. Provide students with objective sheet and discuss.

   C. Provide students with information sheet and discuss.

   D. Provide students with laboratory exercises.

   E. Discuss and demonstrate laboratory exercises.

   F. Review and give test.

   G. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Diagram of a "Typical" Animal Cell

      2. TM 2--Types of Animal Cells

      3. TM 3--Formed Elements of Blood

   E. Instructor notes for laboratory exercises

   F. Laboratory exercises

      1. LE 1--What Are Cells?

      2. LE 2--Studying Cell Parts

      3. LE 3--Animal and Plant Cell Differences

   G. Answers to laboratory exercises

   H. Test

   I. Answers to test

III. Unit references

A. *Agricultural Education Curriculum*, College of Agriculture, University of Illinois, Urbana, Illinois, 1989.

B. Otto, James H., Towle, Albert, *Modern Biology*, Holt, Rinehart and Winston, Publishers, New York, 1985.

C. Slesnick, Irwin L.; Balzer, Leron; McCormack, Alan J.; Newton, David E.; Rasmussen, Fredrick A.; *Biology*, Scott, Foresman and Company, Glenview, Illinois, 1985.

CELL STRUCTURE

AG 530 - C

INFORMATION SHEET

I. Terms and definitions

A. Organelles--Special structures in the cytoplasm. Each performs one or more special tasks to help keep the cell alive, e.g., the mitochondria, Golgi complex, ribosomes, contractile vacuole, and so on

B. Nerve--Composed of many neurons bunched together

C. Neuron--Nerve cells that transmit messages from one part of the body to another

D. Adenosine Triphosphate (ATP)--A chemical compound produced in the mitochondrion. Stores energy that is used to carry out cellular functions

E. Chromosomes--Molecules of DNA wrapped around proteins, which are found in the nucleus; control cell functions and the inheritance of traits

F. Centriole--Small, dark-staining organelle lying near the nucleus in the cytoplasm of animal cells

G. Differentiation--A process of changing a relatively unspecialized cell to a more specialized cell

H. DNA--Deoxyribose nucleic acid; present in chromosomes and contains genetic information

I. Erythrocyte--Red blood cells

J. Golgi bodies--Cell organelle found in the cytoplasm of all cells except mature sperm and red blood cells

K. Hemoglobin--The red, iron-containing, protein pigment of the erythrocytes that transports oxygen and carbon dioxide and aids in regulation of pH

L. Leukocytes--White blood cells; colorless cells exhibiting phagocytosis and ameboid movement

M. Lysosome--Intracellular organelle present in many animal cells; contains a variety of hydrolytic enzymes that are released when the lysosome ruptures

N. Messenger RNA--A particular kind of ribonucleic acid which is synthesized in the nucleus and passes to the ribosomes in the cytoplasm; combines with RNA in the ribosomes and provides a template for the synthesis of an enzyme or some other specific protein

O. Microtubule--A cytoplasmic organelle, an elongated slender tube; contains a specific protein, tubulin

P. Mitochondria--Spherical or elongated intracellular organelles which contain the electron transmitter system and certain other enzymes

Q. Nucleolus--A spherical body found within the cell nucleus believed to be the site of synthesis of ribosomes

R. Nucleus--The organelle of a cell containing the hereditary material

S. Plasma membrane--A living, functional part of the cell through which all nutrients entering the cell and all waste products or secretions leaving it must pass

T. Platelet--A small, colorless blood corpuscle of mammals that plays an important role in blood coagulation

U. Reticulum--A network of fibrils or filaments, either within a cell or in the intercellular matrix

V. Ribonucleic acid (RNA)--Nucleic acid containing the sugar ribose; present in both nucleus and cytoplasm and of prime importance in the synthesis of proteins

W. Ribosomes--Minute granules composed of protein and ribonucleic acid; the site of protein synthesis

X. Transfer RNA--A form of RNA which serves as adaptor molecules in the synthesis of proteins. An amino acid is bound to a specific kind of transfer RNA and then arranged in order by the complementary nature of the nucleotide triplet (codon) in template or messenger RNA and the triplet antocodon of transfer RNA

Y. Vacuole--Small space within a cell, filled with watery liquid and separated by a vacuolar membrane from the rest of the cytoplasm

II. Cell

A. Specific, separate mass of living material that is surrounded by a semi-permeable membrane

B. The basic structural unit of life

C. All organisms (except viruses) are composed of one or more cells

III. Cell theory

A. All organisms are made of one or more cells

B. Cells are alike in their structure and composition

C. All cells carry out similar functions that keep them alive

D. New cells arise only from old cells, usually by dividing into two equal parts at regular intervals

IV. How cells differ from each other

A. Size

B. Shape

C. Organization

V. Animal cell diagram (Transparency 1)

VI. Cell components and functions

A. Plasma membrane (Cell membrane)

1. Encloses the cell, separating it from the outside environment

2. Regulates passage of liquids into and out of the cell

B. Nucleus

1. Contains the heredity information that directs all cell activity

2. Contains the nucleolus

C. Nucleolus

1. Produces ribonucleic acids (RNA)

2. Assembles subunits of ribosomes

D. Cytoplasm

1. Living material inside the cell

2. Assists in transport of substances within the cell

VII. Cell organelles

A. Endoplasmic reticulum

1. Cell skeletal system

2. Serves as transport network and storage area for substances within the cell

B. Ribosome--Manufactures cell proteins

C. Golgi apparatus--Packages and distributes proteins for storage within cell and transport out of cell

D. Lysosome

1. Breaks down food and foreign material

2. Removes waste materials from cell

E. Mitochondrion

1. Serves as powerhouse for cell--releases body heat and energy

2. Produces ATP (Adenosine Triphosphate) in which energy for cell activities is stored

F. Vacuole

1. Supports cell wall of plant cells through internal pressure

2. Digests food materials, remove wastes and stores substances

G. Microtubules (Centrioles)

1. Long, thin, hollow cylinders found in many cells

2. Give support to cell, help keep its shape

3. Aid in moving the cell or moving other substances past the cell

H. Microfilaments

1. Thin, tiny, threadlike fibers

2. Contract like muscles

3. Aid in cell movement

I. Microvilli

1. Modified plasma membrane that forms fingerlike projections for more surface area

2. Found in intestines

VIII. Differences between plant and animal cells

A. Plant cells

1. Cell wall

a. Made of cellulose

b. Gives support and shape

2. Plastids

a. Leucoplasts

(1) Colorless structures where glucose is changed into starch

(2) Storage for starch, lipids or proteins

b. Chromoplasts

(1) Manufacture and store pigments

(2) Give fruits, vegetables and leaves their bright color

c. Chloroplasts

(1) Contain green chlorophyll pigment

(2) Site of photosynthesis (food production) in the plant cell

B. Animal cells

1. Microtubules give the cell its shape

2. Centrioles

a. Located near nucleus

b. Function in cell division for reproduction

IX. Specialized animal cells (Transparency 2)

A. Blood cells (Transparency 3)

1. Red blood cells contain hemoglobin to carry oxygen to cells and carbon dioxide from cells

2. White blood cells--important in body defense

a. Phagocytic leukocytes flow to the infection site and engulf the bacteria

b. Lymphocytes attack foreign cells directly or secrete an enzyme that immobilizes foreign substances

c. Many white blood cells die while defending the body and make up pus

3. Platelets--important in blood clotting

B. Nerve cells--Carry messages and direction throughout the nervous system

C. Muscle cells

1. Striated--Skeletal or voluntary muscle cells (controlled by conscious choice)

2. Smooth--Involuntary muscle cells found in the walls of the digestive tract, blood vessels, urinary organs and reproductive organs

3. Cardiac--Conduct impulses within the heart

D. Bone cells--Make up most of the skeleton on vertebrate animals

E. Fat cells

1. Make up fat (adipose tissue) which is deposited around internal organs, between muscle branches and under the skin

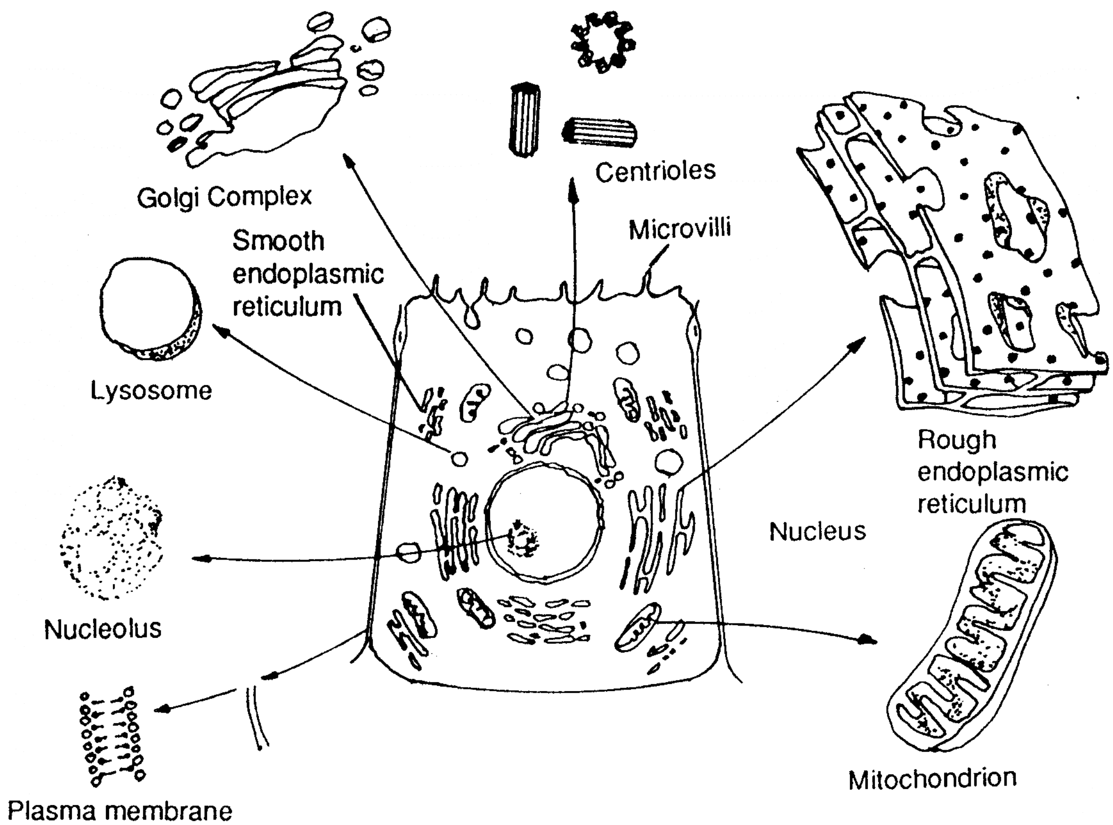
2. Supplies reserve energy when food supply is scarce or sporadic

F. Gamete (sex cells)

1. Reproductive cell

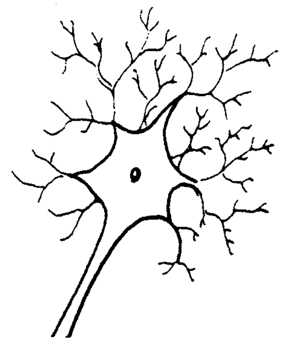
2. An egg or sperm

DIAGRAM OF A "TYPICAL" ANIMAL CELL



Types of Animal Cells

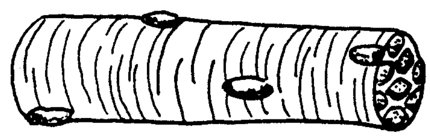
Nerve cell, showing cell body (soma) surrounded by numerous dendritic extensions and a portion of the axon extending below.



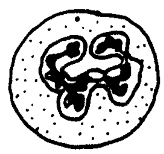
Epithelial cell from lining of the mouth.

Smooth musle cell from intestinal wall.

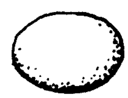
Striated muscle cell from skeletal muscle.



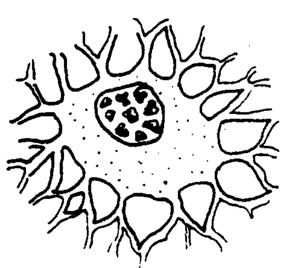
White blood corpuscle.



Red blood corpuscle (erythrocyte).

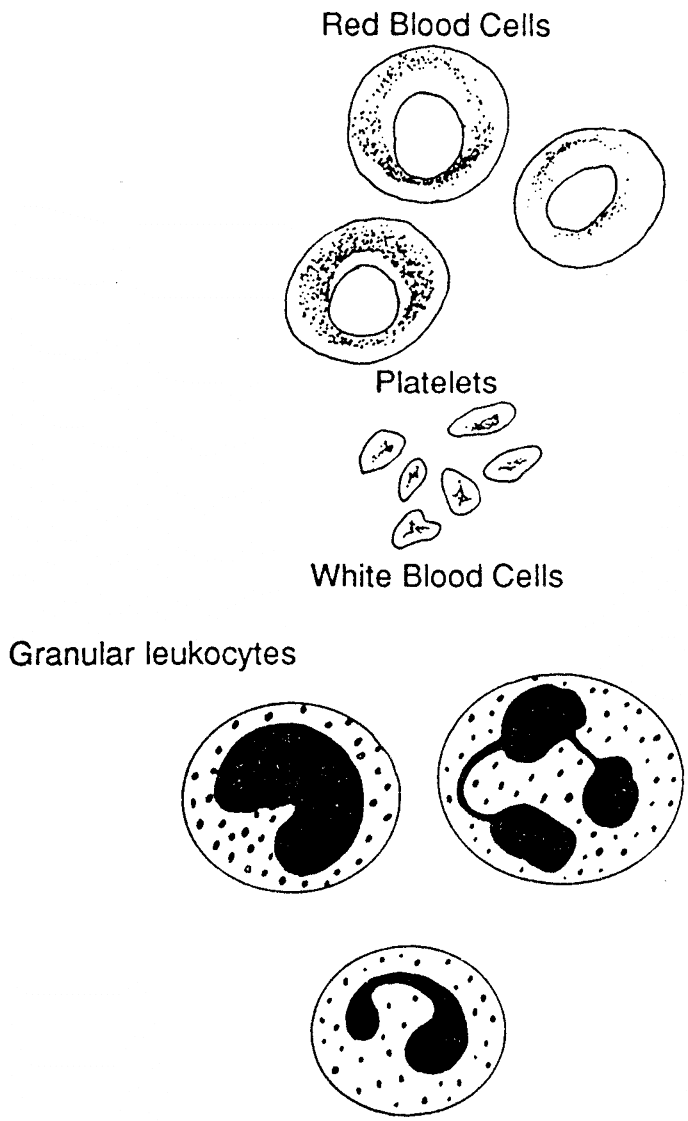


Bone cell.



Human spermatozoon. (Not drawn to the same scale.)

Formed Elements of Blood



CELL STRUCTURE

AG 530 - C

INSTRUCTOR NOTES FOR LABORATORY EXERCISES

Lab #1

Point out to students that the cell theory was not generally accepted in Hooke's time.

Cork cells are excellent for use in observing the cell wall structure. Ask students to think about whether cork cells are living or nonliving.

Students may have to make several attempts before slicing the cork thin enough for observation. It is easier to use large corks when cutting.

Part I:

Step g: It is important that students understand that the cork cells are not living and therefore are lacking cellular structures.

Part II:

Caution students to avoid using too much water in the preparation of the slide. The drop of water should come to the edge of the cover glass.

Step d: Point out to students that iodine will enable them to see the parts of the cell more clearly.

Part III:

Point out to students that the chromosomes are only visible when the cell is dividing.

Lab #2

Sugar helps prevent the exploding of the nuclei and chloroplasts. Make a .58 M sucrose solution as directed below. Buffering this solution will also prevent the explosion of the cell parts. To buffer the solution add 0.1 g of potassium bisulphate (KH_2PO_4). The pH should be about 5.7.

Solution preparation:

The following general instructions apply for the preparation of most solutions: Solvents should be added to solutes. Use distilled water, not tap water, for all reagents. When preparing an acid or base solution, *slowly* add the acid or base to the water. Never add water to a concentrated acid or base.

To make percentage solutions measure 1 ml of solute per percentage. Add the solute to enough solvent to make 100 ml of solution. When dissolving a solid in water, measure 1 g of solute per percentage and mix the solute with enough water to make 100 ml of the solution.

Iodine solution (also available ready-made)

Dissolve 5.0 g of potassium iodide [KI] and 1.5 g of iodine crystals in 500 ml of distilled water. Store in brown bottle or other glass container that shields the liquid from light. *CAUTION: Iodine dust and vapors are toxic and irritating. Avoid body contact and inhalation of fumes. Should body contact occur, flush immediately with water.*

Sucrose solution

0.58 M: Put 99.5 g of sucrose in a flask. Add enough distilled water to make exactly 500 ml of solution. Stir until sucrose is dissolved, heating if necessary. Refrigerate. Quantity is enough for 50 students.

Part I:

You may wish to prepare the pea mixture ahead of time and give 30 to 50 ml to each student for filtration.

If time and availability of centrifuge are limited, prepare the filtrate and centrifuge it ahead of time for the students. The layers will remain separated and intact for over 24 hours. (Longer if refrigerated.)

Supervise the students' placement of test tubes in the centrifuge so that the centrifuge is balanced.

Lab 3:

Students will specifically observe the cell walls of plant cells and the plasma membranes of animal cells. They will also observe the food-producing organelles of plants--the chloroplasts.

Part I:

Point out to students that such movement (cyclosis) often requires observing one cell for several minutes.

On diagram: Students can stain the *Elodea* with iodine and observe one of the spike cells. The nucleus should become more clearly defined with iodine stain.

Part II:

Human cheek cells are excellent for the observation of cell membranes as well as cytoplasm.

Part II:

On diagram: Stress to students that although they appear different, both cork and cheek cells are the basic units of life.

CELL STRUCTURE

AG 530 - C

LABORATORY EXERCISE #1--WHAT ARE CELLS?

Name ______________________________ Score ______________________________

Materials needed

Microscope
Slides
Cover glasses
Forceps
Bottle cork
Razor blade
Onion
Scalpel
Iodine stain

Part I: Observing Cork Cells

More than 300 years have passed since Robert Hooke first described cork cells in his book *Micrographia*. In this investigation, you will repeat Hooke's early experiment with cork cells.

Carefully shave a very thin section from a bottle cork with a razor blade. Prepare a wet mount slide of the cork slide. Examine the specimen under low power, studying it in different positions. In the space provided, draw a sketch of what you observe.

Now examine the specimen under high power. Draw the cells as you see them under high power.

a. How would you describe the units that compose the cork?

b. Are these units of similar shape?

c. Are they of similar size?

d. Are they filled with any material?

e. If so, explain what that content appears to be.

f. Are there spaces between the cells?

g. Do you think that these cells are alive?

Part II: Onion Cells

The epidermis of the onion is ideal for cell study because it is composed of a single layer of cells. As you study these cells, you are looking into functioning units of living material.

Cut an onion lengthwise. Remove a thick scale and peel the delicate, transparent tissue from the *inner surface*. Cut a square of the tissue and mount it on a slide in a drop of water. (Note: Avoid wrinkling the tissue.) Add a cover glass. Examine the living cells under low power.

a. What is the shape of the cells?

b. Are they similar in shape?

c. What color is the living cytoplasm?

Carefully raise one side of the cover glass and add a drop of iodine stain.

d. What effect does iodine have on the cells?

Select one cell that shows the contents clearly. Move it to the center of the microscopic field. Using high power, examine all the parts of the cell.

e. What is the appearance of the cytoplasm?

f. What is the appearance of the nuclei?

g. Are the nuclei always in the same position in the cell?

____

h. Does the onion epidermal cell have depth? ______________________________

i. Explain your answer. ______________________________________

____

Draw the onion cells under high power.

Part III: Summary

a. What are the units of cork seen under the microscope? ____________________

____

b. How did the cork units differ from those of the onion epidermis? ______________

____

____

c. Why is an iodine stain used in this investigation? ______________________

____

d. Identify and give the function of the nucleus. __________________________

____

Part IV: Investigations On Your Own

1. Observe many different types of nonliving and living cells. Compare your findings to the cork and onion cells that you observed in this investigation. Draw sketches of the cells and their organelles.

2. It is possible to observe the mitochondria of some cells under the light microscope. Cut a strip of celery stalk containing "strings". Place this strip, with the inner surface up, in a 5% sucrose solution. Cut a thin strip from between the "strings". Observe the mitochondria. If you add a few drops of 0.001% Janus Green B solution, the mitochondria will stain a blue color. However, this color will quickly fade because of enzyme action.

CELL STRUCTURE

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LABORATORY EXERCISE #2--STUDYING CELL PARTS

Name ______________________________________ Score ___________________________________

Slesnick, Irwin L., *Biology Laboratory Manual*, Scott, Foresman and Company, 1985. Reprinted by permission of Scott, Foresman and Company.

Introduction

One way scientists study the insides of cells is by breaking cells apart and spinning them in an *ultracentrifuge*. The ultracentrifuge spins test tubes containing cellular materials at very high speeds. The rapid spinning breaks the cell walls and causes the heaviest cell parts to sink to the bottom of the test tube. Then, these cell parts can be removed for further study. Spinning the remaining material allows additional cell parts to be isolated for study. Though you probably do not have access to an ultracentrifuge, you can isolate and study some cell parts by spinning cellular material in a *centrifuge*. The centrifuge works on the same principle as the ultracentrifuge, but the centrifuge spins at lower speeds. In this laboratory exercise you will use a centrifuge to isolate parts of plant cells.

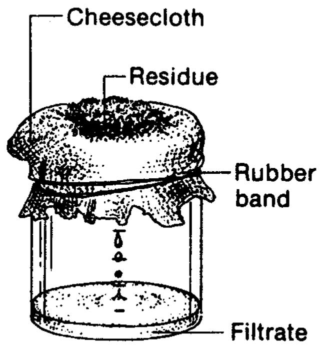
Materials needed

100 ml 0.58 M sucrose solution
50 ml fresh, green peas
Blender
Cheesecloth square, 12 cm x 12 cm
250-ml beaker
Rubber band
Stirring rod
Centrifuge tube
Centrifuge
5 microscope slides
Toothpick
2 ml iodine solution
5 coverslips
Compound microscope
4 disposable Pasteur pipettes
Colored pencils

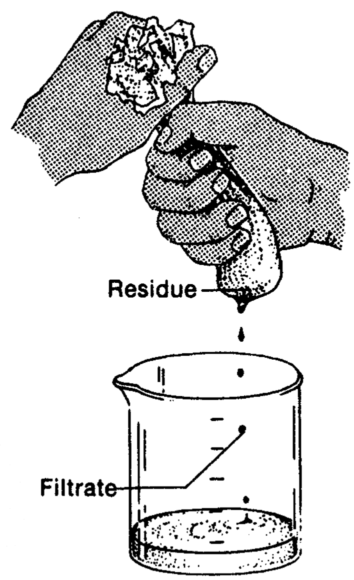
Part I: Procedure

1. Pour 100 ml of sucrose solution into a blender. Add about 50 ml of peas. Securely cover the blender with its fitted lid. Blend the mixture at highest speed for three minutes. The blending of this mixture will break the cell walls and release cell parts into the sucrose solution.

2. Loosely stretch a piece of cheesecloth over a beaker. Secure the cheesecloth with a rubber band. Pour the blended pea and sucrose mixture through the cheesecloth into the beaker, as shown in **a** on the following page. The liquid that passes through the cheesecloth is called the *filtrate*. The solid material that collects on top of the cheesecloth is called *residue*. If the cheesecloth becomes clogged and no longer allows liquid to pass through it, remove the rubber band, and fold the corners of the cheesecloth, as shown in **b.** Then, gently squeeze the pea and sucrose mixture so that more filtrate drips into the beaker.



a. Filtering pea mixture



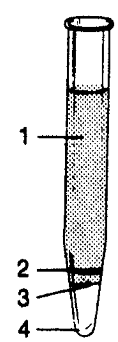
b. Squeezing residue

3. Stir the filtrate with a clean stirring rod. Fill a centrifuge tube three-quarters full of filtrate. Insert your tube and another student's tube, equally full of filtrate, into the holders opposite each other in the centrifuge. This placement balances the centrifuge and allows the centrifuge to spin evenly. Spin the centrifuge at the highest speed possible for ten minutes.

4. While your filtrate is spinning, make a wet mount slide of a small sample of residue, and stain the sample with iodine. *CAUTION: Avoid getting iodine on your hands. Iodine can stain your hands and clothes and is poisonous if ingested.*

5. View the stained residue under a microscope at low and high power. A blue-black color indicates the presence of starch. In the table below record if starch was present in the sediment. Sketch and label cell parts you recognize in the space provided in the Cell Parts Table.

6. After ten minutes, stop the centrifuge, and remove your centrifuge tube. The tube should contain four distinct layers of material. Observe these layers, and use colored pencils to draw them in **c**, below. Number the layers from top to bottom.



7. Use a pipette to carefully remove several drops of material from the lightest material at the top of the centrifuge tube. Place a drop of this material on a clean microscope slide. Stain this material with iodine, and add a coverslip.

8. Observe the stained material under low and high power. Record the results of the starch test in the table. Sketch what you see in the space in the table.

9. Repeat steps 7 and 8 for the other three layers.

Table. Cell Parts

Layer	Labeled sketch of cell parts observed	Results of starch test	Cell part	Function
Residue			Fibers	
1 (top)			Cell Wall	
2				
3				
4 (bottom)			Leucoplast	

Part II: Analysis

1. Complete the right half of the Cells Parts Table.

2. What does the iodine test indicate about the functions of certain cell parts?____________________

   ____

3. Which plant cell parts were not separated using this technique? Give reasons why you might not have been able to see these cell parts.

   ____

   ____

   ____

4. Rank the cell parts you observed in order of density from least dense to most dense. Explain how you knew the relative density of the cell parts.

   ____

   ____

   ____

CELL STRUCTURE

AG 530 - C

LABORATORY EXERCISE #3--ANIMAL AND PLANT CELL DIFFERENCES

Name ______________________________ Score ______________________________

Materials needed

Elodea leaves (*Anacharis*)
Microscope
Slides
Cover glasses
Medicine dropper
Colored pencils
Human cheek cells
Toothpick (flat type)
Methylene blue

Part I: Cells of a Leaf

Although most cells of plants and animals are similar in structure, there are a few major differences. In this investigation, you will observe these differences under the microscope.

Prepare a wet mount of an *Elodea* leaf. The whole leaf should be used. Examine the leaf under the low power of the microscope. Then select a portion of the leaf where the cells are particularly distinct. Center this portion in the microscope field. Bring it into focus under high power. Use the fine adjustment to observe the cells at various depths.

a. In which layer are the widest cells located? ______________________________

____

Observe the small, oval, green bodies that appear in the cells. These are the chloroplasts.

b. Are any of the chloroplasts moving? ______________________________

c. If you see movement, are all the chloroplasts moving in the same direction? ______________

d. Are they all moving at the same speed? ______________________________

e. Can you observe any structures for movement? ______________________________

f. Explain how the chloroplasts move. ______________________________

____

Draw some cells of an *Elodea* leaf. Use arrows to indicate the direction of chloroplast movement. Label your drawing, indicating the **cell wall, chloroplasts, cytoplasm and nucleus.**

Part II: Human Epithelial Cells

In this part, you will examine the cell structure of human epithelial (cheek) cells, and you will note the absence of the cell wall that was present in the elodea cells.

Gently scrape the inside of your cheek with a clean toothpick. Prepare a wet mount of the material that you have scraped from your cheek. Add a drop of methylene blue and a cover glass. Examine the cells under low power of the microscope. Switch to high power. Carefully look for the outer edge of the cytoplasm.

a. How does it compare with the outer edge of the elodea cells? ____________________

b. What is this outer edge called? ____________________

c. Describe the shape of the cheek cells. ____________________

d. In what ways do the cheek cells differ from the elodea cells? ____________________

____

____

e. Why did you use methylene blue in this investigation? ____________________

____

f. Describe the appearance of the cytoplasm. ____________________

____

In the space provided, draw a single cheek cell (high power) and label the **plasma membrane**, **cytoplasm**, and **nucleus**.

Part III: Summary

a. In what ways do elodea cells differ from human cheek cells? ______________________

____

b. What is the function of chloroplasts? ______________________

____

c. Why are chloroplasts green in color? ______________________

____

d. What is the outer covering of a cheek cell called? ______________________

e. Do cheek cells contain chloroplasts?______________________

f. Are both plants and animals composed of cells?______________________

Explain your answer based on observations of elodea and cheek cells.

____

____

Part IV: Investigations On Your Own

1. You can investigate many types of plant cells and identify the cell walls as well as the organelles. You may want to include potato cells, tomato pulp cells, and beet cells in your investigation.

2. There are many interesting investigations that one can do with human cells. Some skin taken from under the fingernails can be studied. These cells can be compared with those from the cheek. Identify the structures that you observe.

CELL STRUCTURE

AG 530 - C

ANSWERS TO LABORATORY EXERCISES

Lab #1:

Part I:

Diagram: Power 100X; 430-450X

a. Appear like stacked boxes.
b. No
c. Yes
d. No
e. They may be filled with water.
f. No, they are closely joined.
g. No

Part II:

a. Rectangular
b. Yes
c. Grey
d. The individual structures become more distinct
e. Yellow in color
f. Yellow to brown
g. No
h. Yes
i. Different parts of the cell are in focus as the body tube is raised and lowered.

Diagram: Power 430X

Part III:

a. Empty cell walls
b. The cork units were not alive - no cytoplasm.
c. To help in the examination of cell structures.
d. Nucleus contains the chromosomes (will not be evident).

Lab #2

Part II:

1. Table--Cell Parts

Layer	Labeled Sketch of cell parts observed	Results of starch test	Cell Part	Function
Residue	Students may sketch large pieces of cell walls and fibers	Negative	Fibers	Strengthen the cell walls
1 (top)	Students may sketch cell walls fragments and mitochondria	Negative	Cell wall	Protects the cell
2	Students should sketch chloroplasts	Negative	Chloroplast	Manufactures food for the plant
3	Students should sketch nuclei	Negative	Nucleus	Directs the cells' activities
4 (bottom)	Students should sketch leucoplasts	Positive	Leucoplast	Stores starch

2. The presence of starch indicates that the cell part functions to store food.

3. Cell membranes, endoplasmic reticulum, Golgi apparatus, mitochondria, microtubules, microfilaments, ribosomes and nucleoli remained unobservable. They were broken apart or are too small to see with compound microscope.

4. Cell wall fragments; chloroplasts; nuclei; leucoplasts. The cell parts settle according to their density after being centrifuged. Least dense materials are at the top.

Lab #3

Part I:

a. The inner layers
b. Most likely
c. Yes
d. No
e. No
f. They are carried along in the circulating cytoplasm.

Part II:

a. It appears to be thinner and less rigid.
b. Plasma membrane
c. Broad and flat
d. Cheek cells tend to be less uniform in shape because of the plasma membrane, rather than the rigid surface of the cell wall.
e. It makes cell structures more distinct.
f. Grainy and dotted

Part III:

a. Elodea cells have rigid cell walls and chloroplasts. Cheek cells have thin cell membranes.
b. Production of food
c. They contain the pigment chlorophyll.
d. Cell membrane
e. No, they are animal cells.
f. Yes. They are both made up of structural units called cells.

CELL STRUCTURE

AG 530 - C

UNIT TEST

Name ______________________________________ Score ___________________________________

1. Match the terms on the right with the correct definitions by placing the appropriate numbers in the blanks provided.

_____a. The organelle of a cell containing the hereditary material

_____b. Red blood cells

_____c. Composed of many neurons bunched together

_____d. White blood cells; colorless cells exhibiting phagocytosis and ameboid movement

_____e. Small, dark-staining organelle lying near the nucleus in the cytoplasm of animal cells

_____f. A living, functional part of the cell through which all nutrients entering the cell and all waste products or secretions leaving it must pass

_____g. A particular kind of ribonucleic acid which is synthesized in the nucleus and passes to the ribosomes in the cytoplasm; combines with RNA in the ribosomes and provides a template for the synthesis of an enzyme or some other specific protein

_____h. Present in chromosomes and contains genetic information

_____i. Special structures in the cytoplasm. Each performs one or more special tasks to help keep the cell alive

_____j. The red, iron-containing, protein pigment of the erythrocytes that transports oxygen and carbon dioxide and aids in regulation of pH

_____k. Intracellular organelle present in many animal cells; contains a variety of hydrolytic enzymes that are released when the organelle ruptures

_____l. A network of fibrils or filaments, either within a cell or in the intercellular matrix

_____m. A cytoplasmic organelle, an elongated slender tube; contains a specific protein, tubulin

1. Organelles
2. Nerve
3. Neuron
4. Adenosine Triphosphate (ATP)
5. Chromosomes
6. Centriole
7. Differentiation
8. DNA
9. Erythrocyte
10. Golgi bodies
11. Hemoglobin
12. Leukocytes
13. Lysosome
14. Messenger RNA
15. Microtubule
16. Mitochondria
17. Nucleolus
18. Nucleus
19. Plasma membrane
20. Platelet

_____n. Nucleic acid containing the sugar ribose; present in both nucleus and cytoplasm and of prime importance in the synthesis of proteins
acid (RNA)

_____o. Cell organelle found in the cytoplasm of all cells except mature sperm and red blood cells

_____p. A form of RNA which serves as adaptor molecules in the synthesis of proteins

_____q. A chemical compound produced in the mitochondrion. stores energy that is used to carry out cellular functions

_____r. Small space within a cell, filled with watery liquid and separated by a vacuolar membrane from the rest of the cytoplasm

_____s. A spherical body found within the cell nucleus believed to be the site of synthesis of ribosomes

_____t. Minute granules composed of protein and ribonucleic acid; the site of protein synthesis

_____u. Nerve cells that transmit messages from one part of the body to another

_____v. A small, colorless blood corpuscle of mammals that plays an important role in blood coagulation

_____w. Spherical or elongated intracellular organelles which contain the electron transmitter system and certain other enzymes

_____x. Molecules of DNA wrapped around proteins, which are found in the nucleus; control cell functions and the inheritance of traits

_____y. A process of changing a relatively unspecialized cell to a more specialized cell

21. Reticulum
22. Ribonucleic
23. Ribosomes
24. Transfer RNA
25. Vacuole

2. List the three things which define a cell.

a.______________________________

b. ______________________________

c.______________________________

3. State the four basic ideas of the cell theory.

a.______________________________

____

b. ______________________________

____

c.______________________________

____

d. ______________________________

____

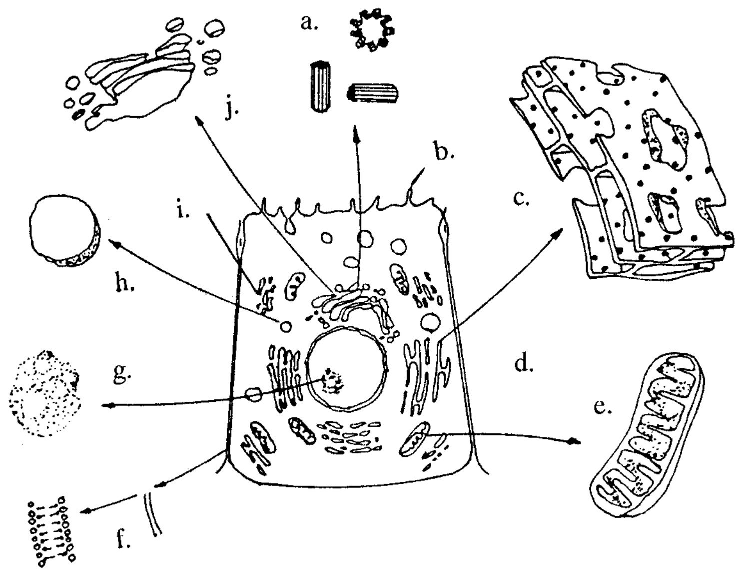
4. List the three ways that cells can differ from one another.

a.______________________________

b. ______________________________

c.______________________________

5. Label the correct parts of the cell on the diagram below.



a.__________________ b. __________________

c.__________________ d. __________________

e.__________________ f. __________________

g. __________________ h. __________________

i.__________________ j.__________________

6. List and describe the cell components and their functions.

a.____

b.____

c.____

d.____

7. Name and describe the functions of the cell organelles.

a.____

b.____

c.____

d.____

e. ______

______

______

f. ______

______

______

g. ______

______

______

h. ______

______

______

i. ______

______

______

8. Describe the differences between animal and plant cells.

a. Plant cells ______

______

______

______

______

b. Animal cells ______

______

______

______

______

9. List and describe the functions of the major types of specialized animal cells.

a.____________________

b.____________________

c.____________________

d.____________________

e.____________________

f.____________________

CELL STRUCTURE

AG 530 - C

ANSWERS TO TEST

1.

a. 18	j. 11	r. 25
b. 9	k. 13	s. 17
c. 2	l. 21	t. 23
d. 12	m. 15	u. 3
e. 6	n. 22	v. 20
f. 19	o. 10	w. 16
g. 14	p. 24	x. 5
h. 8	q. 4	y. 7
i. 1		

2. Specific, separate mass of living material that is surrounded by a semi-permeable membrane; The basic structural unit of life; All organisms (except viruses) are composed of one or more cells

3. All organisms are made of one or more cells; Cells are alike in their structure and composition; All cells carry out similar functions that keep them alive; New cells arise only from old cells, usually by dividing into two equal parts at regular intervals

4. Size; Shape; Organization

5.

a. Centrioles	b. Microvilli
c. Rough endoplasmic reticulum	d. Nucleus
e. Mitochondrion	f. Plasma membrane
g. Nucleolus	h. Lysosome
i. Smooth endoplasmic reticulum	j. Golgi Complex

6. Answer should include the following information:
   a. Plasma membrane (Cell membrane): Encloses the cell, separating it from the outside environment; Regulates passage of liquids into and out of the cell
   b. Nucleus: Contains the heredity information that directs all cell activity; Contains the nucleolus
   c. Nucleolus: Produces ribonucleic acids (RNA); Assembles subunits of ribosomes
   d. Cytoplasm: Living material inside the cell; Assists in transport of substances within the cell

7. Answer should include the following information:
   a. Endoplasmic reticulum: Cell skeletal system; Serves as transport network and storage area for substances within the cell
   b. Ribosome--Manufactures cell proteins
   c. Golgi apparatus--Packages and distributes proteins for storage within cell and transport out of cell
   d. Lysosome: Breaks down food and foreign material; Removes waste materials from cell
   e. Mitochondrion: Serves as powerhouse for cell--release body heat and energy; Produces ATP (Adenosine Triphosphate) in which energy for cell activities is stored
   f. Vacuole: Supports cell wall of plant cells through internal pressure; Digests food materials, remove wastes, and stores substances
   g. Microtubules (Centrioles): Long, thin, hollow cylinders found in many cells; Give support to cell, help keep its shape; Aid in moving the cell or moving other substances past the cell

h. Microfilaments: Thin, tiny, threadlike fibers; Contract like muscles; Aid in cell movement

i. Microvilli: Modified plasma membrane that forms fingerlike projections for more surface area; Found in intestines

8. Answer should include the following information:

   a. Plant cells: Cell wall is made of cellulose and gives support and shape; Plastids--Leucoplasts: Colorless structures where glucose is changed into starch; Storage for starch, lipids or proteins; Chromoplasts: Manufacture and store pigments; Give fruits, vegetables and leaves their bright color; Chloroplasts: Contain green chlorophyll pigment; Site of photosynthesis (food production) in the plant cell
   b. Animal cells: Microtubules give the cell its shape; Centrioles: Located near nucleus; Function in cell division for reproduction

9. Answer should include the following information:

   a. Blood cells: Red blood cells contain hemoglobin to carry oxygen to cells and carbon dioxide from cells; White blood cells--important in body defense; Phagocytic leukocytes flow to the infection site and engulf the bacteria; Lymphocytes attack foreign cells directly or secrete an enzyme that immobilizes foreign substances; Many white blood cells die while defending the body and make up pus; Platelets--important in blood clotting
   b. Nerve cells--Carry messages and direction throughout the nervous system
   c. Muscle cells: Striated--skeletal or voluntary muscle cells (controlled by conscious choice); Smooth--involuntary muscle cells found in the walls of the digestive tract, blood vessels, urinary organs and reproductive organs; Cardiac--conduct impulses within the heart
   d. Bone cells--Make up most of the skeleton on vertebrate animals
   e. Fat cells: Make up fat (adipose tissue) which is deposited around internal organs, between muscle branches and under the skin; Supplies reserve energy when food supply is scarce or sporadic
   f. Gamete (Sex cells): Reproductive cell; An egg or sperm

FUNCTIONS OF THE CELL

AG 530 - D

UNIT OBJECTIVE

After completion of this unit, students should be able to define terms associated with cell functions and explain cellular transport. Students should also be able to explain photosynthesis, respiration and fermentation. This knowledge will be demonstrated by completion of laboratory exercises and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with cell functions to the correct definitions.
2. Explain the different ways materials can pass through a cell membrane (Cellular Transport).
3. List three reasons why photosynthesis is the most important process in the world.
4. Explain the processes involved in photosynthesis.
5. List five factors that affect photosynthetic rate.
6. Explain the process of respiration.
7. Outline the relationship between photosynthesis and respiration.
8. Explain the process of aerobic respiration.
9. Explain the process of fermentation.
10. Define homeostasis and explain how cells achieve this state.
11. Study the movement of substances across membranes.

FUNCTIONS OF THE CELL

AG 530 - D

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

  A. Make transparencies and necessary copies of materials.

  B. Provide students with objective sheet and discuss.

  C. Provide students with information sheet and discuss.

  D. Provide students with laboratory exercises.

  E. Discuss and demonstrate laboratory exercises.

  F. Review and give test.

  G. Reteach and retest if necessary.

II. Instructional materials

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Transparency masters

    1. TM 1--Importance of Photosynthesis

    2. TM 2--Photosynthesis

    3. TM 3--Photosynthesis and Respiration in Relation to Dry Weight

    4. TM 4--Diagram of Aerobic Respiration

    5. TM 5--Diagram of Fermentation

  E. Instructor notes for laboratory exercises

  F. Laboratory exercises

    1. LE 1--Studying the Movement of Substances Across Membranes

  G. Answers to laboratory exercises

  H. Test

  I. Answers to test

III. Unit references

A. *Agricultural Education Curriculum*, College of Agriculture, University of Illinois, Urbana, Illinois, 1989.

B. Otto, James H., Towle, Albert, *Modern Biology*, Holt, Rinehart and Winston, Publishers, New York, 1985.

C. Slesnick, Irwin L.; Balzer, Leron; McCormack, Alan J.; Newton, David E.; Rasmussen, Fredrick A.; *Biology*, Scott, Foresman and Company, Glenview, Illinois, 1985.

FUNCTIONS OF THE CELL

AG 530 - D

INFORMATION SHEET

I. Terms and definitions

A. Diffusion--Movement of molecules from a region of high concentration to a region of low concentration

B. Permeable--Allowing the passage of substances; as in a membrane which allows substances to pass through

C. Selectively permeable membrane--Membrane through which some substances can pass but others cannot

D. Osmosis--Diffusion of water through a selectively permeable membrane

E. Hypotonic--A condition in which one solution has a lower concentration of dissolved material than another solution

F. Hypertonic--A condition in which one solution has a greater concentration of dissolved material than another solution

G. Isotonic--A condition in which two solutions have equal concentrations of dissolved substances

H. Plasmolysis--A condition in which a cell shrinks from loss of water

I. Endocytosis--Process in which large solids are taken in by a cell (also called phagocytosis)

J. Exocytosis--Process in which large solids are discharged from the cell

K. Pinocytosis--Process in which cells take in very small particles and droplets of liquids

L. Cell respiration--Process of breaking molecules apart to release energy

M. Glycolysis--A series of reactions in cell respiration in which a glucose molecule is broken down into two molecules of pyruvic acid, forming two molecules of ATP

N. Aerobic respiration--A series of reactions, conducted in the presence of oxygen, in which glucose in converted to carbon dioxide and water

O. Fermentation--Process in which the breakdown of glucose is completed without oxygen; glucose is converted to carbon dioxide and either alcohol or lactic acid

P. Photosynthesis--Process by which plants transform solar energy into chemical bond energy

Q. Chloroplasts--Special plant organelles in which photosynthesis takes place

R. Homeostasis--The ability of an organism to maintain a stable environment when outside conditions change

S. Hydrolysis--The splitting of a compound into parts by the addition of water between certain of its bonds, the hydroxyl group being incorporated in one fragment and the hydrogen atom in the other

T. Metabolism--The sum of all the physical and chemical processes by which living organized substance is produced and maintained; the transformation by which energy and matter are made available for the uses of the organism

U. Adenosine diphosphate (ADP)--A molecule which functions in energy storage and transfer; formed from ATP

V. Adenosine triphosphate (ATP)--A molecule which stores energy that is used to carry out cellular functions; formed when ADP accepts a phosphate group plus energy

II. Cellular transport

A. Passive transport

1. Moves molecules from regions of high concentration to regions of lower concentration

2. Does not require cellular energy

B. Active transport

1. Method of moving cells from lower concentration region to higher concentration region

2. Requires cellular energy

3. Allows cells to get rid of substances that would be harmful in high concentrations

Example: Wastes are actively transported out of some kidney cells

C. Endocytosis

1. The taking in of large molecules or particles by a cell without passing through the plasma membrane

a. Cell forms pocket, surrounds the substance, seals itself, and becomes a vacuole within the cell

b. Material is then broken down and absorbed into the cell

2. Phagocytosis--Process by which simple unicellular animals can take in relatively large particles of food from their environment

3. Pinocytosis--Liquids or macromolecules are taken in instead of large particles

D. Exocytosis--The passage of large molecules to the outside of a cell enclosed in a membrane

1. Molecule enclosed in membrane in cytoplasm, moves to plasma membrane, membranes fuse, the part of the membrane at the surface of the cell opens up and allows it to pass

2. Protein molecules, lipids and many cell wastes are discharged by exocytosis

III. Reasons photosynthesis is the most important process in the world (Transparency 1)

A. Plants produce food by photosynthesis

B. Plants produce food used directly by man

C. Plants produce food used indirectly by man through meat and milk produced by livestock

(Note: Green plants, through the process of photosynthesis, are the basic factory of the world, on which all life is dependent. A corn plant produces about 5 grams of sugar during 14 hours of sunlight. During a 100-day period, a 20-acre field of corn with 20,000 plants per acre could produce two and one-half tons of. sugar An estimated 150 billion tons of sugars are produced by plants each year by photosynthesis. This would be a pile of sugar 40 miles square at the base and 2 miles high at the peak.)

IV. Process of photosynthesis (Transparency 2)

A. Carbon dioxide (CO_2) enters the leaf from the surrounding air through the stoma

(Note: After CO_2 enters the stoma, it enters the intercellular spaces of the mesophyll tissue. Here it comes in contact with the wet walls of the mesophyll cells. The CO_2 dissolves in the water of the mesophyll cells.)

B. Water moves from the soil into the root, stems and leaves through the xylem tissue

C. The molecules of water (H_20) and carbon dioxide (CO_2) are synthesized (put together) in the chlorophyll of a plant with energy from sunlight

D. The end result is the formation of sugar which is transported by the phloem tissue to the part of the plant where it is used

(Note: The process can be illustrated by the chemical equation which is written: 6 parts carbon dioxide (6 CO_2) + 6 parts water (6 H_2O) + 672 K cal of radiant energy (sunlight) in the presence of chlorophyll of plants = sugar ($C_6H_{12}O_6$) retained by the plant + oxygen (6 O_2) given off into the atmosphere.)

V. Factors that affect photosynthetic rate

A. Water supply

B. Temperature

C. Light quality

D. Light intensity

E. Deficiency of certain plant nutrients

VI. Process of respiration

(Note: As will all living things, plants require energy to carry out their growth and development process. This energy comes from a very complex process called respiration. In a sense, respiration in plants is the reverse of photosynthesis as sugar is broken down to produce energy.)

A. Sugar is broken down to produce energy for essential plant functions

B. Respiration consumes oxygen (O_2) and glucose ($C_6H_{12}O_6$)

C. Respiration gives off carbon dioxide (CO_2) and water (H_2O)

(Note: The process can be illustrated by the chemical equation which is written: Sugar ($C_6H_{12}O_6$) + 6 parts oxygen (6 O_2) = six parts carbon dioxide (6 CO_2) + 6 parts water (6 H_2O).)

VII. Relationship between photosynthesis and respiration (Transparency 3)

Photosynthesis	Respiration
1. A building process (+)	1. A destruction process (-)
2. Sugars manufactured	2. Sugars consumed
3. CO_2 is consumed	3. CO_2 is given off
4. Oxygen is given off	4. Oxygen is consumed
5. Requires light	5. Goes on day and night
6. Only takes place in cells containing chlorophyll	6. Carried on in all cells
7. Sugar ($C_6H_{12}O_6$) is the end product	7. Energy produced for plant functions is end product

(Note: A green plant grown in the dark loses in weight because its stored foods are respired and nothing is added through photosynthesis.)

VIII. Aerobic respiration (Transparency 4)

A. Breakdown of glucose in presence of oxygen

1. Pyruvic acid converted to carbon dioxide and water

2. Additional 36 molecules ATP eventually formed from products of these reactions (total of 38 molecules ATP formed--two formed in glycolysis)

B. Chemical equation

ADP + Phosphate + Glucose + Oxygen ----- Carbon dioxide + Water + Energy

ADP + P + $C_6H_{12}O_6$ + $6O_2$ ---- CO_2 + $6H_2O$ + ATP

IX. Fermentation (Transparency 5)

A. Breakdown of glucose without oxygen

1. Pyruvic acid converted to carbon dioxide and either alcohol or lactic acid

2. No additional energy is produced

a. Total energy is the two ATP produced in glycolysis

b. Very inefficient in energy production

B. Energy from fermentation

1. Some organisms, such as bacteria, obtain all their energy from fermentation

2. Some cells revert to fermentation when oxygen is in short supply

Example: Muscle cells during intense exercise

X. Homeostasis

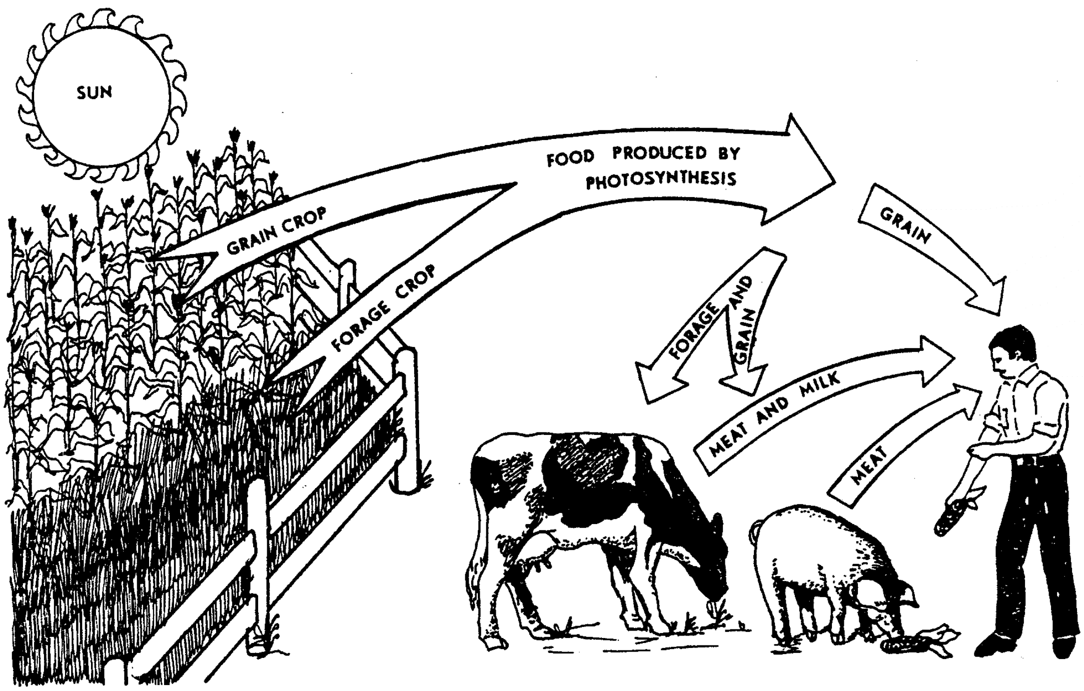
A. The ability of a cell or organism to maintain a stable internal environment when outside conditions change. The internal stability of living things

B. Feedback mechanism

1. Makes homeostasis possible by helping the cell respond to both internal and external changes

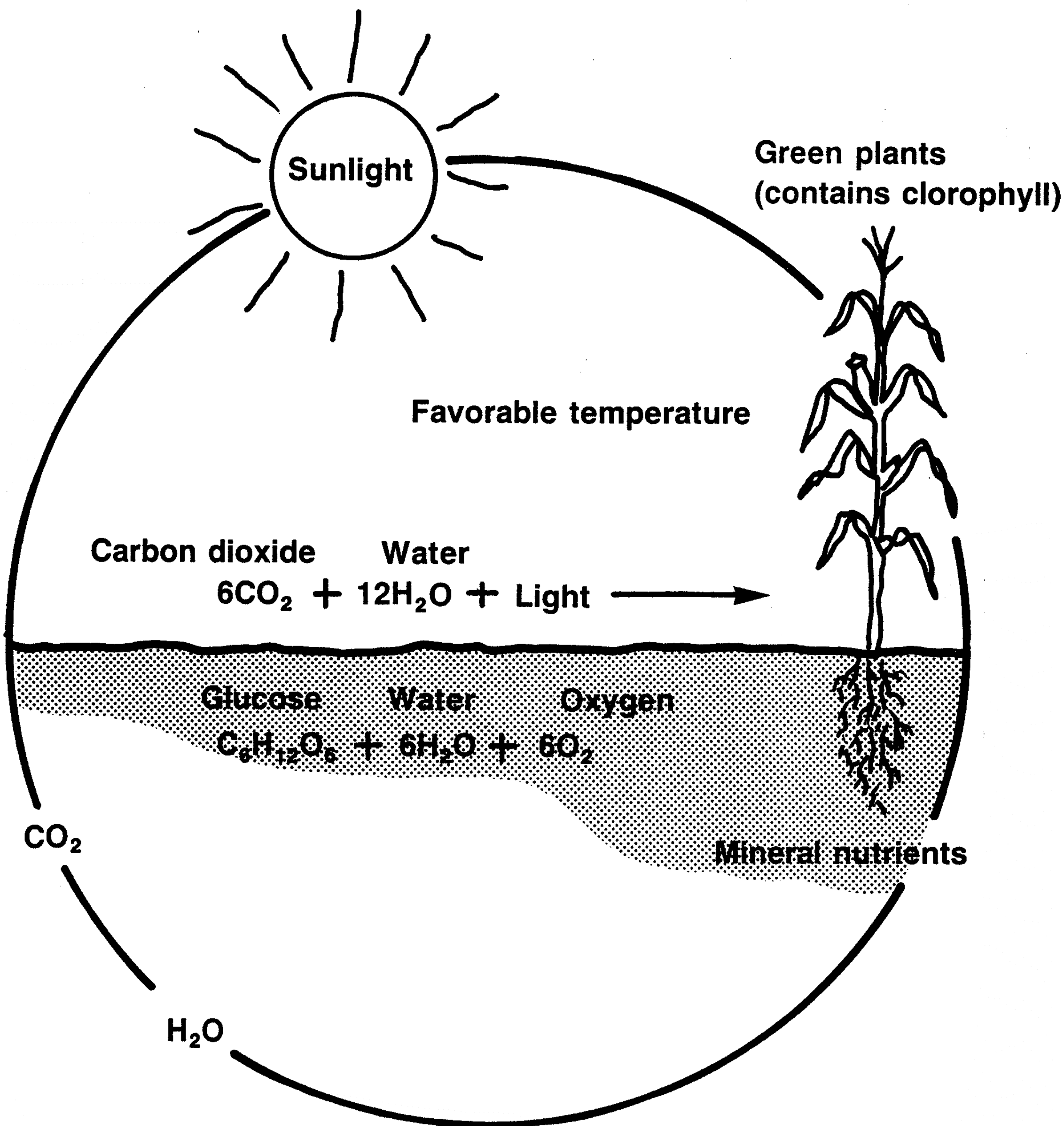
2. Example: Damaged cell--Increased rate of chemical building blocks entering the cell for repairing the cell. As a result, more waste products form in the cell and must also have increased rate of excretion

Importance of Photosynthesis

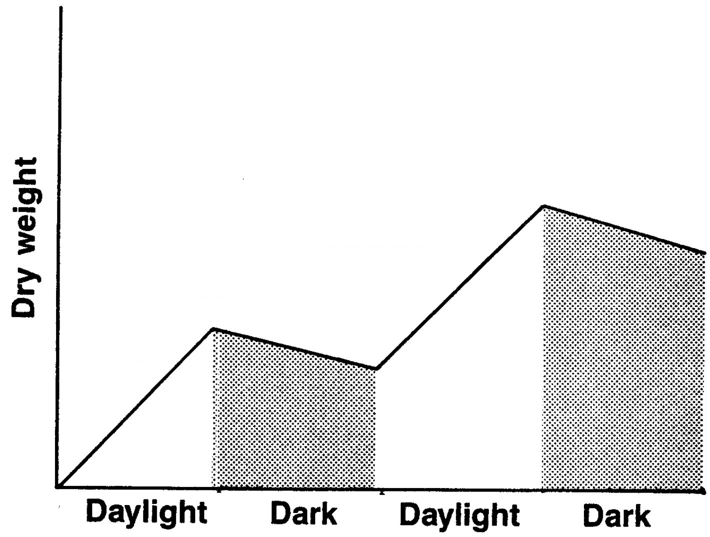


Through the process of photosynthesis, crop plants produce food. This plant-produced food is used directly by man or indirectly through meat and milk produced by livestock.

Photosynthesis



Photosynthesis and Respiration in Relation to Dry Weight



Daylight hours

- **The sugar produced by photosynthesis is greater than the sugar used by respiration.**
- **Result is increase in dry weight.**

Dark hours

- **No sugar is produced by photosynthesis.**
- **Sugar is used by respiration.**
- **Result is decrease in dry weight.**

Diagram of Aerobic Respiration

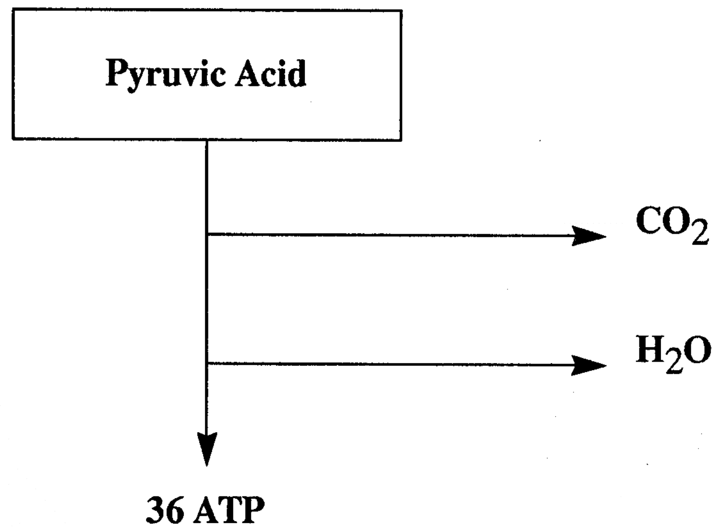
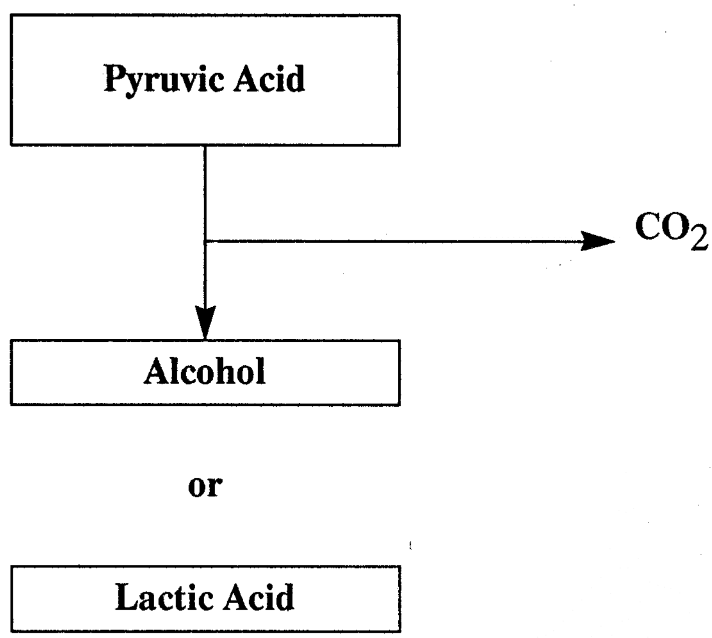


Diagram of Fermentation



FUNCTIONS OF THE CELL

AG 530 - D

INSTRUCTOR NOTES FOR LABORATORY EXERCISE

Solution preparation:

The following general instructions apply for the preparation of most solutions: Solvents should be added to solutes. Use distilled water, not tap water, for all reagents. When preparing an acid or base solution, *slowly* add the acid or base to the water. Never add water to a concentrated acid or base.

To make percentage solutions measure 1 ml of solute per percentage. Add the solute to enough solvent to make 100 ml of solution. When dissolving a solid in water, measure 1 g of solute per percentage and mix the solute with enough water to make 100 ml of the solution.

<u>Albumin solution (10%)</u>

Add 20 g of egg albumin or 30 ml of egg white to 180 ml of distilled water. Refrigerate until needed.

<u>Benedict's Solution (also available ready-made)</u>

Add 173 g of sodium or potassium citrate and 100 g of anhydrous sodium carbonate [Na_2CO_3] to 700 ml of distilled water. Heat until chemicals are dissolved. Filter. Dissolve 17.3 g crystalline copper sulfate [$CuSO_4$] in 100 ml of distilled water. Slowly pour the first solution into the copper sulfate solution, stirring constantly. Dilute with distilled water to make exactly 1 L of Benedict's solution.

<u>Glucose solution (10%)</u>

Dissolve 50 g of glucose in 450 ml of distilled water. Refrigerate.

<u>Iodine solution (also available ready-made)</u>

Dissolve 5.0 g of potassium iodide [KI] and 1.5 g of iodine crystals in 500 ml of distilled water. Store in brown bottle or other glass container that shields the liquid from light. *CAUTION: Iodine dust and vapors are toxic and irritating. Avoid body contact and inhalation from fumes. Should body contact occur, flush immediately with water.*

<u>Salt solution (10%) [NaCl]</u>

Dissolve 40 g of salt in 360 ml of distilled water. Refrigerate.

<u>Starch solution (10%)</u>

Dissolve 100 g of cornstarch in 250 ml of distilled water, forming a paste. Pour the paste into 650 ml of boiling (distilled) water. Cook for several minutes, stirring constantly. Cool and refrigerate.

Dialysis tubing should be at least 25 mm in diameter.

It is recommended that students wear safety glasses or goggles throughout this laboratory exercise.

You may wish to provide equipment for setting up hot water baths in step 10.

You may wish to prepare the mixture for the inside of the cell model ahead of time.

Part I:

Step 5: Make sure that the students tie off the ends of their cell models securely. If liquid leaks out of their cell models, have the student empty the liquid into a container and retie the ends securely before proceeding with the experiment.

Step 7: Cell model should sit in the iodine solution for at least 30 minutes. The longer it stays in the iodine, the closer to equilibrium the solutions will be.

Step 9: Students can use the end of the string to pull the cell model out of the iodine solution. Students should use a spoon to transfer the cell to another clean container.

Step 10: Students can also test for oil by placing several drops of the liquid on a piece of brown paper. After the water evaporates, a translucent spot indicates the presence of oil.

Caution students to be careful when using the Bunsen burner. Make sure that loose hair and clothing are secured away from the flame.

Students can also detect starch by adding two drops of iodine solution to 2 ml of liquid from the beaker. This test may yield a stronger color change if starch is present.

Part II:

If aquarium water is not available, use dechlorinated tap water. Allow several liters of tap water to stand out in an open container, such as an aquarium, for several days.

A biuret, nitric acid or ninhydrin test can also be used to test for protein. Caution students to handle these reagents carefully if you decide to use these tests. Contact with the skin can cause stains or burn the skin.

EXTENSION: Students can do Part II using an animal cell such as a cheek or blood cell.

Part IV:

The *Elodea* cells returned to normal because the concentration of water was greater on the outside of the cell when the cell was placed in aquarium water. Water flowed into the cell by osmosis, restoring it to its normal dimensions.

The vacuole of the cell shrank because the concentration of water inside the cell was higher than that outside the cell. Water left the vacuole by osmosis, restoring the cell to its normal state.

FUNCTIONS OF THE CELL

AG 530 - D

LABORATORY EXERCISE #1--STUDYING THE MOVEMENT OF SUBSTANCES ACROSS MEMBRANES

Name ____________________ Score ____________________

Slesnick, Irwin L., *Biology Laboratory Manual*, Scott, Foresman and Company, 1985. Reprinted by permission of Scott, Foresman and Company.

Introduction

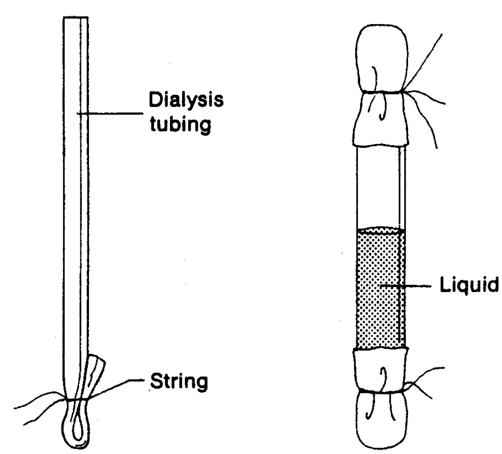
To carry out basic life functions, cells need to exchange materials with their environment. These materials move in and out of the cell, passing through the cell membrane. Some molecules can move easily and quickly across the cell membrane by diffusion. Other molecules cannot diffuse across the cell membrane. In this laboratory you will make a model of a cell. Then, you can study the diffusion of various substances across a material that is *selectively permeable* to certain materials, as is a cell membrane. You will also observe plant cells in different environments to learn how the movement of water across the cell membrane affects the cell.

Materials needed

Dialysis tubing, 15 cm long
Tap water
Thread, 30 cm
50-ml graduated cylinder
250-ml graduated cylinder
Large beaker, small bowl
 or small container
10 ml 10% starch solution
10 ml 10% glucose solution
3 ml vegetable oil
10 ml 10% albumin solution
Stirring rod
Small funnel
500-ml beaker
200-ml dilute iodine solution
Spoon
2 test tubes
Medicine dropper
2 ml Benedict's solution
Bunsen burner
Test-tube holder
3 *Elodea* leaves
3 microscope slides
3 coverslips
Grease pencil
Aquarium water
10% salt solution
Distilled water
Compound microscope

Part I: Diffusion Across the Membrane of a Model Cell

1. Soak a piece of dialysis tubing in tap water for several minutes. To separate the tube walls, rub the surfaces of the tube between your thumb and forefinger. Fold one end of the tubing, and secure that end with string, as shown in **a.**



a. Setting up dialysis tubing **b. Cell model**

2. Measure and mix 10 ml of starch solution with 10 ml of glucose solution and 10 ml of albumin (protein) solution. Then, add 3 ml of oil to the mixed solutions. Stir this mixture, and pour it into a graduated cylinder. On the line below, record the volume of the liquid.

   (a)____

3. Using a funnel, pour the liquid from step 2 into your dialysis tubing until the tubing is half full. Firmly tie off the open end of the tubing as shown in **b.** on previous page. Leave the long thread attached. Record the amount of liquid left in the graduated cylinder on the line below.

   (b)____

4. To find the volume of liquid in your cell model, subtract the volume recorded on line (a) from that recorded on line (b). Write this sum on the space in Table I below.

5. Invert your cell model over the sink. Make sure that no liquid leaks from your cell model. Then, rinse the surface of the cell model under tap water. Place the cell model in a clean 250-ml beaker.

6. Fill the larger graduated cylinder with about 200 ml of iodine solution. CAUTION: Avoid getting iodine on your hands. It stains and is poisonous if ingested. Record the volume of iodine solution on the line below.

   (c)____

7. Pour enough iodine solution over your cell model to cover the top surface of the cell model. Record on line (d) the volume of iodine solution remaining in your graduated cylinder.

   (d)____

8. Allow your cell model to remain in the iodine solution overnight. To find the amount of iodine surrounding the cell, subtract the volume on line (c) from that on line (d). In the space in the table, record the amount of iodine solution surrounding your cell model.

Table 1. Movement of substance across a membrane.

Liquid	Volume		Iodine present		Starch present		Oil present		Glucose present		Albumin present	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Liquid surrounding cell model												
Liquid inside cell												

9. After at least 24 hours have passed, use the attached string to lift the cell model out of the beaker. Let the excess liquid drip back into the beaker. Place the cell model in a clean, empty beaker, bowl, or container. Measure the amount of liquid remaining in the 250-ml beaker, and record this amount in the table.

10. Run the following tests on the liquid in the 250-ml beaker to determine if any of the substances inside the cell model have diffused through the membrane. If starch crossed the membrane, it would react with iodine, producing a blue-violet color. In Table I, record if a reaction of starch and iodine occurred. Look for oil droplets on the surface of the liquid. Record your observations in the table. Put about 2 ml of liquid into each of two test tubes. You will test the liquid in one test tube for albumin and the liquid in the other test tube for glucose. To test for albumin, heat the test tube over a Bunsen burner until the contents in the test tube come to a boil. A cloudy, white precipitate indicates albumin is present. To test for glucose, add 1 ml of Benedict's solution to the second test tube. Heat the test tube over the Bunsen burner for five minutes. If glucose is present, the heated liquid will turn green, orange, yellow, red or brown.

11. Remove the cell model from the container and untie one end of the dialysis tubing. Pour the liquid into the smaller graduated cylinder. Record in Table I the volume of liquid in the graduated cylinder. This amount is the volume of liquid that remained in your cell model. Repeat the tests in step 10 using the liquid from your cell model. Record in the table the substances that were present. You will be checking for the presence of the original substances in the liquid and for the movement of iodine into the liquid.

12. Dispose of the liquids and clean your equipment.

<u>Part II: Osmosis in a Living Cell</u>

1. Use a grease pencil to label one slide "Aquarium water", the second slide, "Salt water", and the third "Distilled water". Place several drops of the liquid named on the label in the center of the slide that bears that label.

2. Select three small *Elodea* leaves, and place each one in the liquid on the center of the slide. Add a coverslip.

3. Examine each slide under the microscope using low power first, then high power. In the spaces provided, draw and label a typical cell from each leaf as it appears under high power. Notice the size of the vacuole in each cell.

Part III: Analysis

1. Table II lists approximate molecular weights of the molecules dissolved in the liquids used in Part I. Use this information to explain the results of the laboratory. How is a substance's molecular weight related to the substance's diffusion rate?

____

____

Table II. Molecular weight

Substance	Approximate molecular weight
Water	18
Glucose	180
Iodine	250
Starch	1,000
Oil	1,000
Albumin	40,000

2. Did the amounts of liquid inside and outside the cell model change significantly? Explain why or why not.

____

____

3. In Part II, how did the three liquids affect the *Elodea* cells? Use the terms *osmosis, isotonic, hypertonic and hypotonic* to explain your results.

____

____

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____

4. How does the structure of the *Elodea* cell protect the cell if the cell is placed in distilled water? What might happen to blood cells placed in distilled water? Explain your answer.

____

____

____

5. Kidney machines use dialysis tubing in a special bath to remove wastes from a patient's blood. What causes the waste products in the blood to pass through the tubing into the bath?

____

____

Part IV: Going Further

1. Use forceps to dunk the *Elodea* leaf that was in salt water into a beaker of aquarium water. Then, using aquarium water, make a wet mount of the leaf. After about ten minutes, observe the leaf cells under low power and then high power. Draw some of the leaf cells. Compare your drawing to the drawings that you did in step 3 of Part II. If the cell changed in appearance, explain why.

2. Repeat the above procedure with the leaf that was placed in distilled water. Again, draw the leaf cells, and explain any changes that you observe.

FUNCTIONS OF THE CELL

AG 530 - D

ANSWERS TO LABORATORY EXERCISE

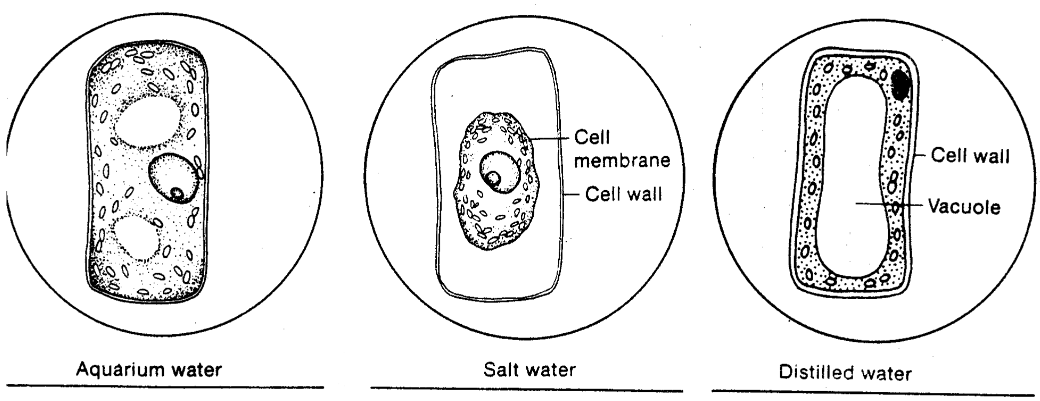
Part I:

(a) Approximately 33 ml
(b) Answers will vary, but should be around 15 ml
(c) Answers may vary, but should be about 200 ml
(d) Answers may vary, but may range between 0 and 25 ml

Table I: Glucose will probably diffuse out of the cell model. Iodine will probably diffuse into cell model. The volume of liquid inside and outside the cell model will probably remain relatively constant.

Part II:

Step 3:



Part III:

1. The larger the molecular weight, the slower the rate of diffusion.

2. No, because diffusion was taking place in both directions. About the same amount of water entered as left the cell.

3. Osmosis occurred in all slides. Because aquarium water is isotonic to the cell, the amount of water flowing in and out of the cell was equal. Salt water is hypertonic to the cell, so water flowed out of the cell and the cell shrank. Distilled water is hypotonic to the cell, so the net flow of water into the cell caused the vacuole to enlarge. (Excess water is stored in the vacuole.)

4. The rigid cell wall prevents the cell membrane from expanding to the bursting point in a hypotonic solution. A blood cell, which lacks a cell membrane, will burst in a hypotonic solution.

5. Wastes move from a region of high concentration (in the blood) to a region of low concentration (into the bath) by diffusion.

FUNCTIONS OF THE CELL

AG 530 - D

UNIT TEST

Name ______________________________________ Score ___________________________________

1. Match the terms on the right with the correct definitions by placing the appropriate numbers in the blanks provided.

_____a. A series of reactions in cell respiration in which a glucose molecule is broken down into two molecules of pyruvic acid, forming two molecules of ATP		1. Diffusion
_____b. Special plant organelles in which photosynthesis takes place		2. Permeable
_____c. Allowing the passage of substances; as in a membrane which allows substances to pass through		3. Selectively permeable membrane
_____d. Process in which cells take in very small particles and droplets of liquids		4. Osmosis
_____e. A molecule which functions in energy storage and transfer		5. Hypotonic
_____f. Process by which plants transform solar energy into chemical bond energy		6. Hypertonic
_____g. A condition in which one solution has a lower concentration of dissolved material than another solution		7. Isotonic
_____h. The splitting of a compound into parts by the addition of water between certain of its bonds, the hydroxyl group being incorporated in one fragment and the hydrogen atom in the other		8. Plasmolysis
_____i. A condition in which two solutions have equal concentrations of dissolved substances		9. Endocytosis
_____j. Process in which the breakdown of glucose is completed without oxygen; glucose is converted to carbon dioxide and either alcohol or lactic acid		10. Exocytosis
_____k. Process in which large solids are taken in by a cell		11. Pinocytosis
_____l. Membrane through which some substances can pass but others cannot		12. Cell respiration
		13. Glycolysis
		14. Aerobic respiration
		15. Fermentation
		16. Photosynthesis
		17. Chloroplasts
		18. Homeostasis
		19. Hydrolysis
		20. Metabolism

_____m.	A condition in which a cell shrinks from loss of water	21. Adenosine diphosphate
_____n.	Diffusion of water through a selectively permeable membrane	22. Adenosine triphosphate
_____o.	Process of breaking molecules apart to release energy	
_____p.	The sum of all the physical and chemical processes by which living organized substance is produced and maintained; the transformation by which energy and matter are made available for the uses of the organism	
_____q.	A condition in which one solution has a greater concentration of dissolved material than another solution	
_____r.	A molecule which stores energy that is used to carry out cellular functions	
_____s.	A series of reactions, conducted in the presence of oxygen, in which glucose is converted to carbon dioxide and water	
_____t.	Movement of molecules from a region of high concentration to a region of low concentration	
_____u.	The ability of an organism to maintain a stable environment when outside conditions change	
_____v.	Process in which large solids are discharged from the cell	

2. Explain the different ways materials can pass through a cell membrane.

a.____

____

____

b. ____

____

____

c.____

____

____

d. ______________________________

____

____

3. List three reasons why photosynthesis is the most important process in the world.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

4. Explain the processes involved in photosynthesis.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

5. List five factors that affect photosynthetic rate.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

6. Explain the process of respiration.

____

____

____

____

7. Outline the relationship between photosynthesis and respiration.

Photosynthesis	Respiration
a. ________	a. ________
b. ________	b. ________
c. ________	c. ________
d. ________	d. ________
e. ________	e. ________
f. ________	f. ________
g. ________	g. ________

8. Explain the process of aerobic respiration.

____

____

____

____

____

9. Explain the process of fermentation.

____

____

____

____

10. Define homeostasis and explain how cells achieve this state.

FUNCTIONS OF THE CELL

AG 530 - D

ANSWERS TO TEST

1.
a.	13	i.	7	p.	20
b.	17	j.	15	q.	6
c.	2	k.	9	r.	22
d.	11	l.	3	s.	14
e.	21	m.	8	t.	1
f.	16	n.	4	u.	18
g.	5	o.	12	v.	10
h.	19				

2. Answer should include the following information:

   a. Passive transport: Moves molecules from regions of high concentration to regions of lower concentration; Does not require cellular energy
   b. Active transport: Method of moving cells from lower concentration region to higher concentration region; Requires cellular energy; Allows cells to get rid of substances that would be harmful in high concentrations
   c. Endocytosis: The taking in of large molecules or particles by a cell without passing through the plasma membrane; Cell forms pocket, surrounds the substance, seals itself, and becomes a vacuole within the cell; Material is then broken down and absorbed into the cell; Phagocytosis--Process by which simple unicellular animals can take in relatively large particles of food from their environment; Pinocytosis--Liquids or macromolecules are taken in instead of large particles
   d. Exocytosis: The passage of large molecules to the outside of a cell enclosed in a membrane; Molecule enclosed in membrane in cytoplasm, moves to plasma membrane, membranes fuse, the part of the membrane at the surface of the cell opens up and allows it to pass; Protein molecules, lipids and many cell wastes are discharged by exocytosis

3. Plants produce food by photosynthesis; Plants produce food used directly by man; Plants produce food used indirectly by man through meat and milk produced by livestock

4. Answer should include the following information:

   Carbon dioxide (CO_2) enters the leaf from the surrounding air through the stoma; Water moves from the soil into the root, stems and leaves through the xylem tissue; The molecules of water (H_20) and carbon dioxide (CO_2) are synthesized (put together) in the chlorophyll of a plant with energy from sunlight; The end result is the formation of sugar which is transported by the phloem tissue to the part of the plant where it is used

5. Water supply; Temperature; Light quality; Light intensity; Deficiency of certain plant nutrients

6. Answer should include the following information: Sugar is broken down to produce energy for essential plant functions; Respiration consumes oxygen (O_2) and glucose ($C_6H_{12}O_6$); Respiration gives off carbon dioxide (CO_2) and water (H_2O)

7.

Photosynthesis	Respiration
a. A building process (+)	a. A destruction process (-)
b. Sugars manufactured	b. Sugars consumed
c. CO_2 is consumed	c. CO_2 is given off
d. Oxygen is given off	d. Oxygen is consumed
e. Requires light	e. Goes on day and night
f. Only takes place in cells containing chlorophyll	f. Carried on in all cells
g. Sugar ($C_6H_{12}O_6$) is the end product	g. Energy produced for plant functions is end product

8. Answer should include the following information:

a. Breakdown of glucose in presence of oxygen: Pyruvic acid converted to carbon dioxide and water; Additional 36 molecules ATP eventually formed from products of these reactions total of 38 molecules ATP formed--two formed in glycolysis)

b. Chemical equation:
ADP + Phosphate + Glucose + Oxygen ----- Carbon dioxide + Water + Energy
ADP + P + $C_6H_{12}O_6$ + $6O_2$ ---- CO_2 + $6H_2O$ + ATP

9. Answer should include the following information:

Breakdown of glucose without oxygen; Pyruvic acid converted to carbon dioxide and either alcohol or lactic acid; No additional energy is produced; Total energy is the two ATP produced in glycolysis; very inefficient in energy production; Energy from fermentation: Some organisms, such as bacteria, obtain all their energy from fermentation; Some cells revert to fermentation when oxygen is in short supply

10. Answer should include the following information:

The ability of a cell or organism to maintain a stable internal environment when outside conditions change; The internal stability of living things; Feedback mechanism: Makes homeostasis possible by helping the cell respond to both internal and external changes

ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

UNIT OBJECTIVE

After completion of this unit, students should be able to describe the primary animal tissues and identify the types of tissues. Students should also be able to list the functions and major organs of each of the animal systems. This knowledge will be demonstrated by completion of laboratory exercises and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Describe the four primary animal tissues.
2. Identify the types of epithelial tissue when given a description of each.
3. Identify the types of connective tissue when given a description of each.
4. Identify the types of muscular tissue when given a description of each.
5. Identify the types of nervous tissue when given a description of each.
6. State the functions and list the three major organs of the circulatory system.
7. State the functions and list the seven major organs of the digestive system.
8. State the functions and list the two major organs of the respiratory system.
9. State the function and list the two major organs of the excretory system.
10. State the function and list the three major organs of the nervous system.
11. State the function and list the major organ of the endocrine system.
12. State the functions and list the major organ of the skeletal system.
13. State the function and list the major organ of the muscular system.
14. State the function and list the two major organs of the reproductive system.
15. Discuss the nervous system anatomy.
16. Discuss the respiratory system.
17. Discuss the structure of the heart.

ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Make transparencies and necessary copies of materials.

   B. Provide students with objective sheet and discuss.

   C. Provide students with information sheet and discuss.

   D. Provide students with laboratory exercises.

   E. Discuss and demonstrate laboratory exercises.

   F. Review and give test.

   G. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Typical Neuron

      2. TM 2--Types of Epithelial Tissue

      3. TM 3--Arrangement of Connective Tissue in a Muscle

      4. TM 4--Muscular Tissue

      5. TM 5--Circulatory System

      6. TM 6--Digestive System

      7. TM 7--Respiratory System

      8. TM 8--Excretory System

      9. TM 9--Nervous System

      10. TM 10--Endocrine System

      11. TM 11--Skeletal System

12. TM 12--Muscular System

13. TM 13--Reproductive System

E. Laboratory exercises

1. LE 1--Nervous System Anatomy

2. LE 2--Respiratory System

3. LE 3--Heart Structure

F. Answers to laboratory exercises

G. Test

H. Answers to test

III. Unit references

A. *Agricultural Education Curriculum*, College of Agriculture, University of Illinois, Urbana, Illinois, 1989.

B. Otto, James H., Towle, Albert, *Modern Biology*, Holt, Rinehart and Winston, Publishers, New York, 1985.

C. Slesnick, Irwin L.; Balzer, Leron; McCormack, Alan J.; Newton, David E.; Rasmussen, Fredrick A.; *Biology*, Scott, Foresman and Company, Glenview, Illinois, 1985.

D. Smith, G.C., et al., *Laboratory Manual for Meat Science*, 2nd edition, American Press, Boston, Massachusetts, 1978.

ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

INFORMATION SHEET

I. Primary animal tissues

A. Epithelial tissue

1. Covers an internal or external surface

2. Body surface, body cavities linings, body ducts and passages and the secretory portion of glands which provide lubricating mucus or hormones and enzymes

B. Connective tissue

1. Sheets or bands of tissue composed of strands or fibrils of three proteins (collagen, elastin, reticulum) distributed in a watery matrix of ground substance

2. Forms a part of the skeletal system (for example, a ligament connects a bone to another bone)

3. Forms the firm attachment against which a muscle pulls (muscle connections to bone)

4. Surrounds, collects and forms a harness to regulate and control muscle fibers, muscle fiber bundles and entire muscles during contraction and relaxation

C. Muscular tissue

1. Most common tissue found in most animals

2. The cell or muscle fiber is made up of elongated strands specialized for contraction

3. The contractile elements of the fiber are micro fibrils

D. Nervous tissue (Transparency 1)

1. Conducts impulses after receiving some stimulus

2. Neuron--The essential cell of the nervous system

3. Dendrites--Nerve fibers connected to the nerve cell body that conduct impulses <u>toward</u> the cell body

4. Axon--Nerve fibers connected to the nerve cell body that conduct impulses <u>away</u> from the cell body

II. Types of epithelial tissue (Transparency 2)

A. Simple (single-layered)

1. Squamous

a. Flat

b. Found in blood vessels and linings of body cavities and viscera

2. Cuboidal

a. Short prism

b. Found in ducts and passageways and the active tissue of glands

3. Columnar

a. Tall, sometimes ciliated

b. Found in intestines and trachea

4. Pseudostratified columnar

a. Vary in length

b. Found in upper respiratory

B. Stratified (multi-layered)

1. Stratified squamous

a. Cuboidal shaped; thickest and toughest of epithelial tissues

b. Forms outer skin layer; the first part of the digestive tract, and, in ruminants, the fore stomach

2. Stratified columnar--found in pharynx and salivary ducts

3. Transitional

a. Stretches from many layers thick to a single layer

b. Found in areas subjected to stretching, such as the bladder

4. Glandular

a. Can be cuboidal or columnar

b. Found in mucous or hormonal glands

5. Yellow

a. Kinked fibers that tend to regain shape after being stretched

b. Found at base of skull

6. Branching

a. Netlike, star shaped

b. Found in lymphatic tissue and bone marrow

III. Types of connective tissue (Transparency 3)

A. Endomysium--Connective tissue surrounding the individual muscle fibers

B. Perinysium--Connective tissue around groups or bundles of muscle fibers

C. Epinysium--Connective tissue surrounding the entire muscle

IV. Types of muscular tissue (Transparency 4)

A. Striated-voluntary--The skeletal muscles

B. Striated-involuntary--The cardiac muscle of the heart; controlled by the autonomic system

C. Smooth-involuntary--Muscles of the gastrointestinal tract; also found in the walls of blood vessels, urinary tract and reproductive tract

V. Types of nervous tissue

A. Sensory--Conduct impulses from skin or sense organs to nerve center

B. Motor--Conduct impulses from the nerve centers to muscles or glands

C. Association--Form connections between other neurons

VI. Circulatory system (Transparency 5)

A. Function--Carries gases, digested food and other materials to all parts of the body

B. Major organs

1. Heart

2. Arteries

3. Veins

VII. Digestive system (Transparency 6)

A. Function--Takes in food, digests food and eliminates undigested wastes

B. Major organs

1. Mouth
2. Pharynx
3. Esophagus
4. Stomach(s)
5. Small intestine
6. Large intestine (includes cecum, colon and rectum)
7. Accessory organs (includes pancreas, liver, gall bladder)

VIII. Respiratory system (Transparency 7)

A. Function--Takes in air, uses certain gases from the air, expels waste gases

B. Major organs

1. Lungs
2. Air passages

IX. Excretory system (Transparency 8)

A. Function--Eliminates wastes produced inside the cells

B. Major organs

1. Kidney
2. Bladder

X. Nervous system (Transparency 9)

A. Function--Collects information from inside and outside the body to help regulate body functions

B. Major organs

1. Brain
2. Spinal cord
3. Nerves

XI. Endocrine system (Transparency 10)

A. Function--Helps regulate the chemical substances in the body

B. Major organs--Ductless glands

Example: Pineal, Pituitary, Thyroid, Parathyroids

XII. Skeletal system (Transparency 11)

A. Function--Provides a framework for the body and protects many vital organs

B. Major organs--Bones

XIII. Muscular system (Transparency 12)

A. Function--Acts on the skeleton to allow body movement

B. Major organs--Muscles

XIV. Reproductive system (Transparency 13)

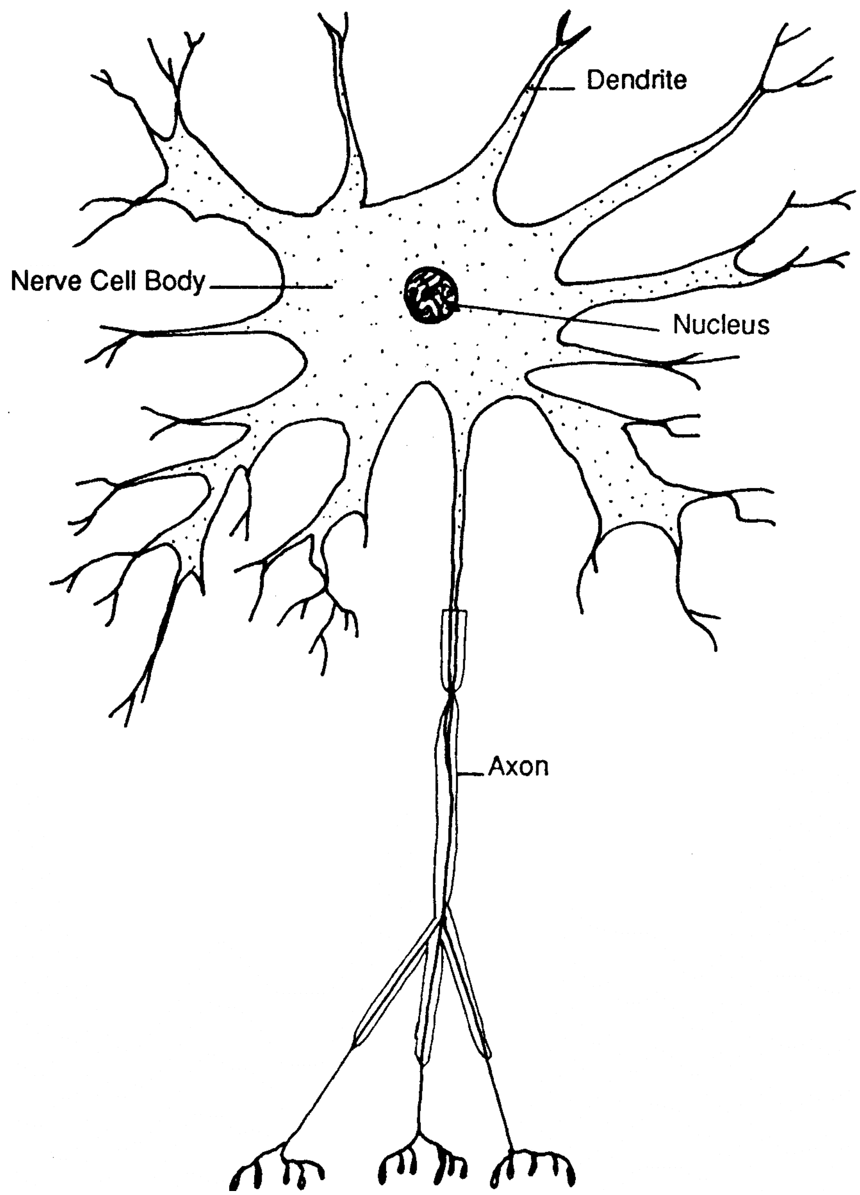
A. Function--Makes the sex cells necessary for producing offspring

B. Major organs

1. Ovaries

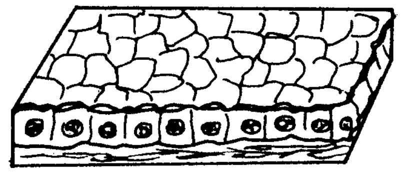
2. Testes

Typical Neuron

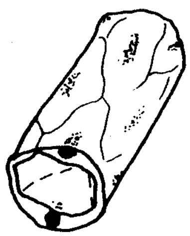


Types of Epithelial Tissue

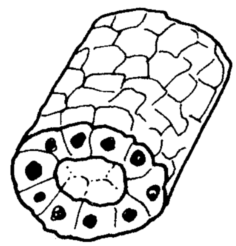
Simple Squamous



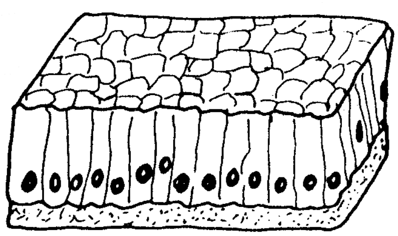
Simple Cuboidal



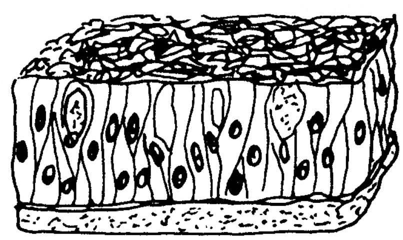
Simple Squamous in Tubular Arrangement



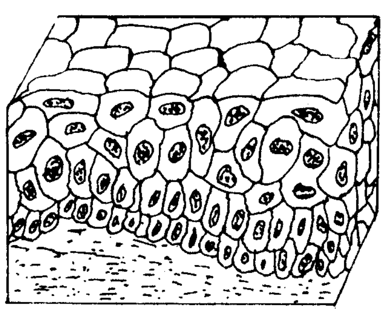
Simple Cuboidal forming a small duct



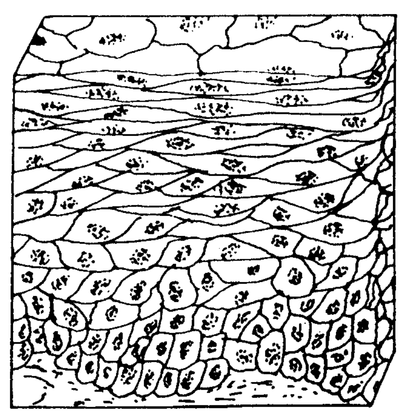
Simple Columnar



Pseudostratified Columnar with Cilia

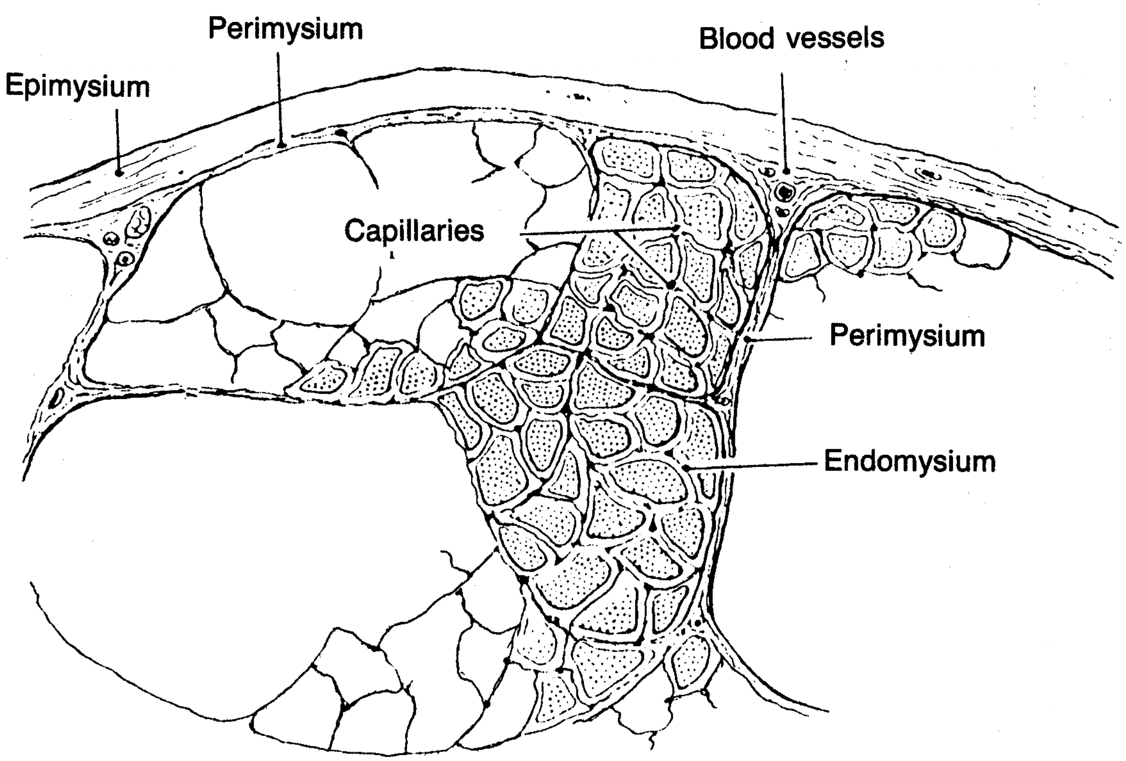


Transitional

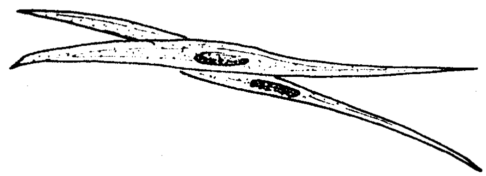


Stratified Squamous (Moist Type)

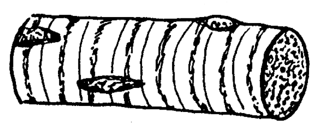
Arrangement of Connective Tissue in a Muscle



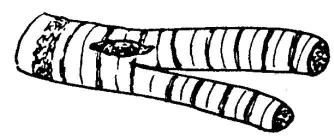
Muscular Tissue



Elongate, spindle-shaped,
pointed ends - Smooth



Elongate, cylindrical,
blunt ends - Skeletal



Elongate, cylindrical; fibers
branch and fuse - Cardiac

Comparison

	Skeletal	*Smooth*	*Cardiac*
Location	Attached to skeleton	Walls of viscera	Wall of heart
Number of nuclei per cell	Many	One	One
Position of nuclei	Peripheral	Central	Central
Cross striations	Present	Absent	Present
Speed of contraction	Most rapid	Slowest	Intermediate
Ability to remain contracted	Least	Greatest	Intermediate
Type of control	Voluntary	Involuntary	Involuntary

CIRCULATORY SYSTEM

Function--Carries gases, digested food and other materials to all parts of the body

MAJOR ORGANS

Heart
Arteries
Veins

DIGESTIVE SYSTEM

Function--Takes in food, digests food, eliminates undigested wastes

MAJOR ORGANS

Mouth
Pharynx
Esophagus
Stomach(s)
Small intestine
Large intestine
Accessory organs

RESPIRATORY SYSTEM

Function--Takes in air, uses certain gases from the air, expels waste gases

MAJOR ORGANS

Lungs
Air passages

EXCRETORY SYSTEM

Function--Eliminates wastes produced inside the cells

MAJOR ORGANS

Kidney
Bladder

NERVOUS SYSTEM

Function--Collects information to regulate body functions

MAJOR ORGANS

Brain
Spinal cord
Nerves

ENDOCRINE SYSTEM

Function--Regulation of body chemical substances

MAJOR ORGANS

Ductless glands

SKELETAL SYSTEM

Function--Body framework, protects vital organs

MAJOR ORGANS

Bones

MUSCULAR SYSTEM

Function--Allows body movement

MAJOR ORGANS

Muscles

REPRODUCTIVE SYSTEM

Function--Produce sex cells

MAJOR ORGANS

Ovaries
Testes

ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

LABORATORY EXERCISE #1--NERVOUS SYSTEM

Name ______________________________ Score ______________________________

Introduction

Examination of the fetal pig allows you to observe organs you may otherwise never have the opportunity to examine. A study of the nervous system would not be complete without examination of the brain itself. Because the brain is soft, study of this organ is limited. Because of the close similarity of a pig's brain to a human's brain, this study will allow you to observe and identify several structures nearly identical to your own.

Next, let's review the functions of the parts of the brain we will study in this lab. The *Pia mater* and *Dura mater* are membranes that protect the brain. The *Cerebrum* controls emotions and intelligence; interprets all senses, such as vision and hearing; contains motor and sensory areas. The *Cerebellum* coordinates muscular activities.

Materials needed

Fetal pig
Scissors
Dissecting pan
Tweezers

Part I: Procedures

1. Remove the skin from the top of the fetal pig's head by making the 3 cuts shown in Figure 1.

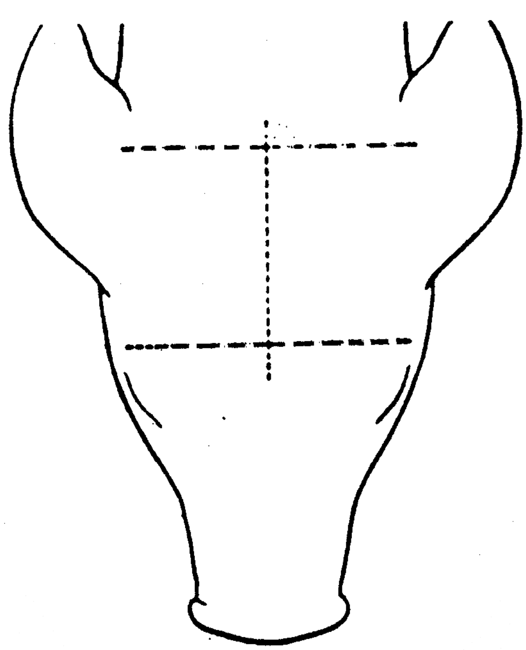


Figure 1

2. Peel back the skin. An area where the skull bones appear to meet, forming an X, should be visible.

3. Carefully insert scissors or tweezers through this point of weakness (soft spot) and slide point between bone and brain tissue. DO NOT push straight down into the brain tissue. It is very soft and is easily destroyed.

4. Use tweezers to slowly break away as much skull as possible beginning at the soft spot. CAUTION: Be careful of flying bone chips. For maximum safety, eye goggles should be worn. DO NOT dig deeply into the brain tissue. When you finish, your pig should resemble the diagram in Figure 2.

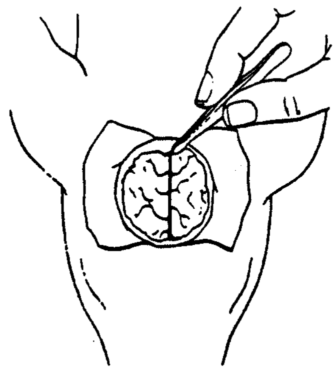


Figure 2

5. Attempt to locate the following parts based on the description of the structures which follows:
   a. Dura mater - tough membrane just below the skull

   b. Pia mater - thin membrane lying over the brain

   c. Cerebrum - large mass of brain tissue divided into left and right halves

   d. Longitudinal fissure - long furrow which divides cerebrum into left and right halves

   e. Gyri - small folds or ridges of the cerebrum

   f. Sulci - small fissures or furrows between gyri

The alternating gyri and sulci give brain tissue its characteristic convoluted (wrinkled) surface.

6. On figure 3, fill in the parts underlined in step 5.

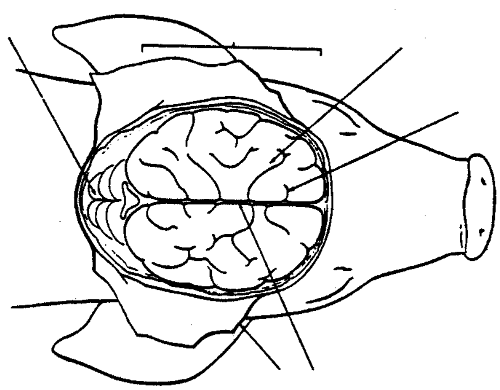


Figure 3

7. Continue to break bone away from the skull toward the neck. Notice that the bone is becoming thicker as you proceed back toward the neck. Further removal of the bone should expose the pig's *cerebellum*. The cerebellum is a mass of brain tissue below the cerebrum. If you have difficulty seeing the cerebellum, remove the meninges (a jelly-like substance.)

8. Label the cerebellum on Figure 3.

Part II: Analysis

1. Match the following four parts of the brain to their functions.
   (Note: The functions may be used more than once.)

_____Dura mater	a. Controls emotions
_____Cerebrum	b. Protects the brain
_____Cerebellum	c. Coordinates muscular activity
_____Pia mater	

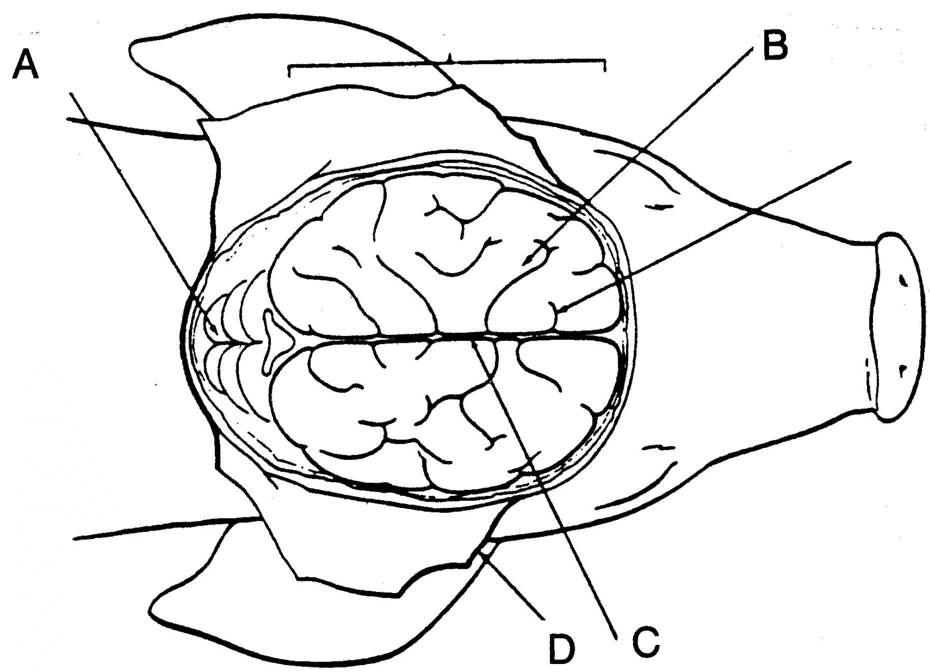
2. List two types of materials required to perform this experiment.
   a.____

   b. ____

3. Using the figure below, identify the parts labeled A, B, C, and D.

   a.______________________ c. ______________________

   b. ______________________ d. ______________________



ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

LABORATORY EXERCISE #2--RESPIRATORY SYSTEM

Name ______________________________ Score ______________________________

Introduction

The respiratory systems of pigs and humans are very similar. Thus, by observing fetal pig respiratory structures, you can see what your own respiratory system is like.

The respiratory system may be divided into two general areas or regions. First, several structures are located in the oral (mouth) cavity. The remaining organs are located in the thoracic (chest) cavity.

Before we begin the dissection, let's review the functions of the parts of the respiratory system we will explore in this lab.

Hard and soft palate--separate nasal chamber from oral chamber (mouth). The palates are the roof of the mouth and the floor of the nasal chamber

Epiglottis--covers trachea during swallowing; prevents food and water from entering the lungs

Trachea--passageway for air from pharynx to lungs

Diaphragm--muscle below lungs involved in inhalation and exhalation processes

Alveoli--air sacs in lungs where gas exchange with blood occurs

Materials needed

Fetal pig	Pencil
Scissors	Dissecting pan

Part I: Oral Cavity

1. With scissors, cut along each side of your pig's mouth to drop the lower jaw. This is necessary to observe the structures located in the back of the mouth.

2. Locate the structures described on the following page in Table 1 as shown in Figure 1 on your fetal pig.

Table 1

Part	Location and Function
Tongue	Found on lower jaw. Contains taste buds and helps to push food back into esophagus when swallowing
Esophagus	Found at back of mouth. Leads to stomach; horizontal, narrow opening at back of mouth
Nasopharynx (Pharynx)	Found at back of mouth. Carries air from nasal chamber or space above palate (roof of mouth) into trachea, an opening that appears somewhat round at back of mouth
Hard palate	Found in upper jaw of pig. Front portion of roof of mouth. Separates nasal chamber (space above mouth) from mouth
Soft palate	Found in upper jaw of pig. Back portion of roof of mouth. Separates nasal chamber from mouth
Epiglottis	Found in back of mouth. Appears on back end of tongue. Looks somewhat like a flap. It closes shut when swallowing occurs and thus prevents food or liquid from entering lungs
Glottis	Found at back of mouth of pig. Opening that leads to the trachea. Seen as slit under epiglottis in pig. Closed by the epiglottis
Nares	Found at very front of upper jaw. Two small openings (nostrils) through which air passes in and out of nasal chamber

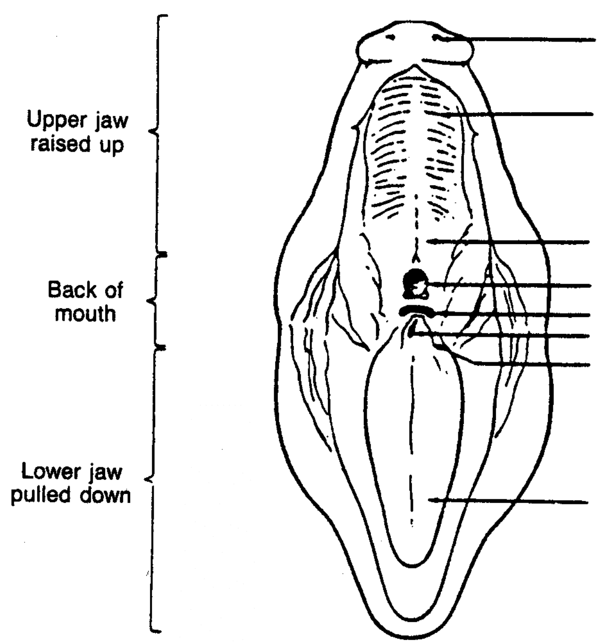


Figure 1

3. Label the following structures in Figure 1: Tongue, Hard palate, Soft palate, Nares, Esophagus, Epiglottis, Glottis and Nasopharynx.

   If all structures shown are not visible, extend the cuts to expose all of the mouth. You may need to cut through the jawbones.

Part II: Chest Cavity

1. The heart is located between the lungs. It is enclosed in a tough membrane called the pericardium. Partially covering the heart is a gland called the thymus.

2. Remove as much of the pericardium and thymus as necessary to totally expose the heart. DO NOT remove any lung tissue.

3. Cut the vessels leading to and from the heart. Also, cut any pericardium or other tissue that may be holding the heart. Remove the heart from the pig. DO NOT damage or cut the lungs.

4. Extend the cut in your pig's chest cavity made during the removal of the heart. Continue cutting in a straight line along the middle of the chest up to the chin.

5. Locate the *trachea*, a long tube composed of ringlike sections extending along the middle of the chest cavity.

6. Push aside muscle attached to the anterior (or top) portion of the trachea. A slight bulge in the trachea is the *larynx*, or voice box.

7. Cut lengthwise into the larynx with scissors. *Vocal cords* should be visible.

8. Locate the *left* and *right lungs*. These organs are composed of soft tissue and have many lobes which occupy most of the chest cavity.

9. Remove any tissue covering the lower portion of the *trachea*. The *trachea* branches into each lung. These branches are the *left* and *right bronchi*.

   Between the chest and abdominal cavity is a very thin muscle. This muscle, called the *diaphragm*, separates the thoracic cavity from the abdominal cavity and aids in inhaling and exhaling.

10. Using the above descriptions and what you observe in your fetal pig, label the following structures on Figure 2: Trachea, Larynx, Vocal cords, Diaphragm, Left lung, Right lung, Left bronchus, and Right bronchus.

    (Remember, left and right sides are reversed in Figure 2)

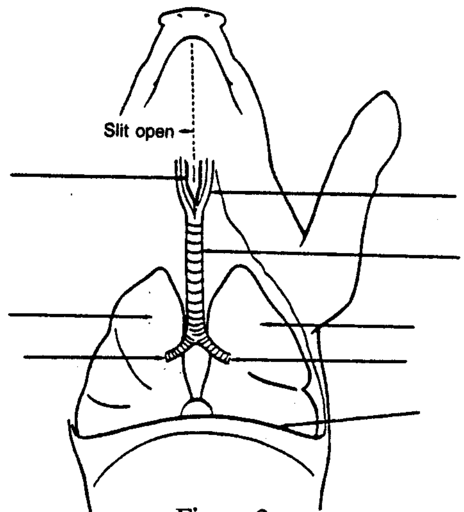


Figure 2

Part III: Lung Anatomy

1. Remove either the left or right lung by cutting with scissors where the bronchus branches from the trachea.

2. Starting where the bronchus enters the lung, use a pencil to push aside all of the soft lung tissue. This should reveal the branches of the bronchus. These branches are called *bronchial tubes*.

    The *bronchial tubes* branch extensively in the lungs. They end as many small air sacs called *alveoli*. *Alveoli* are very thin-walled and are surrounded by capillaries of the lungs. It is in the *alveoli* where gas exchange occurs between blood and air.

Part IV: Analysis

1. Match the part of the respiratory system to its correct function.

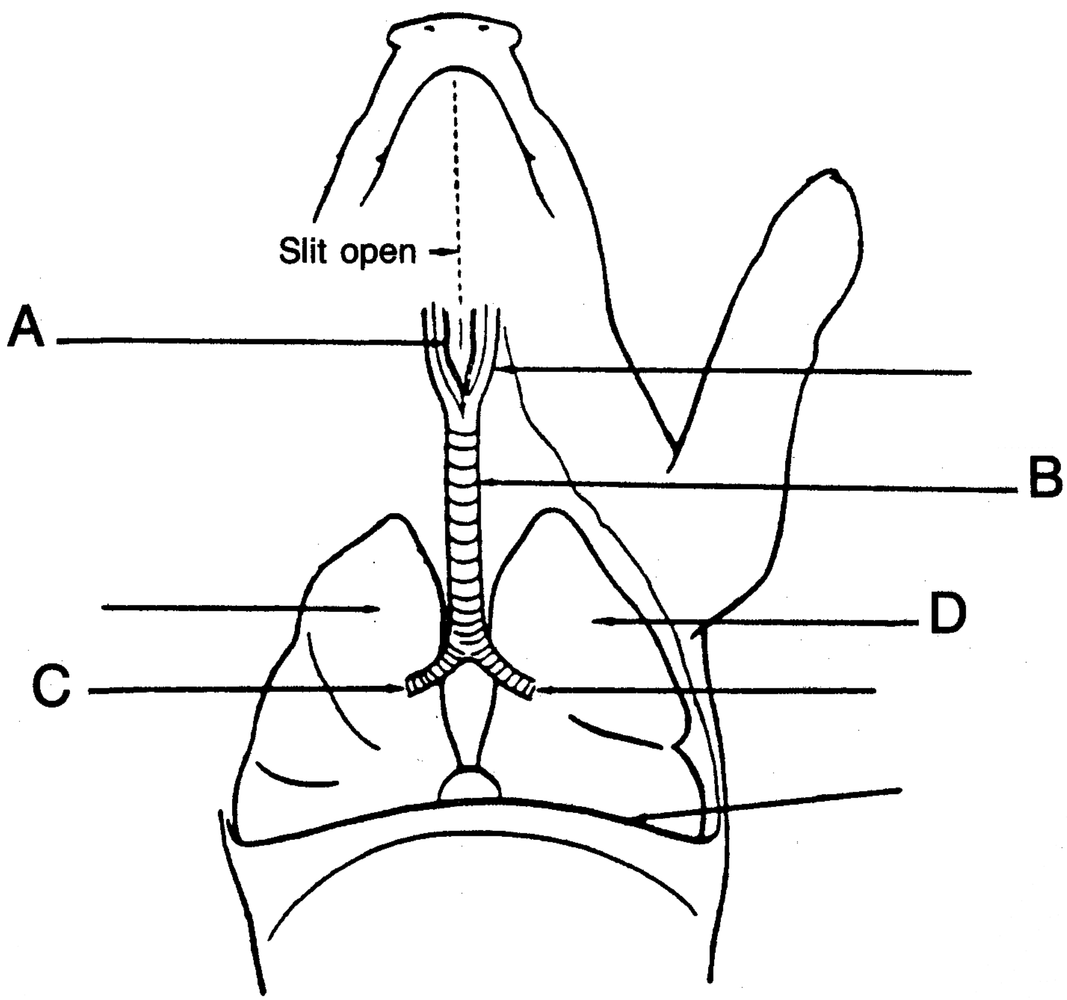
_____Nasopharynx	a.	Muscle below lungs involved in inhalation and exhalation process
_____Epiglottis	b.	Air sacs in lungs
_____Diaphragm	c.	Passageway for air from pharynx to lungs
_____Alveoli	d.	Covers trachea during swallowing

2. List two materials required to perform this lab.

    a.____

    b. ____

3. Identify the parts labeled A through D on the figure below.



A. ______________________ B. ______________________

C. ______________________ D. ______________________

ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

LABORATORY EXERCISE #3--HEART STRUCTURE

Name ______________________________ Score ______________________________

Introduction

The heart is a muscular organ which pumps blood. It is divided into four chambers. The two upper chambers take in blood. The two lower chambers pump blood out of the heart. An upper chamber is called an *atrium*. A lower chamber is called a *ventricle*.

Blood moves in only one direction in the heart. Between each atrium and each ventricle there is a valve. The valve acts like a door that opens in one direction. Each valve keeps the blood moving in only one direction.

Blood first moves into the two upper chambers. The top chambers then pump blood through the valves into the lower chambers. As the lower chambers fill with blood, the valves close. When the lower chambers squeeze together, blood is forced out of the heart. Blood does not move back into the top chambers.

Figure 1 traces the flow of blood though the animal heart. It contains the names and locations of all the major blood vessels and heart structures. Trace the path of blood from the head through the heart and back out to the head. Do the same for blood coming from the legs.

Heart Structure

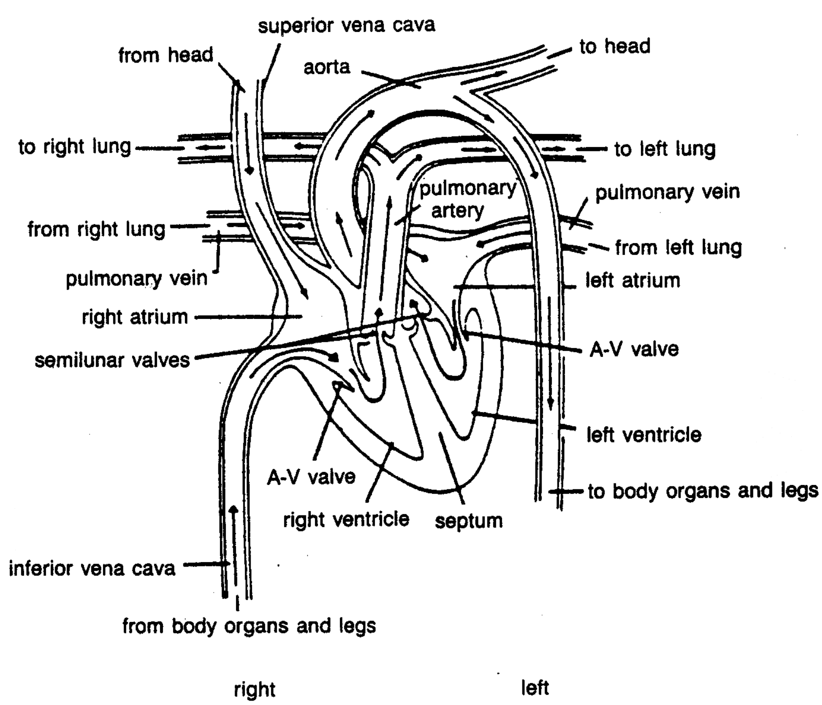


Figure 1

Before beginning the experiment, let's become familiar with the terms *deoxygenated* and *oxygenated*. All blood vessels bringing blood to the heart's right side and leaving from the right ventricle contain blood that is deoxygenated. Deoxygenated blood is blood that is low in oxygen and high in carbon dioxide.

All blood vessels bringing blood to the heart's left side and leaving from the left ventricle contain oxygenated blood. Oxygenated blood is blood that is high in oxygen and low in carbon dioxide.

Materials needed

Cow heart (or sheep)	Paper towels
Dissecting pan	Probe

Part I: Examine the Outside of the Heart

1. Place the heart in the dissecting pan so that it looks like the diagram titled Figure 2. The right side of the heart is on your left side. The left side of the heart is on the right.

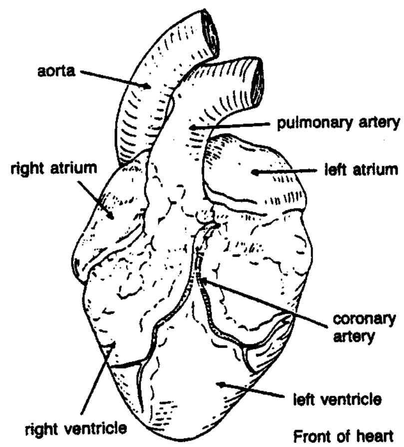


Figure 2

Table 1 **Front Parts of the Heart**

Part	Location	Traits	Name
A	across front of heart center	small blood vessel	coronary artery (KOR uh ner ee)
B	bottom center and right	large muscle section or chamber	left ventricle (VEN trih kul)
C	bottom left	large muscle section or chamber	right ventricle
D	top right	small muscle section or chamber	left atrium (AY tree um)
E	top left	small muscle section or chamber	right atrium
F	top center	large blood vessel from right ventricle	pulmonary artery (POOL muh ner ee)
G	top center behind F	large blood vessel from left ventricle largest artery in body	aorta (ay ORT uh)

2. Use the information in Table 1 and the diagram in Figure 2 to find the following parts on your cow heart: (Place an X after each part you successfully locate).

Coronary artery	______	Right atrium	____
Left ventricle	______	Pulmonary artery	____
Right ventricle	______	Aorta	____
Left atrium	______		

3. Turn the heart over. Note: Right and left change when the heart is turned over. Use the information in Figure 3 and Table 2 to find the following parts: (Place an X after each part you successfully locate).

Vena cava veins	______	Pulmonary vein	____

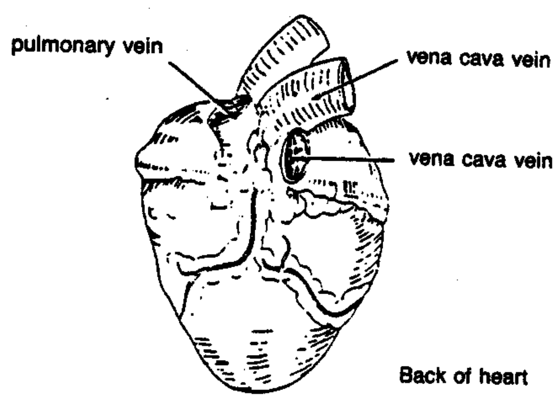


Figure 3

Back Parts of the Heart

Part	Location	Traits	Name
A	top of right atrium (top right)	two large blood vessels, holes may be all that can be seen	vena cava veins (VEE na KAY va)
B	top of left atrium (top left)	large blood vessel, hole may be all that can be seen	pulmonary vein

Table 2

Part II: Examine the Inside of the Heart

1. Your teacher will cut the front and back sections of your cow heart apart. Keeping both halves together, lay the heart in the dissecting pan as you did in the first step of Part I.

2. Remove the top half of the heart and lay it aside. Examine the bottom half of the heart. Note which chamber is the largest.

    a. The largest chamber is the ________________________.

3. Examine the thickness of the muscle that makes up the sides of the heart ventricles. Examine the walls of the atria for thickness, too.

    a. Which chamber, the atrium or ventricle, has thicker walls? ____________________________

    b. Of the right or left ventricle, which has thicker walls? ________________________________

4. Find all of the parts shown in the diagram titled Figure 4. As you locate each part, check it off the list below.

Aorta	______	Left ventricle	____
Valve	______	Left heart valve	____
Right atrium	______	Left atrium	____
Right heart valve	______	Pulmonary artery	____
Right ventricle	______		

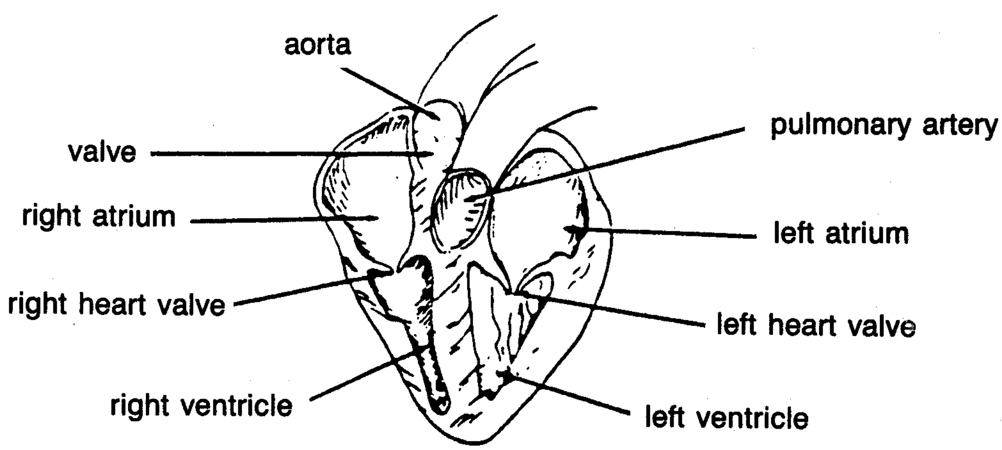


Figure 4

5. Examine the top half of your cow heart. Look for the valves. Remember that valves keep the blood flowing in one direction in the heart. The closing of the valves makes the noise we know as the heart beat.

6. Find all the parts shown in the diagram titled Figure 5. As you locate each part, check it off the list shown below.

Pulmonary artery	______	Right ventricle	____
Left atrium	______	Right heart valve	____
Left heart valve	______	Right atrium	____
Left ventricle	______	Artery valve	____
		Aorta	____

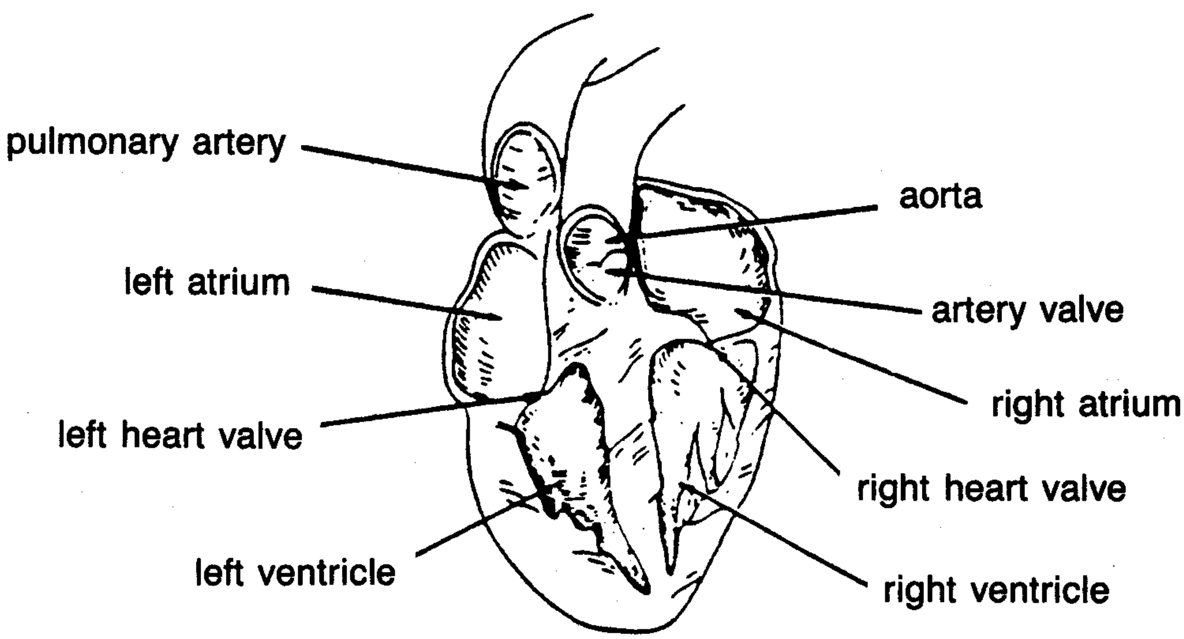


Figure 5

Part III: Analysis

1. What are the largest chambers of the heart?

____

2. What chambers are at the top of the heart?

____

3. Which have thicker walls, atria or ventricles?

____

4. Which ventricle, left or right, has thicker walls?

____

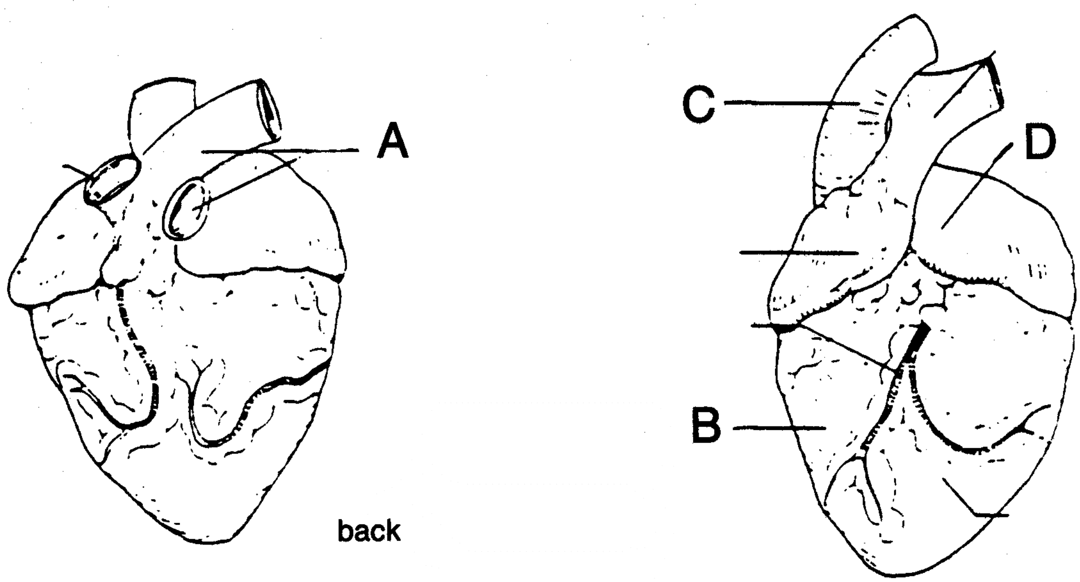
5. Which ventricle pumps blood to the body?

____

6. Which ventricle pumps blood to the lungs?

____

7. Identify the parts labeled A through D on the diagrams below.



A. ______________________ C. ______________________

B. ______________________ D. ______________________

8. Which side of the heart has blood high in oxygen?

____

9. Which side of the heart has blood low in oxygen?

____

10. From what body organ does the blood get oxygen? ______________________

11. Blood is kept moving in only one direction by ______________________

12. The largest artery in the body is called the ______________________

ANIMAL TISSUES, SYSTEMS AND ORGANS

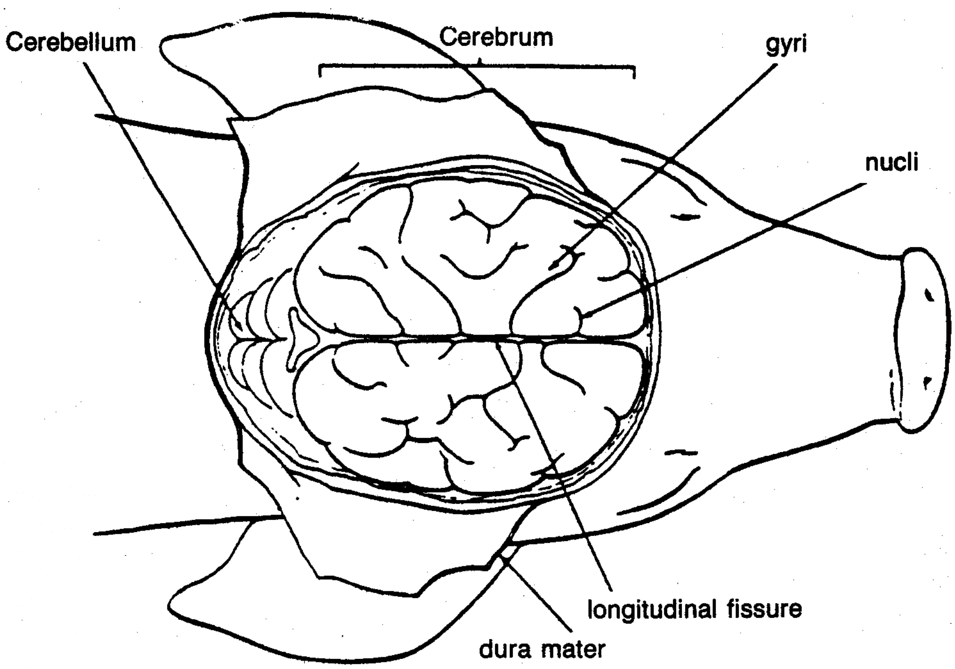
AG 530 - E

ANSWERS TO LABORATORY EXERCISES

Lab #1

Part I:

Step 6:



Part II:

1. b, a, c, b
2. Answer should include any two of the following: Fetal pig, dissecting pan, scissors, tweezers
3. a. Cerebellum
   b. Gyri
   c. Longitudinal fissure
   d. Dura mater

Lab #2

Part I, II:

Students should have labeled Figure 1 and Figure 2 as you see them below:

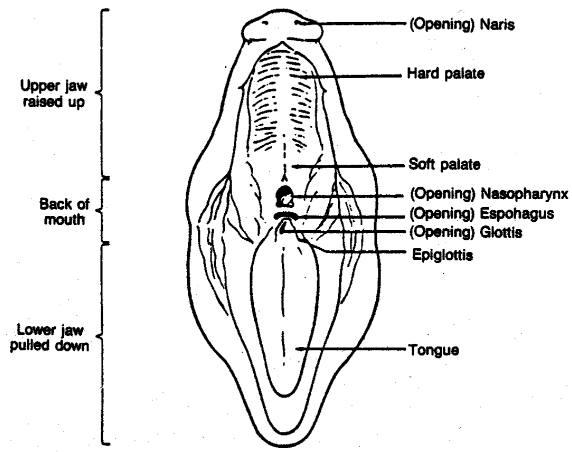


Figure 1

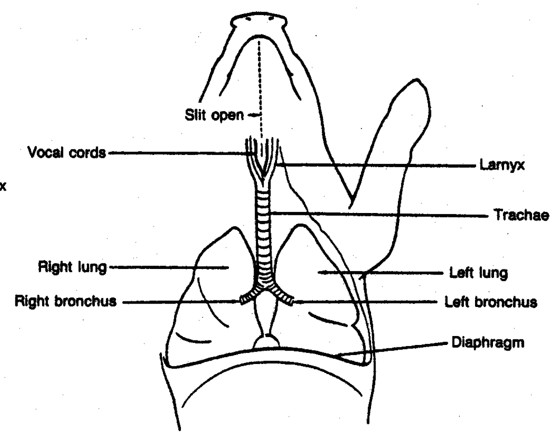


Figure 2

Part IV:

1. c, d, a, b
2. Answer should include any two of the following: Fetal pig, scissors, pencil or dissecting pan
3. A. Vocal cords B. Trachea
   C. Right bronchus D. Left lung

Lab #3

Part I:

Students should have checked off all parts listed in Part I, steps 2 and 3.

Part II:

2. a. Largest chamber in the heart is the Ventricle.
3. a. Chamber with the thickest walls is the Ventricle.
   b. Left ventricle has the thicker walls.
4. Students should have checked off all parts listed in Part II, steps 4 and 6.

Part III:

1. Ventricles
2. Atria
3. Ventricles
4. Left
5. Left
6. Right

7. A. Vena Cava Veins
   B. Right Ventricle
   C. Aorta
   D. Left atrium
8. Left
9. Right
10. Lungs
11. Valves
12. Aorta

ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

UNIT TEST

Name ______________________________ Score ______________________________

1. Describe the four primary animal tissues.

   a.____

   ____

   ____

   b. ____

   ____

   ____

   c.____

   ____

   ____

   d. ____

   ____

   ____

2. Identify the types of epithelial tissue described below. Write the correct name in the blank.

a.________________________	Found in ducts and passageways; short prism-shaped
b. ________________________	Found in pharynx and salivary ducts
c.________________________	Kinked fibers that tend to regain shape after being stretched
d. ________________________	Found in blood vessels; flat-shaped
e.________________________	Forms outer skin layer; thickest and toughest of epithelial tissues
f.________________________	Tall; found in intestines and trachea
g. ________________________	Netlike, star-shaped
h. ________________________	Stretches from many layers thick to a single layer

i. ___________________________ Found in upper respiratory; vary in length

j. ___________________________ Found in mucous or hormonal glands

3. Match the types of connective tissue with their correct description by placing the appropriate number in the blank.

1. Endomysium 2. Perinysium 3. Epinysium

_____a. Connective tissue around groups or bundles of muscle fibers

_____b. Connective tissue surround the individual muscle fibers

_____c. Connective tissue surrounding the entire muscle

4. Identify the types of muscular tissue described below. Write the correct name in the blank.

a.______________________________ Muscles of the gastrointestinal tract

b. _____________________________ The skeletal muscle

c.______________________________ The cardiac muscle

5. Identify the types of nervous tissue described below. Write the correct name in the blank.

a.___________________________ Conduct impulses from skin or sense organs to nerve centers

b. __________________________ Form connections between other neurons

c. ___________________________ Conduct impulses from the nerve centers to muscles or glands

6. State the functions and list the three major organs of the circulatory system.

Functions: ____

____

Major organs:

a.____

b. ____

c.____

7. State the functions and list the seven major organs of the digestive system.

Functions: ____

____

Major organs:

a.____

b. ____

c.____

d. ____

e.____

f.____

g. ____

8. State the functions and list the two major organs of the respiratory system.

Functions: ____________________________________

____

Major organs:

a.____

b. ____

9. State the function and list the two major organs of the excretory system.

Function: ____________________________________

____

Major organs:

a.____

b. ____

10. State the function and list the three major organs of the nervous system.

Function: ____________________________________

____

Major organs:

a.____

b. ____

c.____

11. State the function and list the major organ of the endocrine system.

    Function: ______________________________

    ____

    Major organ: ______________________________

12. State the functions and list the major organ of the skeletal system.

    Functions: ______________________________

    ____

    Major organ: ______________________________

13. State the function and list the major organ of the muscular system.

    Function: ______________________________

    ____

    Major organ: ______________________________

14. State the function and list the two major organs of the reproductive system.

    Function: ______________________________

    ____

    Major organs:

    a.______________________________

    b. ______________________________

ANIMAL TISSUES, SYSTEMS AND ORGANS

AG 530 - E

ANSWERS TO TEST

1. Answer should include the following information:
   a. Epithelial tissue: Covers an internal or external surface; Body surface, body cavities linings, body ducts and passages and the secretory portion of glands
   b. Connective tissue: Sheets or bands of tissue composed of strands or fibrils of three proteins (collagen, elastin, reticulum) distributed in a watery matrix of ground substance; Forms a part of the skeletal system; Forms the firm attachment against which a muscle pulls (muscle connections to bone); Surrounds, collects and forms a harness to regulate and control muscle fibers, muscle fiber bundles and entire muscles during contraction and relaxation
   c. Muscular tissue: Most common tissue found in most animals; The cell or muscle fiber is made up of elongated strands specialized for contraction; The contractile elements of the fiber are micro fibrils
   d. Nervous tissue: Conducts impulses after receiving some stimulus; Neuron--The essential cell of the nervous system; Dendrites--Nerve fibers connected to the nerve cell body that conduct impulses <u>toward</u> the cell body; Axon--Nerve fibers connected to the nerve cell body that conduct impulses <u>away</u> from the cell body

2. a. Cuboidal f. Columnar
   b. Stratified columnar g. Branching
   c. Yellow h. Transitional
   d. Squamous i. Pseudostratified columnar
   e. Stratified squamous j. Glandular

3. a. 2 b. 1 c. 3

4. a. Smooth-involuntary
   b. Striated-voluntary
   c. Striated-involuntary

5. a. Sensory b. Association c. Motor

6. Function--Carries gases, digested food and other materials to all parts of the body
   Major organs: Heart; Arteries; Veins

7. Function--Takes in food, digests food and eliminates undigested wastes
   Major organs: Mouth; Pharynx; Esophagus; Stomach(s); Small intestine; Large intestine (includes cecum, colon and rectum); Accessory organs (includes pancreas, liver, gall bladder)

8. Function--Takes in air, uses certain gases from the air, expels waste gases
   Major organs: Lungs; Air passages

9. Function--Eliminates wastes produced inside the cells
   Major organs: Kidney ; Bladder

10. Function--Collects information from inside and outside the body to help regulate body functions
    Major organs: Brain; Spinal cord; Nerves

11. Function--Helps regulate the chemical substances in the body
    Major organs: Ductless glands

12. Function--Provides a framework for the body and protects many vital organs
    Major organs: Bones

13. Function--Acts on the skeleton to allow body movement
    Major organs: Muscles

14. Function--Makes the sex cells necessary for producing offspring
    Major organs: Ovaries; Testes

GENETICS AND HEREDITY

AG 530 - F

UNIT OBJECTIVE

After completion of this unit, students should be able to select livestock using the results of performance and progeny testing and based on their genetic makeup. Students should also be able to identify the different systems of breeding livestock and select the method that would best fit the student's particular farming operation. This knowledge will be demonstrated by completion of assignment sheets, laboratory exercises and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with selecting and breeding livestock to the correct definitions.
2. Select from a list hereditary characteristics that are determined by genes.
3. Describe how heritability should affect selection of breeding stock.
4. Match the types of livestock to the correct number of chromosome pairs.
5. Describe in a short paragraph how the genetic makeup of an animal is determined.
6. Distinguish between dominant, recessive and incomplete dominant genes.
7. Distinguish between a simple gene inheritance and multiple gene inheritance.
8. Describe how the sex of the offspring is determined.
9. Distinguish between performance testing and progeny testing.
10. Match the different systems of breeding livestock to the correct definitions.
11. Estimate all possible gene combinations when given the matings using the checkerboard procedure.
12. Observe mitosis and meiosis.
13. Study sex-linked traits.
14. Predict inheritance.
15. Study the influence of chance on inheritance.
16. Breed fruit flies to study genetics.

GENETICS AND HEREDITY

AG 530 - F

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Make transparencies and necessary copies of materials.

   B. Provide students with objectives and discuss.

   C. Provide students with information and discuss.

   D. Provide students with assignment and laboratory sheets.

   E. Develop information on dihybrid crosses for more interested students.

   F. Arrange a field trip to allow students an opportunity to see the different livestock breeding programs.

   G. Obtain sale catalog from production sales for student to study pedigrees.

   H. Take pictures of different hereditary characteristics which may result from selective breeding.

   I. Discuss and demonstrate assignment sheets and laboratory exercises.

   J. Review and give test.

   K. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheets

   D. Transparency masters

      1. TM 1--Sex Determination

      2. TM 2--Inheritance of Color

   E. Assignment sheet

      1. AS 1--Estimate Possible Gene Combinations Using the Checkerboard Procedure

   F. Answers to assignment sheet

G. Instructor notes for laboratory exercises

H. Laboratory exercises

1. LE 1--Mitosis and Meiosis
2. LE 2--Sex-linked Traits
3. LE 3--Predicting Inheritance
4. LE 4--Influence of Chance on Inheritance
5. LE 5--Breeding Fruit Flies to Study Genetics

I. Answers to laboratory exercises

J. Test

K. Answers to test

III. Unit references

A. *Agricultural Education Curriculum*, College of Agriculture, University of Illinois, Urbana, Illinois, 1989.

B. Campbell, John R., Lasley, John F. *The Science of Animals That Serve Mankind*. McGraw-Hill Book Company, 1975.

C. Ensminger, M.E., *Animal Science*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1962.

D. Ensminger, M.E., *Animal Science*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1977.

E. Ensminger, M.E., *Beef Cattle Science*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1968.

F. Ensminger, M.E., *Stockman's Handbook*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1962.

G. Otto, James H., Towle, Albert, *Modern Biology*, Holt, Rinehart and Winston, Publishers, New York, 1985.

H. Slesnick, Irwin L., et. al., *Biology*, Scott, Foresman and Company, Glenview, Illinois, 1985.

GENETICS AND HEREDITY

AG 530 - F

INFORMATION SHEET

I. Terms and definitions

A. Gene--Complex molecule that determines hereditary characteristics of living animals; located at definite places on the chromosomes

B. Chromosome--Thread-like structure which exists in pairs and carries genes

C. Mutation--Random changes that take place in a gene
(Note: These are very rare and may be harmful.)

D. Mitosis--Division of a body cell into two duplicate body cells

E. Meiosis--Division of a sex cell producing a cell or cells containing only one of each gene and chromosome pair

F. Genetics--Branch of biology that deals with the heredity and variation of organisms

G. Gamete--Mature germ cell, egg or sperm

H. Fertilization--Union of the egg and sperm

I. Zygote--Fertilized egg
(Note: In the zygote the genes and chromosomes are restored to pairs.)

J. Homozygous--Animal that is pure for a certain gene such as the polled gene

K. Heterozygous--Animal that is a carrier of a pair of unlike genes

L. Phenotype--The outward appearance of the animal
(Note: Individuals of the same phenotype look alike, but may not breed alike.)

M. Genotype--Genetic make-up of the animal
(Note: Individuals of the same genotype breed alike.)

N. Lethal gene--Genetic factor that causes death of the young during prenatal life, at birth or soon after
(Note: These may be discovered and therefore removed by test mating, especially a bull to his daughters.)

O. F_1--Symbol which represents the first cross from a mating

P. F_2--Symbol which represents second cross from a mating

Q. Heritability--Percentage of differences in a trait that can be explained by inheritance as opposed to environment

R. Dwarfism--Inherited characteristic of cattle resulting in small, deformed animals (Note: Dwarf carrier calves cannot be distinguished from non-dwarf carrier calves. A purebred breeder would therefore want to get rid of all offspring and parents known to carry the dwarf characteristic.)

II. Some hereditary characteristics determined by genes

A. Body size

B. Color of hair coat

C. Eye color

D. Length of leg

E. Dwarfism

F. Ability to fatten

III. Heritability--Some characteristics in animals are highly heritable while others are not; selection of breeding stock should be weighted towards those factors which have a high heritability

Example: Length of hogs has a 60% heritability while litter size has only a 5-15% heritability

(Note: Specific heritability percentages for individual traits are provided in the Selection and Evaluation unit for each livestock species in AG 140.)

IV. Chromosome pairs of different species

A. Cattle--30 pairs

B. Swine--19 pairs

C. Sheep--27 pairs

D. Chickens--39 pairs

E. Humans--23 pairs

F. Horses--32 pairs

(Note: With all possible combinations in chromosome pairs and genes, each parent of the livestock species can transmit over one billion different samples of inheritance. Therefore, no two animals within a given breed are exactly alike except identical twins.)

V. Genetic makeup

A. Determined by the union of two cells, one from each parent

B. Each cell contains one chromosome from each pair in the parent or 1/2 the total number of chromosomes

(Note: These two germ cells indicate whether a calf will be polled instead of horned, black instead of white, a bull instead of a heifer.)

VI. Genes

A. Dominant--Genes that have the ability to cover up or mask the presence of one member of a set of genes in the F_1 generation

Examples: Pure polled; white face in Herefords; drop ears in swine

(Note: Dominance is usually designated by a capital letter.)

B. Recessive--Genes that are covered up or masked in the F_1 generation

Example: Horned; erect ears in swine

(Note: Recessive genes are usually designated by a small letter.)

C. Incomplete dominant--Genes that are neither completely dominant nor recessive and which only contribute to a certain characteristic

Example: Crossing a red and white Shorthorn results in a roan color which is a combination of red and white hairs. Neither characteristic completely masks or is masked by the other

VII. Gene inheritance

A. Simple--One pair of genes determines the inheritance of a particular factor

B. Multiple--Several pairs of genes determine the inheritance of a particular factor

Examples: Genes affecting meat production, milk and butterfat production and growth rate

(Note: Growth rate is hard to identify and is controlled by several genes.)

VIII. Sex determination (Transparency 1)

A. A female egg contains an X chromosome

B. A male sperm contains either an X or Y chromosome

C. Egg and sperm unite randomly to form zygote

1. If egg and sperm contain like chromosomes (X and X), a female is conceived

2. If egg and sperm contain unlike chromosomes (X and Y), a male is conceived

(Note: The male sperm therefore determines the sex of the offspring.)

IX. Production testing

(Note: Production testing is the practice of evaluating and selecting animals on the basis of progeny and performance testing. This is done on characteristics of economic importance.)

A. Performance testing--Practice of evaluating and selecting animals on the basis of their individual merit or performance

(Note: This test applies to the measurement of an animal's ability to grow, convert feed to grain, produce and wean a calf, or yield a high-quality carcass. In order for this test to be of value, the animal should be compared to the performance of other animals of the same age being fed and handled under similar conditions.)

B. Progeny testing--Practice of selecting animals on the basis of the merit of their progeny (offspring)

(Note: In order for this type of test to be of value, several offspring should be evaluated. This test takes much longer than performance testing, but is a better indication of performance.)

X. Systems of breeding

A. Purebred--Member of a breed; animals which possess a common ancestry and distinctive characteristics and are either registered or eligible for registry in the herd book of that breed

B. Inbreeding--System of breeding in which closely related animals are mated

Example: Brother x sister, sire x daughter, son x dam

(Note: Scientists divide inbreeding into various categories according to the closeness of the relationship of the animals mated and the purpose of the mating.)

C. Outcrossing--Mating of animals that are members of the same breed but which show no relationship close up in the pedigree

D. Grading up--System of breeding in which purebred sires of a given pure breed are mated to native or grade females

E. Crossbreeding--Mating animals of different breeds

Example: Hereford x Angus, Simmental x Angus, Hampshire x Suffolk, Duroc x Chester White

XI. Checkerboard system showing gene combinations (Transparency 2)

A. Cross a pure, polled *(PP)* bull with horned *(pp)* cows

1. Mating: *PP* x *pp*

		Male	
		P	*P*
Female	*p*	*Pp*	*Pp*
	p	*Pp*	*Pp*

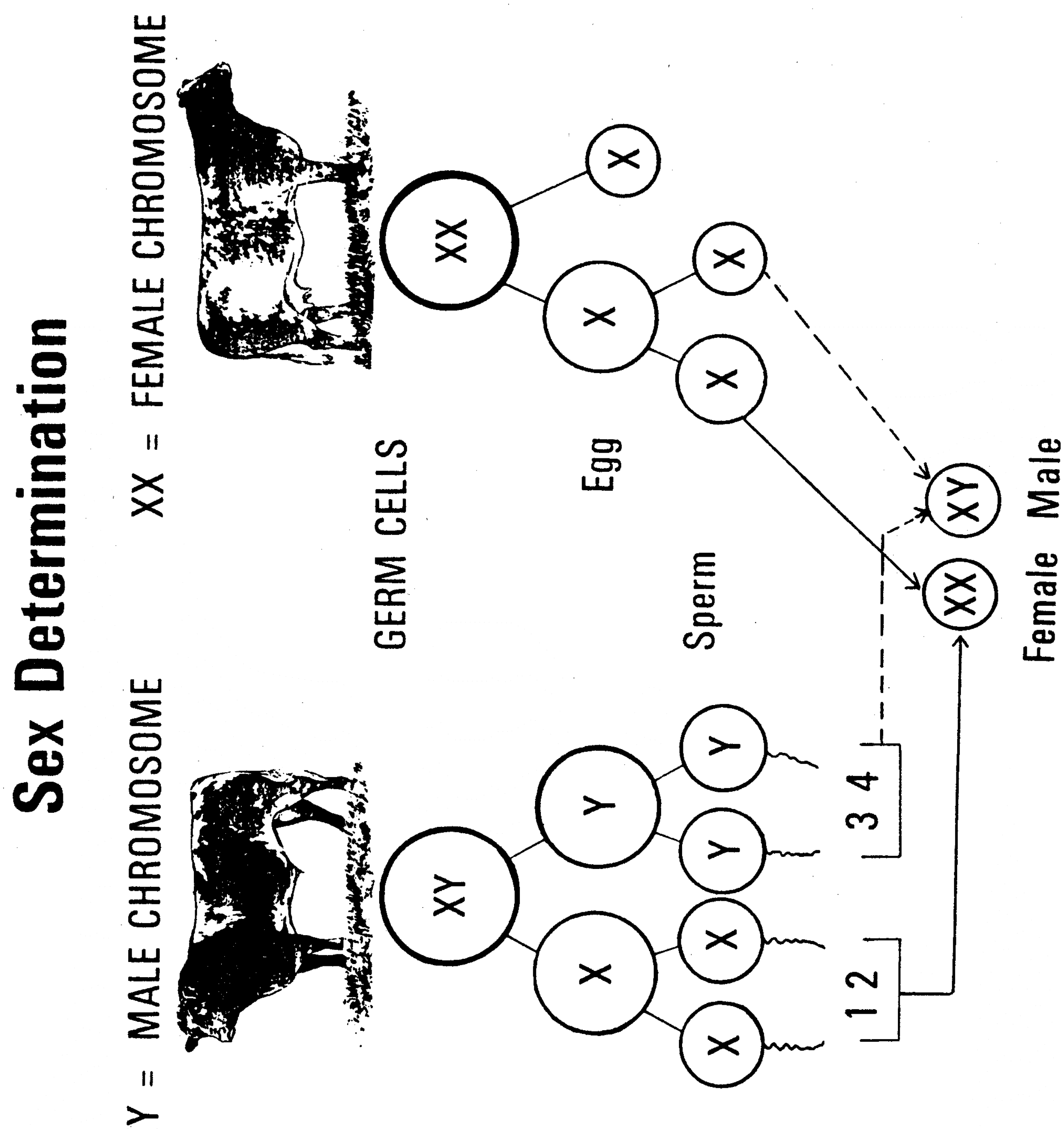
2. F_1 : Genotype--*Pp*
Phenotype--polled

B. Cross F_1 males (*Pp*) with F_1 females (*Pp*)

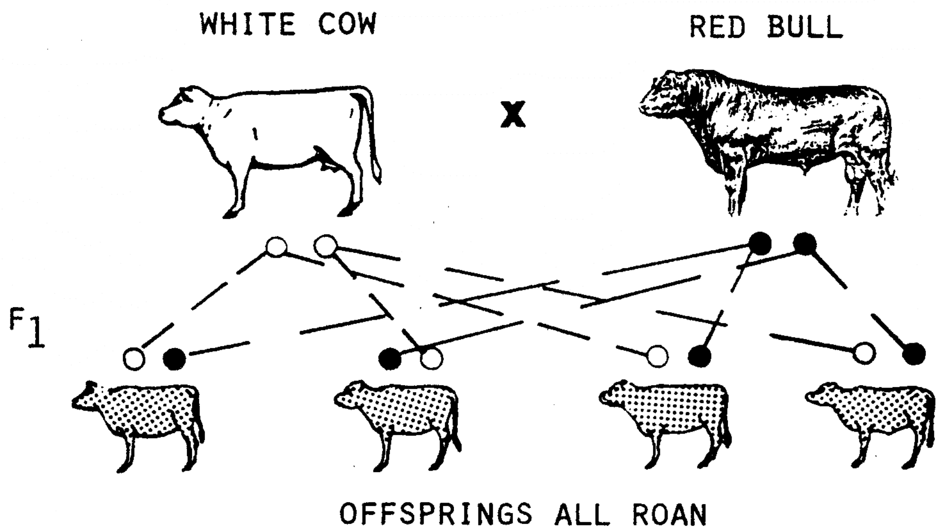
1. Mating: *Pp* x *Pp*

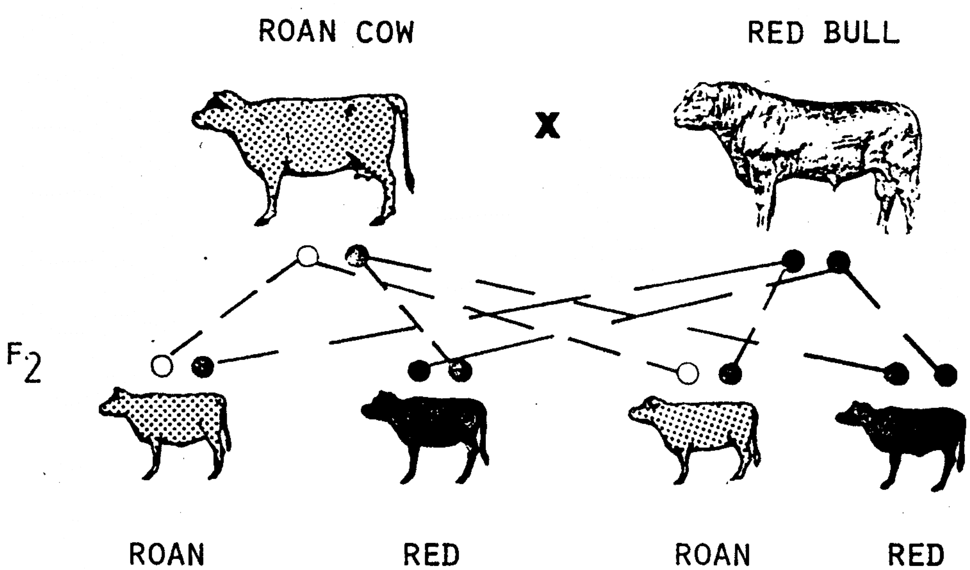
		Male	
		P	*p*
Female	*P*	*PP*	*Pp*
	p	*Pp*	*pp*

2. F2 Genotypic ratio--1 PP:2Pp:1pp
Phenotypic ratio--3 polled: 1 horned


Sex Determination
XY = MALE CHROMOSOME
XX = FEMALE CHROMOSOME
GERM CELLS
Egg
Sperm
XY
XX
X
Y
1 2
3 4
Female
Male

Inheritance of Color





GENETICS AND HEREDITY

AG 530 - F

ASSIGNMENT SHEET #1--ESTIMATE POSSIBLE GENE COMBINATIONS USING THE CHECKERBOARD PROCEDURE

Name ______________________________ Score ______________________________

Calculate each possible gene combination from the following matings. When completed, turn in to instructor for evaluation.

1. In Angus cattle, black hair color (B) is dominant over red hair color (b). What will be the gene combinations of the offspring from the following matings?

   a. BB male x BB female

   What will the F_1 genotype ratio be? ____________________

   What will be F_1 phenotypic ratio be? ____________________

   b. Bb male x bb female

   What will the F_1 genotype ratio be? ____________________

   What will be F_1 phenotypic ratio be? ____________________

c. Bb male x BB female

What will the F_1 genotype ratio be? ______________________

What will be F_1 phenotypic ratio be? _____________________

d. bb male x bb female

What will the F_1 genotype ratio be? ______________________

What will be F_1 phenotypic ratio be? _____________________

2. Suppose you mated a polled cow (*PP*) to a horned bull (*pp*). What will be the offspring's gene combinations?

What will the F_1 genotype ratio be? ______________________

What will be F_1 phenotypic ratio be? _____________________

3. Suppose you mated a polled bull carrying a recessive gene for horns (*Pp*) to a like cow. What would be the gene combination of the offspring?

What will the F_1 genotype ratio be? ______________________

What will be F_1 phenotypic ratio be? ____________________

4. Suppose you made a cross of a bull carrying tall genes (DD) to a cow carrying dwarf genes (dd). What would be the F_1 gene combination of the offspring? (use checkerboard)

5. Mate a bull that carries a dominant gene for tall and a recessive gene for dwarf (Dd) to a heifer with like genes. What would be the possible gene combinations of the offspring? (Use the checkerboard)

How many animals would be pure for tall? ______________________

How many animals would be tall with a recessive gene for dwarf? ______________________________________

How many animals would be dwarf? ___________________________

GENETICS AND HEREDITY

AG 530 - F

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

1. a.

	B	B
B	BB	BB
B	BB	BB

Genotypic ratio All BB

Phenotypic ratio All black

b.

	B	b
b	Bb	bb
b	Bb	bb

Genotypic ratio OBB:2Bb:2bb

Phenotypic ratio 2 Black

2 Red

c.

	B	b
B	BB	Bb
B	BB	Bb

Genotypic ratio 2BB:2Bb:Obb

Phenotypic ratio All Black

d.

	b	b
b	bb	bb
b	bb	bb

Genotypic ratio All bb

Phenotypic ratio All Red

2.

	p	*p*
P	*Pp*	*Pp*
P	*Pp*	*Pp*

Genotypic ratio <u>All *Pp*</u>

Phenotypic ratio <u>All Polled</u>

3.

	P	*p*
P	*PP*	*Pp*
p	*Pp*	*pp*

Genotypic ratio <u>1*PP*:2*Pp*:1*pp*</u>

Phenotypic ratio <u>3 Polled</u>

<u>1 horned</u>

4. a.

	D	D
d	Dd	Dd
d	Dd	Dd

1 pure tall
2 tall with recessive gene for dwarf
1 dwarf

b.

	D	d
D	DD	Dd
d	Dd	dd

GENETICS AND HEREDITY

AG 530 - F

INSTRUCTOR NOTES FOR LABORATORY EXERCISES

Lab #1

The principle of mitosis is the same for both plant and animal cells.
Mitosis insures genetic continuity and identity of the daughter cells.

Part I:

Point out to the students that interphase was once considered a "resting period", but this is not accurate because of the activity in this phase.

Part II:

The differences between plant and animal mitosis are only those of detail.

In diagrams showing stages of mitosis, have students mark those phases where there are definite differences in the details of mitosis from that of the plant cells.

Part III:

The diagram provided emphasizes the reduction of the chromosomes to half their original number.

Part IV:

Sperm formation (spermatogenesis) is identical, except that the primary spermatocyte divides to form two secondary spermatocytes. Thus, no polar bodies are formed and four sperms result.

Lab #2

Solution preparation:

In order to prepare a solution of a given percentage, use the number of grams of material equal to the percentage and add enough solvent to equal 100 ml. For example, a 10% sodium hydroxide solution is prepared by dissolving 10 g of sodium hydroxide in 90 ml water.

To reduce the concentration of an existing solution, pour the required percentage number of milliliters of the solution into a graduated cylinder. Add enough distilled water to bring the total volume in milliliters to equal the percentage of the original solution. For example, to reduce 95% alcohol to 80%, pour 80 ml of 95% alcohol into a graduated cylinder. Add enough distilled water to bring the volume to 95 ml. You now have 95 ml of 80% alcohol.

Hydrochloric acid, 20%

20 parts conc. hydrochloric acid
16 parts water

Carefully pour acid into water. *Never pour water into the acid.*

Part III:

The pipe cleaners should soak for an hour previous to use. They should remain in the solutions until you are ready to use them, for some may turn brown if they dry out. It is important that the brom thymol blue be a weak solution and in its transition color, which is blue green. Dilute about as much powdered brom thymol blue as will stick to half a wet toothpick in 500 ml of hot tap water. If the solution is not in its blue-green transition color, it may be adjusted as follows: Dilute a few drops of the 1% base about 10-fold, and a few drops of the 10% acid about 100-fold. Add a drop of the dilute base to the indicator solution. It should turn a deep blue. If it does not transmit light, it is too concentrated and should be diluted. Next add a few drops of the dilute acid one drop at a time until the indicator turns the blue-green color. If you go past this point, add a drop of the acid. If the indicator seems to go directly from blue to yellow and back, the acid and base solutions are too strong and should be diluted further. *It is essential that the indicator be in its transition color when supplied to the students.*

Four test tubes should be filled with the indicator and labeled, representing the "cytoplasm" of four cells. The pipe cleaner "chromosomes" should be distributed to the cells as directed in the procedure for the student, and the solutions observed for any change in color.

Instruct the students to use forceps to remove and handle the pipe cleaners.

Part IV:

The teacher should carefully dispose of the solutions in the test tubes.

Lab #3

Part I:

With complete dominance, whenever two individuals for a single trait are crossed, the same ratio is obtained.

Part VI:

Randomly distribute ears of corn having the 1:1 or 3:1 ratio of color. These may be obtained from several biological supply houses.

Lab #4

The times for the rounds should be approximately 1-2 minutes in duration. The students should remove the beans as quickly as possible from the boxes.

Part III:

The probability of a 7 being rolled is greater than for any other number. As you get further away from 7 (either higher or lower) the probability of rolling that number gets smaller. Therefore, 2 and 12 have the lowest probability.

Lab #5

Stocks of flies should be ordered about five weeks before they will be used. This is so that they may be recultured to increase the number of flies. Both old stocks for initial observation and new stocks for crosses will be required.

Materials

Ether is highly explosive and its vapors are dangerous. For these reasons we strongly recommend that you use a commercial, non-ether preparation that will anesthetize and immobilize the fruit flies. This type of non-ether preparation is available from biological supply houses.

Schedule:

Day 1	Have students practice handling the flies and make the F_1 cross
Day 7	Discard the F_1 parents and observe the F_1 larvae
Day 14	Transfer six F_1 adults to a fresh vial
Day 21	Record the F_1 offspring and discard the F_1 adults in the fresh vial used to make the F_2 generation
Day 28	Record and discard the F_2 offspring

Part I:

Step 3: Over-anesthetized and dead fruit flies have wings that stick out at right angles to their bodies.

Step 7: You may want the students to save the mixed fruit flies for observation by other classes. If so, have the students place the flies in the vials as they recover. If the flies are not to be used again have the students place the anesthetized flies in the oil morgue. The oil morgue humanely disposes of the flies.

Part II:

Generally it is easier and more accurate for the teacher to collect the virgin flies.

Step 7: The reciprocal cross of vestigial wing males and wild type females may give skewed results due to the males' handicaps in courtship behavior.

GENETICS AND HEREDITY

AG 530 - F

LABORATORY EXERCISE #1--MITOSIS AND MEIOSIS

Name ______________________________________ Score ___________________________________

Selection from Modern Biology, Biology Investigations, Teacher's Edition, by James H. Otto, Albert Towle, W. David Otto, and Myra E. Madnick.

Materials needed

Prepared slides of onion root tip
Microscope
Prepared slide of whitefish blastula
Colored pencils
Biology textbook

Part I: Mitosis in Plant Cells

In this part, you will observe the phases of cell division known as mitosis. The genetic materials are replicated and distributed through the process of mitosis.

Observe the stages of mitosis by examining the cells of an onion root tip with the microscope. The phases of mitosis are: *prophase, metaphase, anaphase* and *telophase. Interphase* is the phase when a cell is preparing for mitosis.

Observe the onion root tip under low power of your microscope. Locate an area of the root tip where mitotic changes can be observed. These changes are best observed in the region between the tip of the root and where the cells are beginning to elongate. Turn to high power to observe the cells more closely. How many stages can you locate? Refer to a biology text to help you identify the phases.

a. What role does the spindle play in the dividing cell? _____________________________________

____

b. Where does the cellulose wall form in the mother cell? __________________________________

____

c. What is its function? ____

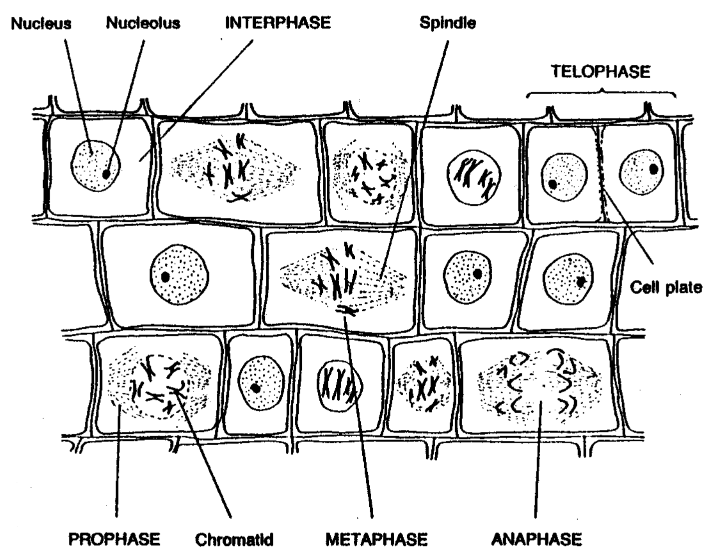
____

d. How can you differentiate prophase from metaphase? ______________________

e. What occurs during interphase? ______________________

In the diagram, label each of the phases of mitosis. Also identify the: **nucleus, nucleolus, spindle, chromatid, cell plate.**

Onion Root Tip (Mitosis)



Part II: Mitosis in Animal Cells

In this part, you will observe the mitotic phases in animal cells. You will observe certain structures that were not present during mitosis in plant cells.

Locate as many phases of mitosis as you can in the prepared slide of the whitefish blastula.

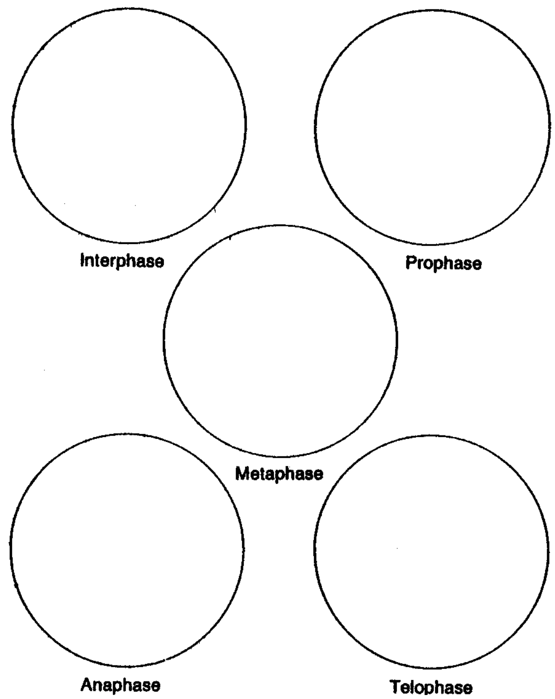
a. How do the poles of the spindle differ from those of the onion root tip? ______________________

b. Compare the separation of daughter cells with that of the plant cell wall. ______________________

c. Are there any structures in the animal cell that were not present in the plant cell? ______________

d. Are there any mitotic structures present in both the plant and animal cells? ______________

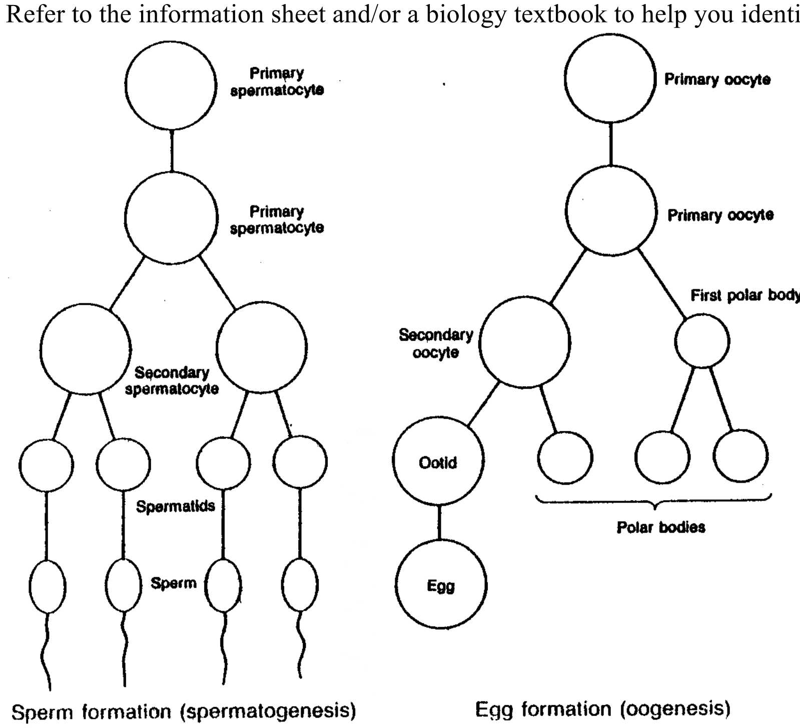
In the space provided, draw an animal cell in each stage of mitosis. Identify structures that differ from plant cell mitosis.



Part III: Chromosome Changes During Meiosis

Meiosis is a process that occurs only in the reproductive cells. This process allows for the reduction in chromosome number during the spermatogenesis and oogenesis.

Simplified diagrams of egg and sperm formation are given. Use these diagrams to indicate changes that occur during meiosis. Refer to the information sheet and/or a biology textbook to help you identify the stages.



Draw 2 pairs of chromosomes (use a different color for each) in the first stage of egg formation, the primary oocyte. Mark one chromosome of each pair *A* and one *B*.

a. What happens in the second cell during oogenesis? ____

____

Show this in the space provided.

b. What are the chromosomes called following this division? __________________________________

____

The chromosomes form pairs, separate, and move toward opposite poles. The primary oocyte divides, forming a secondary oocyte and the first polar body. Follow these steps in the diagram. Identify the chromosomes as *A* and *B* and use colored pencils to illustrate changes.

c. What has occurred during this phase? ____

____

d. What happens when the chromatids separate during the division of the secondary oocyte? ______

____

e. What is the chromosome number of the ootid and second polar body? _____________________

f. What happens to the ootid? ____

____

Fill in the chromosomes of the egg cell and the 3 polar bodies.

g. What is the function of the polar bodies in reproduction?

____

____

Show the chromosome changes for sperm formation just as you did in egg formation.

Part IV: Summary

a. List the stages of mitosis.______________________________

____

b. What is the significance of the mitotic process? ______________________________

____

c. How does mitosis in plant cells differ from mitosis in animal cells? ______________________________

____

____

d. What structures are present in both plant and animal cells? ______________________________

____

e. In what cells does meiosis occur? ______________________________

f. How would you define meiosis? ______________________________

____

g. What is the significance of meiosis? ______________________________

____

____

h. During which stages of the reproductive process does meiosis occur?______________________________

____

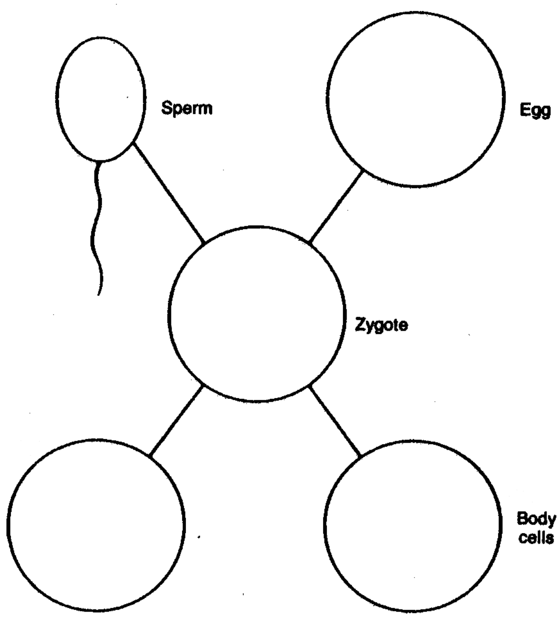
i. What would occur if there were no reduction of chromosome number? ______________________________

____

Part V: Investigations On Your Own

1. Examine different types of animal and plant cells and observe the phases of mitosis. Many prepared slides are available for this type of observation.

2. What happens when the sperm and egg cells produced in oogenesis and spermatogenesis meet? The union of the two cells is called *fertilization*. Illustrate the chromosome makeup of these cells by using colored pencils to fill in the diagram provided. When the zygote (fertilized egg) divides, body cells are formed. Fill in the chromosomes of the body cells.



GENETICS AND HEREDITY

AG 530 - F

LABORATORY EXERCISE #2--SEX-LINKED TRAITS

Name ______________________________________ Score ___________________________________

Materials needed

2 pennies
Adhesive tape
Forceps
4 test tubes (15 cm)
2 untreated white pipe cleaners
4 pipe cleaners soaked in 10% hydrochloric acid solution
2 pipe cleaners soaked in 1% sodium hydroxide solution
Weak brom thymol blue solution

Part I: How is Sex Determined?

Each human body cell contains 23 pairs of chromosomes. One of these pairs is different in the male and female.

a. What is this 23rd pair of chromosomes called? ____

____

Examine the genotype in the figure.

♂XY x ♀XX

Female → / Male ↓	X	X
X	XX	XX
Y	XY	XY

Figure 1

b. What is the genotype of the female? ____

c. Following meiosis, how many different sex chromosomes will be in the eggs? ______________

d. What difference may be seen in the genotype of the male? ______________________________

e. What is the possibility of chromosomes in sperms following meiosis? ____________________

Now let's demonstrate the probability involved in sex determination. Tape an "X" on one side of a penny, and on the other side, tape a "Y". On another penny, tape an "X" on both sides. Now, flip both coins and let them land.

f. What "chromosomes" appear?____

Continue the flips for at least 30 times. Record the chromosome combination that appears each time in the table.

g. What is the approximate ratio of genotypes obtained from flipping the pennies? _____________

CHROMOSOME COMBINATIONS FROM FLIPPING PENNIES	
X and X	X and Y

Figure 2

Now diagram the inheritance of sex chromosomes in the Punnett square.

♂XY x ♀XX

Female → Male ↓		

Figure 3

h. What is the probability that the offspring will be male? ________________________________

i. Female? ____

j. Which gamete actually determines the sex of the offspring?

____

k. Why is it impossible to predict accurately the sex of offspring?______________

Part II: Color Blindness - A Sex-Linked Trait

When a gene is carried on a sex chromosome, it is said to be sex-linked. In humans, the genes controlling color vision are located on the X chromosome. The X chromosome carrying a gene for normal vision is represented X^C, while X^c represents a gene for color blindness. Study the following table before diagramming the inheritance of color blindness in humans.

GENOTYPES		
Female	**Vision Ability**	**Male**
X^CX^C	normal	X^CY
X^CX^c	carrier	----
X^cX^c	color blind	X^cY

Use the Punnett square to determine the color vision ability of the offspring of a couple whose genotypes are X^cY and X^CX^c.

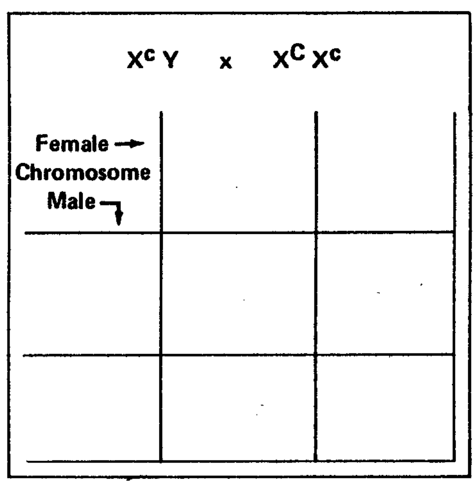


Figure 4

a. What percent of the females are color blind? ______________________

b. What is their genotype? ______________________________

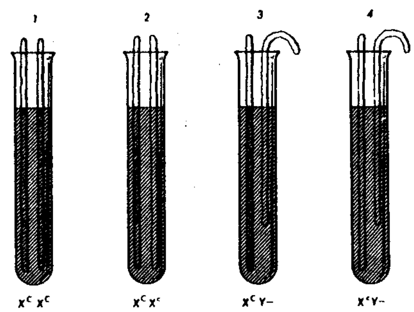
c. What percent of the males are color blind? ______________________

d. How is it possible that some male offspring have normal vision when the male parent is color blind?

____

Part III: A Model of Sex Linkage

In this part, you will use pipe cleaners to represent sex-linked chromosomes and test tubes to represent body cells. Obtain 4 pipe cleaners that have soaked for an hour in a 10% hydrochloric acid solution, 2 pipe cleaners soaked for an hour in a 1% sodium hydroxide solution, and 2 untreated pipe cleaners. Bend 2 untreated cleaners into a cane shape to represent the Y chromosome. Those soaked in the hydrochloric acid solution will represent the X^C chromosome, while those soaked in the sodium hydroxide solution represent the X^c chromosome. Number the test tube "cells" *1* through *4*. Fill each tube two thirds full of brom thymol blue solution. This model demonstrates the masking of the genes when a dominant and recessive gene are present in the same cell. *The color which appears in the test tube cells indicates the phenotype.* The solution turns yellow in the presence of acid (hydrochloric). Distribute the variously treated "chromosomes" as shown:



Technique for setting up the test tube "cells" and pipe cleaner "chromosomes"

Figure 5

Set up two acid "chromosomes" in tube 1; an acid and a base in tube 2; an acid and an untreated cleaner in tube 3; and a base and an untreated cleaner in tube 4. Observe any color change in the tubes. Record your observations and conclusions in the following table:

Genes	Color change	Color vision	Sex
X^CX^C			
X^CX^c			
X^CY^-			
X^cY^-			

Part IV: Summary

a. Why is sex determination considered a matter of chance? ______________________________

____

____

b. Explain why males more often exhibit sex-linked traits than females. ____________________

____

____

c. In the demonstration using pipe cleaners, what percent of the males would be color blind? ______

d. females? ____

e. If the male had been color blind and the female a carrier, what percent of the females would be color blind? ____

f. What percent of the males would be color blind? ________________________________

Part V: Investigations On Your Own

Hemophilia is a sex-linked trait of humans inherited in the same manner as color blindness. Because it often results in death, it is said to be lethal. Prepare a report on this sex-linked disease and other sex-linked traits not studied in this investigation. Include in your report an analysis of where it occurs in populations and the consequences of it being inherited.

GENETICS AND HEREDITY

AG 530 - F

LABORATORY EXERCISE #3--PREDICTING INHERITANCE

Name ______________________________ Score ______________________________

Materials needed

Genetic corn showing a 1:1 ratio of purple-nonpurple
Genetic corn showing a 3:1 ratio of purple-nonpurple
Straight pins

Part I: Predicting Ratios in a Monohybrid Cross

In this part, you will diagram the inheritance of a single trait. Flower position on pea plants is the trait to be studied here.

The parent plants crossed by Mendel are shown in the diagram. *Axial flowers* grow along the stem. *Terminal flowers* develop only at the tip of the stem. Mendel found in pea plants that axial (A) flower position is dominant to terminal (a) flower position. Examine the genotypes of each parent.

a. Which parent is homozygous for the dominant trait? ______________________________

b. the recessive trait? ______________________________

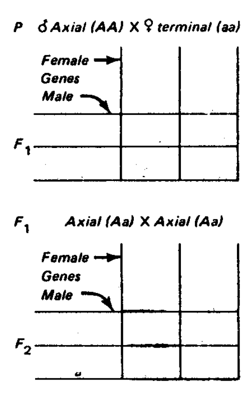
c. What gene will be contained in the gamete of the male parent? ______________________________

d. the female parent? ______________________________

Diagram the cross in the F_1 Punnett square.

e. What genes were inherited by the F_1 offspring? ______________________________

f. When planted, what will be the position of the flowers produced by the F_1 plants? ____________



g. How is the Principle of Unit Characters demonstrated? ______________________________

____

____

h. of dominance? ____

____

____

In the Punnett square, cross the F_1 offspring with themselves to obtain the F_2 generation.

i. Why is this called a monohybrid cross? ____

____

j. What ratio do you predict for phenotype among the F_2 offspring?______________________

____

k. What is the predicted ratio of genotype among the F_2 offspring?______________________

____

l. When complete dominance is involved, would the predicted ratios obtained in this cross hold true for any monohybrid cross? ____

Part II: What Ratios Are Obtained in a Dihybrid Cross?

In horses, black coats and trotting gait are dominant while the recessive alleles are white and pacing gait. If the male is homozygous for both dominant traits:

a. What is the genotype of the male?____

b. What genes are present in the sperms? ____

c. If the female is recessive for both traits, what genes are present in the eggs? ______________

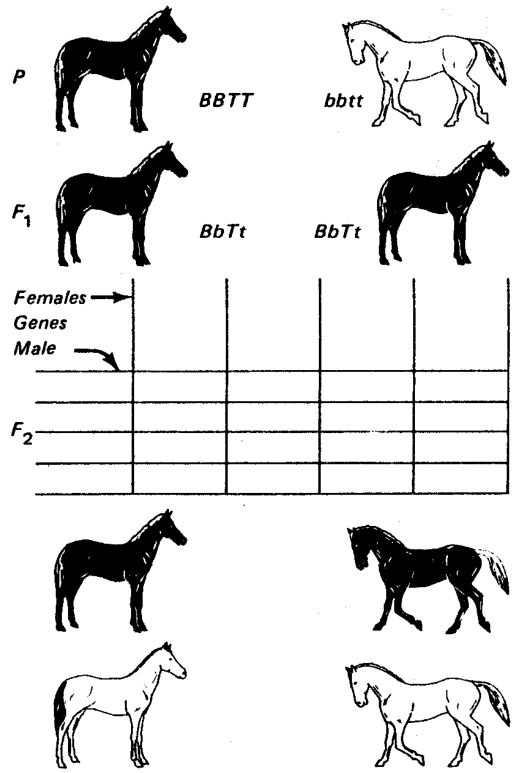
d. What is the genotype of the F_1 generation?___________________________________

e. What is the phenotype of the F_1 generation?__________________________________

____

Assuming a male and female are produced in the F_1, use these as parents to produce the F_2 generation.

Diagram the possible inheritance of the offspring from such a cross in the Punnett square and list the ratio of phenotypes.



____black-trotters

____black-pacers

____white-trotters

____white-pacers

f. **Would a dihybrid cross of this type always produce the same phenotype ratio?________________**

Explain.______________________________

____

g. **Summarize the genotypes of the F_2 offspring in the spaces below.**

____BBTT	____BbTT	____bbTT
____BBTt	____BbTt	____bbTt
____BBtt	____Bbtt	____bbtt

h. Are the ratios obtained from these offspring predictable? ______________________________

Explain. ____

____

____

Part III: How is Incomplete Dominance Shown in a Plant and Animal?

In inheritance involving incomplete dominance, both alleles in a gene pair exert an equal influence on a trait.

When a snapdragon plant bearing red flowers is crossed with a snapdragon plant bearing white flowers, plants bearing pink snapdragons are produced.

a. If the male parent is homozygous for red snapdragons, what kind of gene will be present in the sperms?____

b. If the female is homozygous for white, what kind of gene will be present in each egg? _________

c. What is the genotype of the F_1? ____________________

Female → Genes Males ↓		

Cross two plants producing pink snapdragons to obtain the F_2 generation.

d. Indicate the ratios of colors in the snapdragon flowers produced. ____________________

Part IV: How Do Genetic Traits Appear in Corn?

The color of corn grains (purple or nonpurple) is an inherited characteristic that is easily observed. When pure strains of corn producing purple grains are crossed with pure strains of corn producing nonpurple grains, all of the offspring have purple grains.

Determine what kind of cross produced your ear of corn by counting the number of purple and yellow kernels. Use a straight pin to mark your starting row. Record your count of each row in the table. *Do not pick the kernels from the ear.*

Kind of grains	Number in each row												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
Purple													
Nonpurple (yellow)													

a. What percent of the seeds were purple? ____________________

____

b. Nonpurple? ____________________

____

c. What is the ratio of purple to nonpurple seeds? ____________________

____

d. Based on the ratios, what are the genotypes of the parents crossed to obtain your ear of corn?

____

____

____

e. Explain any evidence of purple color in the nonpurple grains. ____________________

____

____

Part V: Summary

a. Briefly define each of Mendel's Law and Principles that have been demonstrated in the crosses you have completed in this investigation.

Principle of Dominance ______________________________

____

Principle of Unit Characters ______________________________

____

Law of Independent Assortment ______________________________

____

____

Can you answer the following questions?

b. In a cross of two individuals heterozygous for a single trait, what genotype and phenotype ratios would be obtained? ______________________________

c. What phenotype ratio is obtained when individuals heterozygous for two traits are crossed?

____

d. Explain if the Law of Independent Assortment would apply if the genes for coat color and gait in horses were carried on the same chromosomes. ______________________________

____

e. On the basis of your results, explain how genetic principles yield predictable results. __________

____

Part VI: Investigations On Your Own

Obtain an ear of corn showing a 9:3:3:1 ratio (purple-smooth-yellow-shrunken seeds) and determine the genotypes of the parents by counting the characteristics inherited on your ear of corn. Classify and record your count of the seeds. Summarize your findings by determining the genotype and phenotype ratios. Outline a cross of the F_1 and F_2 generations which were used to produce the ratios as you have determined them.

GENETICS AND HEREDITY

AG 530 - F

LABORATORY EXERCISE #4--INFLUENCE OF CHANCE ON INHERITANCE

Name ______________________________ Score ______________________________

Selection from Modern Biology, Biology Investigations, Teacher's Ediction, by James H. Otto, Albert Towle, W. David Otto, and Myra E. Madnick.

Materials needed

2 boxes (bottom half of half-gallon milk carton)
100 red beans
100 white beans

Part I: Demonstrating Chance

The class should be divided into pairs for this study. Each pair of investigators should have two boxes of beans. Each box contains a mixture of 50 red beans and 50 white beans.

a. If each box represents a set of genes from one parent, what could each bean represent?

____

In a series of rounds that will be timed by your teacher, take one bean from each box and lay the pairs in rows: red-red, red-white and white-white.

b. Why must a bean be chosen from each box?______________________________

____

After each round, count the beans in each row and record the selected combinations in the table.

c. How many combinations are possible using two kinds of beans?______________________

d. What accounts for the variation in offspring represented by the pairs of genes? ____________

____

Round	Number of pairs of beans in:			
	Row 1 Red-Red	Row 2 Red-White	Row 3 White-White	Total Pairs
Section 1				
Section 2				
Section 3				
Section 4				
Class Totals				

Part II: Summary

Summarize your observations by calculating the ratios for each type of gene pair using the following procedure:

1. Add the total of your 3 rows and divide the sum by 4. (The 4 represents the reduction that occurs in the formation of eggs and sperm during meiosis.)

2. Divide the quotient into the total for each row.

3. The number obtained expresses a ratio. A sample calculation is given.

   Sample Calculation

   (1) 37 + 86 + 41 = 164
   164 / 4 = 41

   (2) 37 / 41 = 0.9
   86 / 41 = 2.1
   41 / 41 = 1.0

   (3) Ratio .9 red-red; 2.1 red-white; 1.0 white-white; or 1:2:1

a. Express the ratio in whole numbers. ______________________________

____

b. Why is it necessary to have so many beans in each box? ____________________

____

c. Why is it necessary to select so many pairs?______________________________

____

d. What are the chances of selecting the same color in a gene pair?________________

e. What are the chances of selecting a different color?________________________

f. Explain the importance of using two different colors. ______________________

____

g. What genetic principles are demonstrated by this study? ____________________

____

h. How does chance selection of genes, as demonstrated with beans, provide the basis for variation in organisms? ____

____

____

Part III: Investigations On Your Own

Roll dice for 100 times and keep a tabulation of the sum of the numbers which appear on the dice. Plot the tabulations on a sheet of graph paper. Determine the probability of rolling dice to achieve a 2, 3, 4, or 5, etc. Write up your results and include a discussion of how a little knowledge of probability is useful in the study of genetics.

GENETICS AND HEREDITY

AG 530 - F

LABORATORY EXERCISE #5--BREEDING FRUIT FLIES TO STUDY GENETICS

Name ______________________________ Score ______________________________

Introduction

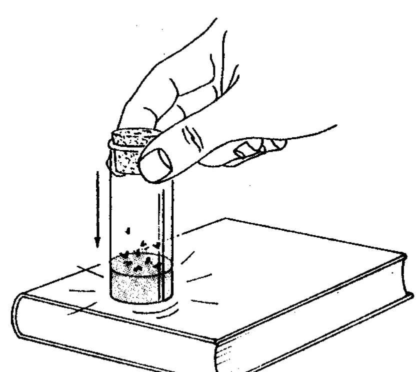
The fruit fly *Drosophila melanogaster* is especially good for genetic research. This is because the flies are small, feed on an inexpensive yeast cell media, and have a short life cycle. Due to these three factors a large population of fruit flies can be raised quickly and inexpensively in a small area. The fruit fly goes through a full generation, from the birth of parents to the birth of offspring, in just ten to fourteen days. This quick maturation enables the results of breeding experiments to be quickly seen. In this laboratory, you will make crosses of fruit flies to study the resulting offspring.

Materials needed

Living *Drosophila* cultures (Wild wing type and vestigial wing type)
Anesthetic
Instant *Drosophila* medium (Commercial preparation)
Two small vials with plastic-foam plugs (4" x 1 1/2")
Forceps
Old culture of "mixed-strain" fruit flies
Re-anesthetizer (Consists of a petri dish, gauze or cotton balls and tape)
Artist's paint brush
Stereoscopic microscope
White index card
Labels or masking tape
Morgue consisting of a jar of oil (vegetable or motor oil)

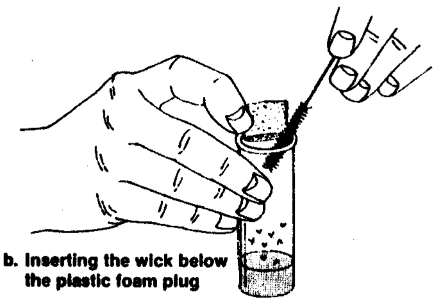
Part I: Anesthetizing and Observing the Fruit Flies

1. Obtain a culture of the mixed fruit flies. Gently tap the bottom of the culture vial on a book to force the flies to the bottom as shown in **a.**



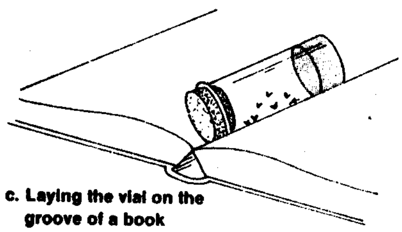
a. Tapping the vial

2. Add the anesthetic to the wick supplied with the anesthetic. Insert the wick into the culture vial just below the plastic foam plug as shown in **b.**



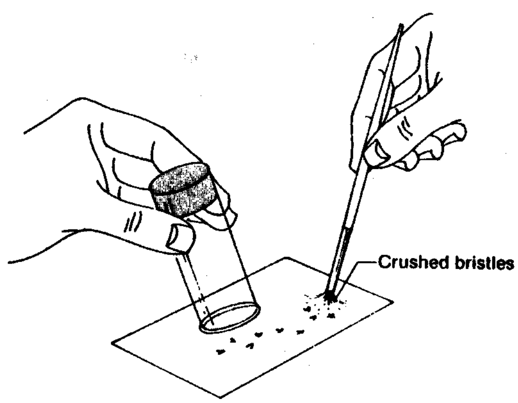
b. Inserting the wick below the plastic foam plug

3. Lay the culture vial on its side in the groove of an open book as shown in **c,** so that the flies do not get stuck in the medium as they become immobilized. Within four minutes all flies should become anesthetized and immobile.



c. Laying the vial on the groove of a book

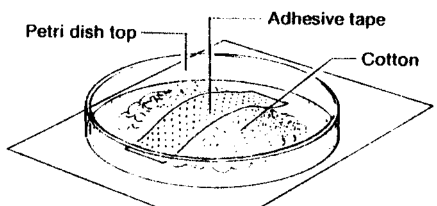
4. Transfer the flies to a white index card as shown in d. Examine the flies under the stereoscopic microscope. Use the paint brush to move the flies around on the card.



d. Transferring the fruit flies to an index card

Check the accuracy of each student's ability to sort the flies according to sex.

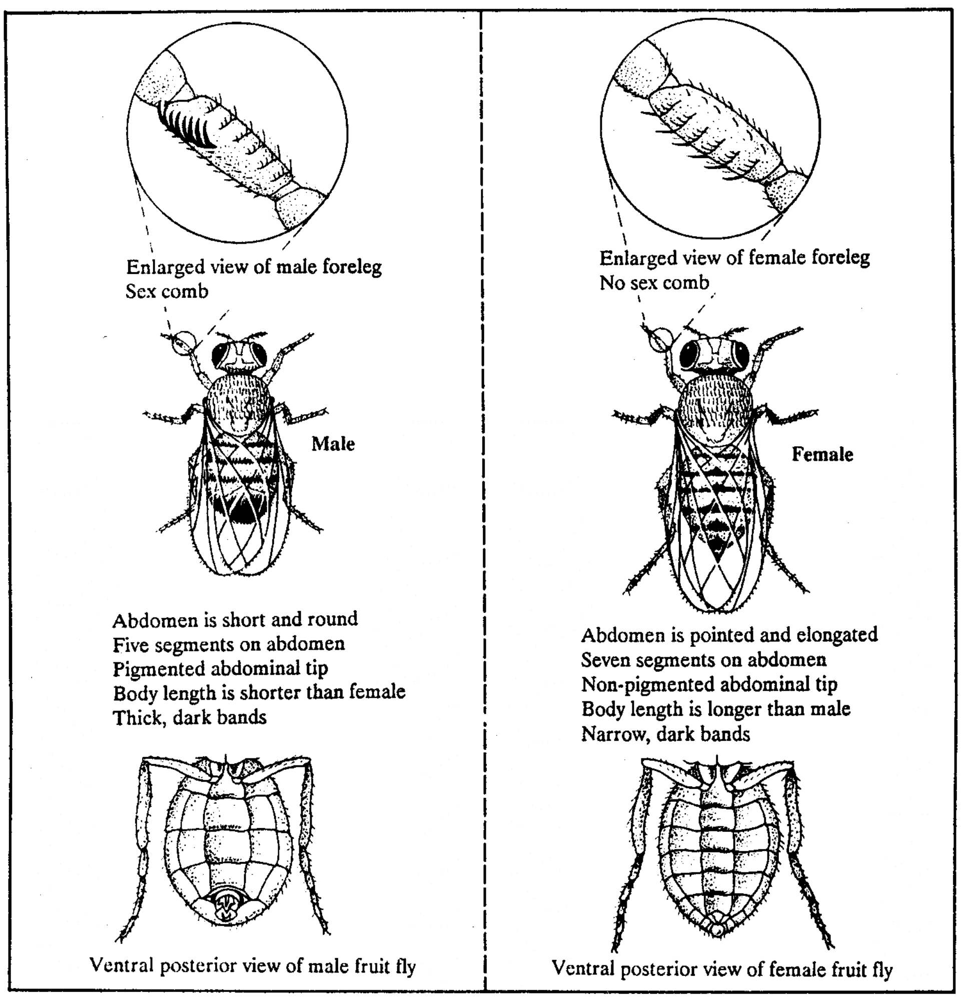
5. If the flies start to recover from the anesthetic use the re-anesthetizer to re-anesthetize the flies. Do this by placing a few drops of the anesthetic on the gauze attached with tape to the bottom of the petri dish which will serve as a re-anesthetizer. Place the dish over the recovering flies until the flies are immobilized once again. Refer to **e** showing the set-up of the petri dish re-anesthetizer.



e. Re-anesthesizer

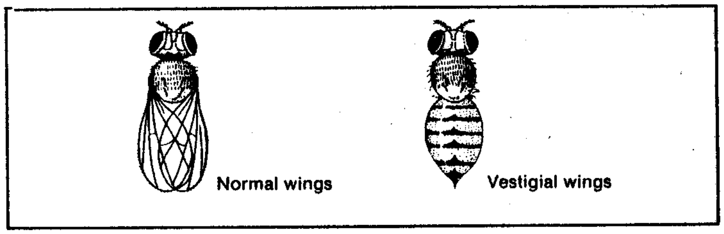
6. Sort your flies according to their sex. Notice in figure f that the male fruit flies have a sex comb, a dark, blunt-shaped abdomen, and five bands compared to the female's lack of a sex comb, and pointed abdomen with seven bands. In addition, the female is generally larger than the male fruit fly. Besides the sex differences, what other distinct difference do you notice?

a.____



f. Physical traits of male and female fruit fly

Draw the difference that you observe on the wingless fruit fly in figure **g** below.



g. Comparison of normal wild type wings and vestigial wings

7. Dispose of the fruit flies when you are finished observing them according to instructions given by your teacher.

<u>Part II: Performing the Parental F_1 Cross</u>

1. Flies from the stock vials of wild wing type and vestigial wing type contain both males and females. In performing a cross the females that are used must be virgins. To be assured of using females that are virgins, the females must be collected before they are twelve-hours-old. This is because female fruit flies are capable of mating with the males only after they are twelve-hours-old. What problems would occur in genetic experimentation if day-old females taken from stock vials containing males and females were used in genetic crosses?

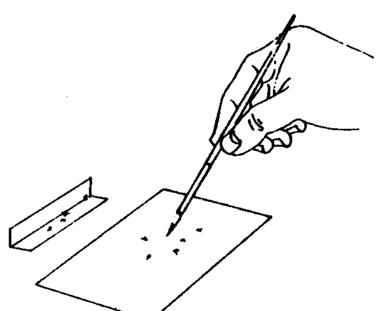
   a.____

   ____

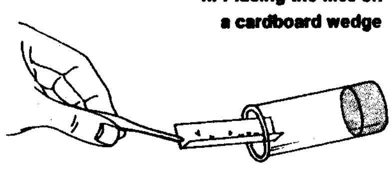
   ____

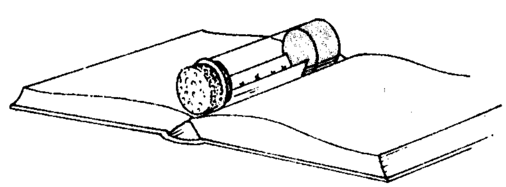
2. Anesthetize flies from the stock vials of the wild wing and the vestigial wing fruit flies. Select three wild winged males and three vestigial winged females.

3. Place the six future parents on a cardboard wedge made from an index card as shown in **h.** Place the wedge on its side in a fresh vial of media until the flies recover. Keep the wedge in the vial throughout the reproductive cycle as a substance on which the larvae can form pupae. Place the vial in an open book as shown in **i** until the flies recover.



h. Placing the flies on a cardboard wedge





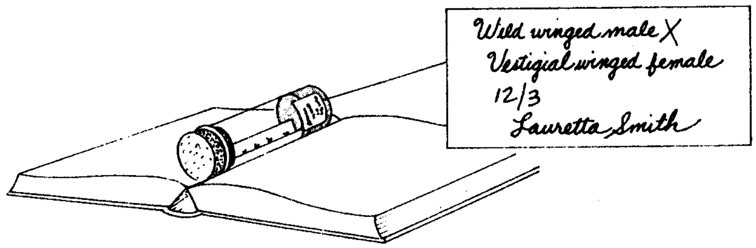
i. How to rest the vial until the fruit flies recover

4. Stick a label on your vial with the following information:

Genetic cross:______________________________________

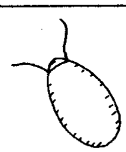
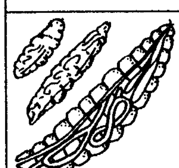
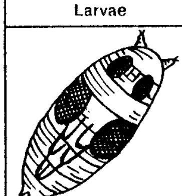
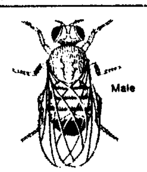
Date:____

Your name: ______________________________________



5. Incubate the flies at about 25-28 degrees Celsius. On about day seven, remove the parent flies from the vial. Dispose of the parent flies as instructed by your teacher. Depending mostly on temperature, the adult flies of the F_1 generation should emerge in about 10 to 14 days. While you are waiting for the F_1 flies to emerge, use the stereoscopic microscope to examine the stages in the life cycle of the fruit fly. Record your observations over the 10-14 day life cycle in Table I below.

Table I. Observations of stages in the fruit fly life cycle

Stage	Date observed	Description/Observations
 Egg		
 Larvae		
 Pupa		
 Adult		

6. After 50 adult flies hatch in the vial, carefully anesthetize them following steps 1-5 in Part I. Then, select any three females and any three males. Place the six flies in a fresh vial of media as you did with the parents of this generation in illustrations **h** and **i.** Label the vial. The offspring that result from this cross will the F_2 generation.

7. Re-anesthetize the remaining F_1 adults. Count and sort the flies from the F_1 parental cross according to sex and wing type. Record the data in Table II. Dispose of the fruit flies as directed by your teacher. Complete the Punnett Square next to Table II showing the expected results from the parental cross. Remember to include in your count the six F_1 flies used in the cross in step 6.

Table II. The F_1 Generation **Parent Cross; Vestigial ♀ x Wild ♂**

	wild		vestigial	
Individual totals	♂	♀	♂	♀
Class Total				

Parent Cross; Vestigial ♀ x Wild ♂
V = Wild wing
v = Vestigial wing
Parent genotypes ________ x ________

F_1 generation

F_1 phenotypes: ____________________

F_1 genotypes: ____________________

		Eggs	
		v	v
Sperm	V		
	V		

Part III: Observing and Interpreting the Results of the F_1 Cross

1. When the larvae are seen in the vials of the F_1 cross (in about seven days) remove the six adults and dispose of them in the manner instructed by your teacher.

2. After more than 50 flies have emerged from the vial (in about 15 days from the date of the cross) anesthetize, count and sort the flies according to sex and wing type. Dispose of the counted flies as directed by your teacher. Record the data you collect in Table III. Complete the Punnett Square next to Table III showing the expected results from the F_1 cross. The F_1 cross results in the F_2 generation of fruit flies.

Table III. The F_2 Generation **F_1 males x F_1 females**

	wild		vestigial	
Individual totals	♂	♀	♂	♀
Class Total				

Parent Cross: F_1♂ x F_1♀
V = Wild wing
v = Vestigial wing
Parent genotypes
F_1 genotypes: ________ x ________

F_2 generation
F_2 phenotypes: ________
F_2 genotypes: ________

		Eggs V	Eggs v
Sperm	V		
	v		

Part IV: Analysis

1. List two differences in body structures that enable you to distinguish male from female fruit flies. ________________________________

____

2. Explain whether it would be necessary to use virgin females for an F_2 cross. ________

____

3. Explain how genetic dominance was shown in the F_1 generation.

____

____

4. For what reasons are parents removed from culture vials on about the seventh day after the larvae appear? ______________________________

____

____

5. What are the genotypic differences between the F_1 flies and the wild type parent flies? _____

____

6. How do the F_2 wild type flies compare genetically with the original parent wild type flies?

____

____

7. How do the results of the F_1 cross illustrate the Law of Segregation? ______________

____

____

____

8. What percentage of the F_2 flies did you expect to have vestigial wings? ______________

____

9. Considering the total number of F_2 flies counted, how many should have had vestigial wings?

____

10. What percentage should have had wild type wings? ______________________________

____

11. How many of the total should have had wild type wings? ______________________________

____

12. How would you explain the difference between expected and actual results in the F_2 generation? ______________________________

____

____

____

GENETICS AND HEREDITY

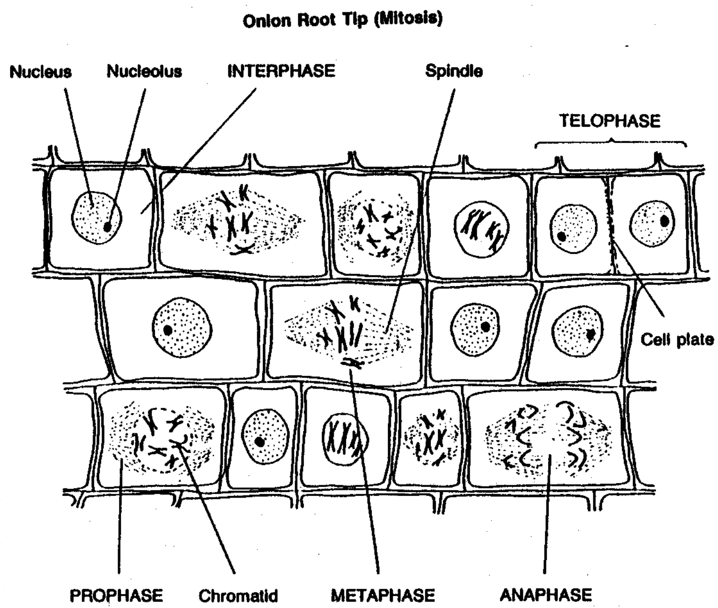
AG 530 - F

ANSWERS TO LABORATORY EXERCISES

Lab #1

Part I:

a. The chromosomes migrate along the spindles.
b. Across the center or the equatorial plate
c. To separate the 2 daughter cells
d. Prophase: formation of asters, disintegration of nucleolus, moving of chromatids to the equator. Metaphase: chromatids line up at equator.
e. A period of growth and other activities (not part of cell division)



Part II:

a. A centriole is present at the poles of the spindle in the animal cell.
b. Animal cells pinch in two; plant cells form a cell wall between daughter cells.
c. Centrioles
d. Chromosomes and spindle fibers

Part III:

a. The chromosomes replicate, but do not separate.
b. Tetrads
c. The chromatids form pairs and separate from the tetrad.
d. Reduction-division occurs.
e. Haploid (n) chromosome number
f. Matures into an egg
g. They have no function and will gradually disintegrate.

Part IV:

a. Prophase, metaphase, anaphase and telophase
b. Insures genetic continuity
c. Centrioles are observed in animal cells; cell plate in plant cells
d. Chromosomes and spindle fibers
e. Reproductive cells
f. Reduction of chromosome number during spermatogenesis and oogenesis.
g. Chromosome number is halved so that full complement can recur at fertilization.
h. Spermatogenesis and oogenesis
i. At fertilization there would be twice as many chromosomes in the zygote.

Lab #2

Part I:

a. Sex chromosomes
b. XX
c. one, an X
d. Y
e. X or Y
f. two X's, or an X and Y

Figure 2: Evaluated to the satisfaction of instructor.

g. 1:1

Figure 3

♂XY x ♀XX

Female → Male ↓	X	X
X	XX	XX
Y	XY	XY

h. 50%
i. 50%
j. male
k. It is purely a matter of chance.

Part II:

Figure 4

X^cY x X^CX^c

Female → Chromosome Male ↓	X^C	X^c
X^c	X^CX^c	X^cX^c
Y	X^CY	X^cY

a. 50%
b. X^cX^c
c. 50%
d. The male offspring inherited X^c from the female parent.

Part III:

Genes	Color change	Color vision	Sex
X^CX^C	Yellow	normal	female
X^CX^c	Yellow	normal/carrier	female
X^CY^-	Yellow	normal	male
X^cY^-	Blue	color blind	male

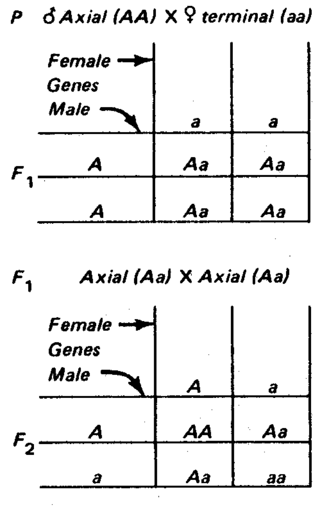
Part IV:

a. There is a 50% probability that a female X will be paired with a male Y chromosome.
b. Males are lacking a corresponding gene on the Y chromosome; therefore, whatever gene is inherited on the female X is exhibited by the male.
c. 50%
d. None
e. 50%
f. 50%

Lab #3

Part I:

a. Male
b. Female
c. A
d. a

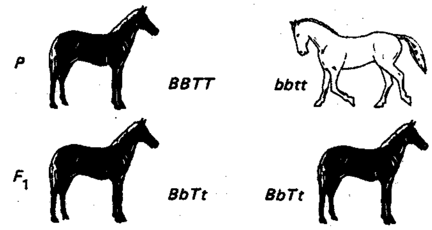


e. A and a
f. Axial
g. The characteristic is determined by a pair of genes, one contributed by each parent.
h. The A gene exerted its influence in spite of the presence of gene a. Gene a was prevented from exerting its influence.
i. Two individuals hybrid for a single trait are being crossed.
j. 3 axial to 1 terminal
k. 1AA : 2 Aa : 1 aa
l. Yes

Part II:

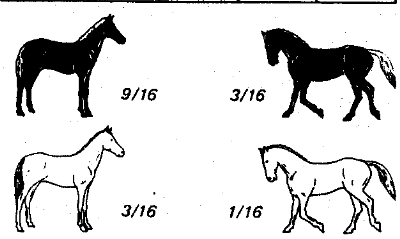
a. BBTT
b. B and T
c. b and t
d. BbTt

e. black, trotters



Females → Genes Male ↓	BT	Bt	bT	bt
BT	BBTT	BBTt	BbTT	BbTt
Bt	BBTt	BBtt	BbTt	Bbtt
bT	BbTT	BbTt	bbTT	bbTt
bt	BbTt	Bbtt	bbTt	bbtt

F_2



9 black-trotters
3 black-pacers
3 thite-trotters
1 white-pacers

f. Yes. Only if complete dominance is involved in both traits.

g.

1 BBTT	2 BbTT	1 bbTT
2 BBTt	4 BbTt	2 bbTt
1 BBtt	2 Bbtt	1 bbtt

h. Yes, if both parents possess two traits that are completely dominant and both parents are hybrid for the traits.

Part III:

a. r
b. w
c. rw

Female → Genes Males ↓	r	w
r	rr	rw
w	rw	ww

d. 1 red, 2 pink, 1 white

Part IV:

a. 50% or 75% depending on the strain. Answers will vary.
b. Answers will vary. 50% or 75% depending on the strain.
c. 1:1 or 3:1, depending on the strain used.
d. Corn having a 1:1 ratio of purple to nonpurple seeds would be the result of a cross between a purple hybrid (Pp) and a nonpurple parent (pp). Corn having a 3:1 ratio would be the result of a cross between two purple hybrids (Pp x Pp).
e. There is none since a gene for purple produces a completely purple seed. Purple is dominant over nonpurple.

Part V:

a. The dominant genes prevent the expression of the recessive genes.
The characteristics are determined by pairs of genes represented by symbols.
Since genes are separated independently of each other during meiosis, it is a matter of chance which genes are present in the gametes.
b. The genotype ratio is 3:1 and the phenotype ratio is 1:2:1.
c. The phenotype ratio is 9:3:3:1.
d. The Law of Independent Assortment applies only when genes are located on different chromosomes.
e. Knowledge of dominance and recessiveness of a trait yield predictable ratios in the offspring.

Lab #4

Part I:

a. A gene or chromosome
b. To represent the gene or chromosome contributed by each parent
c. Three
d. Variation is due to the chance combination of different genes upon fertilization.

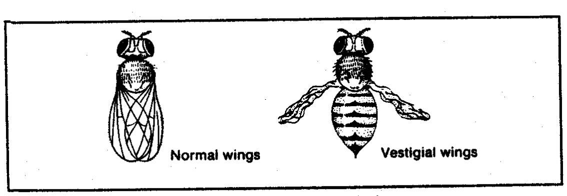
Part II:

a. Should approximate a 1:2:1 ratio
b. To ensure chance selection
c. Large samples are more reliable in obtaining ratios.
d. 50:50
e. 50:50
f. Each color represents one of the gene pairs.
g. Chance distribution and combination of genes; law of segregation.
h. Chance selection of genes allows for recombination of traits in the offspring, with the number of possible combinations being directly proportional to the number of chromosomes and genes in the cells of the organism.

Lab #5

Part I:

a. Some flies have crooked, wrinkled wings while others have normal wings
b.



Part II:

a. The results of the crosses between males and females would not be valid. This is because the genotype of the male that mated with the female would be unknown if an earlier mating took place in the vial. Thus, the mating cross would not be controlled.

Table I. Observations of stages in the fruit fly life cycle

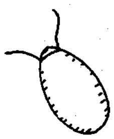
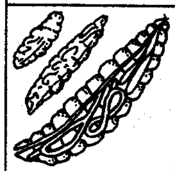
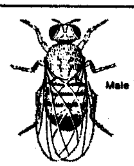
Stage	Date observed	Description/Observations
 Egg	If kept at 25° C 24 hours (Day 1)	Very small elliptical or oblong shape that is creamy white in color. Has two hair-like projections on one end.
 Larvae	96 hours (Days 2-6)	A crawling, wormlike animal that is creamy white in color. Slow moving. The body is segmented. Makes tunnels as it moves through food layer.
 Pupa	96 hours (Days 7-10	A light brown organism encrusted within a thin transparent brown shell. Some adult insect parts (like the eyes and wings) can be seen developing within the pupa.
 Adult	Days 11-14	Has body parts present in most adult insects including head, thorax, and abdomen. Flies in vial above food layer. Adults emerge from the pupa initially unable to fly. Eventually wings expand and dry.

Table II: Totals should show 100% wild winged phenotype

Parent genotypes vv x VV
F_1 phenotypes: All wild
F_1 genotypes: All Vv
Punnett Square:

Punnett Square:	Vv	Vv
	vV	Vv

Part III:

Table III: Totals should show 75% wild and 25% vestigial winged phenotypes

F_1 genotypes: wild Vv x wild Vv
F_2 phenotypes: 3/4 wild , 1/4 vestigial
F_2 genotypes: VV, Vv, vv

Punnett Square:	VV	Vv
	vV	vv

Part IV:

1. Males have a sex comb, five-banded abdomen, blunt abdomen and smaller size.
2. No. All flies in the F_1 vial will have the same genotype.
3. Only the wild wing phenotype appeared in the F_1 generation. The vestigial wing trait was masked.
4. So that the parents will not be counted in the offspring count from the cross.
5. The F_1 flies are heterozygous even though they have a wild phenotype.
6. 50% of the F_2 wild type flies have the same genotype (VV) as the parent wild type flies and 50% have a (Vv) genotype.
7. Since each fly has two alleles for a trait that segregates during gamete formation the offspring of the F_1 cross represent the random combination of these gametes to produce the 3 to 1 ratio.
8. 1/4 or 25%
9. Student answer will vary depending on experimental results.
10. 3/4 or 75%
11. About 3/4 of the total number of F_2 flies
12. There could have been sources of error that entered into the experiment. For example, any of the following could have changed the expected results: death of larvae or eggs, failure to clear parents from vial before counting the flies, small sample size, failure to use virgin females for the crosses.

GENETICS AND HEREDITY

AG 530 - F

UNIT TEST

Name______________________________________Score______________________________________

1. Match the terms on the right to the correct definitions.

_____a.	Mature germ cell, egg or sperm	1. Gamete
_____b.	Fertilized egg	2. Fertilization
_____c.	The outward appearance of the animal	3. Zygote
_____d.	Complex molecule that determines hereditary characteristics of living animals; located at definite places on the chromosomes	4. Homozygous
		5. Heterozygous
		6. Phenotype
_____e.	Branch of biology that deals with the heredity and variation of organisms	7. Genotype
_____f.	Animal that is a carrier of a pair of unlike genes	8. Lethal gene
		9. Gene
_____g.	Thread-like structure which exists in pairs and carries genes	10. Dwarfism
_____h.	Division of a body cell into two duplicate body cells	11. Chromosome
		12. Mutation
_____i.	Genetic makeup of the animal	13. Mitosis
_____j.	Animal that is pure for a certain gene such as the polled gene	14. Meiosis
_____k.	Symbol which represents the second cross from a mating	15. Genetics
		16. F_1
_____l.	Division of a sex cell producing a cell or cells containing only one of each gene and chromosome pair	17. F_2
		18. Heritability
_____m.	Genetic factor that causes death of the young during prenatal life, at birth or soon after	
_____n.	Union of the egg and sperm	

_____o. Percentage of differences in a trait that can be explained by inheritance as opposed to environment

_____p. Inherited characteristic of cattle resulting in small, deformed animals

_____q. Random changes that take place in a gene

_____r. Symbol which represents the first cross from a mating

2. Select from the list hereditary characteristics that are determined by genes.

____a. Body size

____b. Age

____c. Color of hair coat

____d. Eye color

____e. Ability to fatten

____f. Environment

3. Describe how heritability should affect selection of breeding stock.

____

____

____

4. Match the animals on the right to the correct number of chromosome pairs.

____a.	19 pairs	1.	Cattle
____b.	39 pairs	2.	Sheep
____c.	30 pairs	3.	Swine
____d.	23 pairs	4.	Humans
____e.	27 pairs	5.	Chickens
____f.	32 pairs	6.	Horses

5. Describe in a short paragraph how the genetic makeup of an animal is determined.

____

____

____

____

6. Distinguish between dominant, recessive and incomplete dominant genes. Place a "D" in the blank if the statement indicates a dominant characteristic, an "R" in the blank if the statement indicates a recessive characteristic, or an "I" if the statement indicates an incomplete dominant characteristic.

____a. Genes that do not completely mask or are not completely masked by the paired gene.

____b. Genes that are covered up or masked in the F_1 generation.

____c. Genes that have the ability to cover up or mask the presence of one of a set of genes in the F_1 generation.

7. Distinguish between simple gene inheritance and multiple gene inheritance. Place "SG" in the blank if the statement indicates a simple gene inheritance or "MG" in the blank if the statement indicates a multiple gene inheritance.

____a. One pair of genes determine the inheritance of a particular factor.

____b. Several pair of genes determine the inheritance of a particular factor.

8. Describe how the sex of the offspring is determined.

____

____

____

____

9. Distinguish between performance testing and progeny testing by placing "PE" if the statement indicates performance testing or "PR" if the statement indicates progeny testing.

____a. Bull "A" has an excellent track record in producing daughters with strong rear udder attachment.

____b. Bull "B" has won a number of shows because of his outstanding visual characteristics.

10. Match different systems of livestock breeding to the correct definitions.

______a. System of breeding in which closely related animals are mated

______b. Mating of animals that are members of the same breed but which show no relationship close up in the pedigree

______c. Member of a breed; animals which possess a common ancestry and distinctive characteristics and are either registered or eligible for registry in the herd book of that breed

______d. Mating of animals of different breeds

______e. System of breeding in which purebred sires of a given pure breed are mated to native or grade females

1. Crossbreeding
2. Purebred
3. Inbreeding
4. Grading up
5. Outcrossing

11. Estimate the possible gene combinations if you mated a polled bull (Pp) carrying a recessive gene for horns to a horned cow (pp) carrying recessive genes for horns.

a. How many pure polled? ______________________________

b. How many polled with recessive genes for horns? ______________________________

c. How many pure horned? ______________________________

GENETICS AND HEREDITY

AG 530 - F

ANSWERS TO TEST

1. a. 1
   b. 3
   c. 6
   d. 9
   e. 15
   f. 5
   g. 11
   h. 13
   i. 7
   j. 4
   k. 17
   l. 14
   m. 8
   n. 2
   o. 18
   p. 10
   q. 12
   r. 16

2. a, c, d, e

3. Description should include the fact that some factors are more heritable than others and that selection should be weighted towards those factors with high heritability

4. a. 3
   b. 5
   c. 1
   d. 4
   e. 2
   f. 6

5. The description should include that genetic makeup is determined by the union of two cells, one from each parent, and that each cell contains one chromosome from each pair in the parent or 1/2 the total number of chromosomes

6. a. I   b. R   c. D

7. a. SG   b. MG

8. Description should include: A female egg contains an X chromosome; A male sperm contains either an X or Y chromosome; Egg and sperm unite randomly to form zygote: If egg and sperm contain like chromosomes (X and X), a female is conceived; If egg and sperm contain unlike chromosomes (X and Y), a male is conceived

9. a. PR   b. PE

10. a. 3
    b. 5
    c. 2
    d. 1
    e. 4

11. a. none
    b. two
    c. two

BREEDING AND REPRODUCTION

AG 530 - G

UNIT OBJECTIVE

After completion of this unit, students should be able to describe the parts and processes of reproduction and be able to apply this information to improve their livestock management skills. Students should also be able to demonstrate the ability to test cows for pregnancy and bulls for fertility. This knowledge will be demonstrated by completion of laboratory exercises and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with reproduction to their correct definitions.
2. List and describe six types of mating systems.
3. List and define the four parts of the estrous cycle.
4. Identify the best time to breed livestock.
5. Select the components of the male reproductive tract.
6. Match male reproductive organs to their correct descriptions.
7. Identify the parts of a cow's reproductive tract and related organs.
8. Match the female reproductive organs to their correct functions.
9. Describe the effects of estrogen and progesterone produced by the ovaries and testosterone produced by the testes.
10. Select advantages of fertility testing in bulls.
11. Select causes of sterility and delayed breeding in bulls.
12. Name the parts of a sperm cell.
13. Label types of abnormal sperm.
14. Describe the quality of bovine semen based on color, foreign material, wave pattern and progressive motility.
15. Name the two best times to check for fertility in bulls.
16. List and describe nine factors causing infertility.
17. Identify the gestation periods of cattle, horses, swine and sheep.
18. Select advantages of pregnancy testing.

19. Name three distinct indications of pregnancy detectable in rectal examination.
20. Calculate the estimated size of a fetus given the months a cow has been pregnant.
21. Describe the reason for using the left hand in rectal examinations.
22. Name the techniques used in pregnancy testing of ewes and sows.
23. Describe the signs of estrus in cows.
24. State which sign of estrus is the most important with regard to time of insemination.
25. List the average estrous cycles of cows, mares, sows and ewes.
26. Name the time when a cow ovulates with respect to standing heat.
27. Select factors that contribute to poor conception rates.
28. Select the reasons why time of insemination is important.
29. Label equipment necessary for artificial insemination.
30. Match methods of thawing semen to the correct procedures.
31. Label errors in inseminating a cow with relationship to the misplacement of the inseminating tube.
32. Evaluate semen based on color, foreign material, wave pattern motility and abnormal sperm.
33. Identify events from an estrous cycle chart.
34. Demonstrate the ability to pregnancy test a cow using a rectal examination.
35. Demonstrate the ability to inseminate a reproductive tract acquired from a slaughterhouse.
36. Demonstrate the ability to inseminate a cow.
37. Observe and record placental and fetal development.
38. Examine the anatomy of the female reproductive tract.

BREEDING AND REPRODUCTION

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SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Make transparencies and necessary copies of material.

B. Provide students with objectives and discuss.

C. Provide students with information and discuss.

D. Provide students with assignment sheets and laboratory exercises.

E. Obtain semen samples for use in class.

F. Obtain and review *Diagnostic and Therapeutic Techniques in Animal Reproduction* by R. Zemjanis. Publisher: Williams & Wilkins Co., Baltimore, 1970.

G. Arrange with veterinarian to allow students an opportunity to see a bull being fertility tested.

H. Secure pregnant reproductive tracts from slaughterhouse showing the different stages of pregnancy.

I. Arrange with slaughterhouse to use cattle before slaughter to check for pregnancy.

J. Invite a veterinarian to help students pregnancy test cows.

K. Obtain equipment used for artificial insemination for display.

L. Show U of I slides on Artificial Insemination and Heat Detection.

M. Obtain reproductive tracts from slaughterhouse.

N. Demonstrate the procedure for inseminating cattle on a reproductive tract from slaughterhouse using dye to illustrate where you would deposit semen in the tract.

O. Contact local artificial inseminator to assist with demonstration, to serve as resource person, and to provide necessary equipment.

P. Discuss and demonstrate assignment sheets and laboratory exercises.

Q. Review and give test.

R. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Reproductive Tract of a Bull

2. TM 2--Reproductive Tract of a Cow

3. TM 3--Parts of Reproductive Tract Positioned Within Cow's Body

4. TM 4--Reproductive Tract of a Sow

5. TM 5--Reproductive Tract of a Mare

6. TM 6--Parts of a Sperm Cell

7. TM 7--Stages of Pregnancy

8. TM 8--Time to Breed (Cow)

9. TM 9--Time of Insemination and Conception Rate (Mare)

10. TM 10--Time to Breed (Sow)

11. TM 11--Tools Used in Inseminating

12. TM 12--Errors in Placing Inseminating Tube

E. Assignment sheets

1. AS 1--Evaluate Semen Based on Color, Foreign Material, Wave Pattern, Motility and Abnormal Sperm

2. AS 2--Identify Events From an Estrous Cycle Chart

F. Answers to assignment sheets

G. Laboratory exercises

1. LE 1--Pregnancy Test a Cow Using Rectal Examination

2. LE 2--Inseminate Reproductive Tract Acquired From Slaughterhouse

3. LE 3--Inseminate a Cow

4. LE 4--Placental and Fetal Development

5. LE 5--Anatomy of the Female Reproductive Tract

H. Answers to laboratory exercises

I. Test

J. Answers to test

III. Unit references

A. *Agricultural Education Curriculum*, College of Agriculture, University of Illinois, Urbana, Illinois, 1989.

B. Barrick, R. Kirby, Harmon, Hobart L., *Animal Production and Management*, McGraw-Hill Book Company, 1988.

C. Campbell, John R., Lasley John F., *The Science of Animals That Serve Mankind*, McGraw-Hill Book Company, 1975.

D. Ensminger, M.E., *Animal Science*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1965.

E. Ensminger, M.E., *Beef Cattle Science*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1968.

F. Hafez, E.S.E., ed., *Reproduction in Farm Animals*. Lea and Febiger Publishers, Inc., Philadelphia, 1962.

G. Otto, James H., Towle, Albert, *Modern Biology*, Holt, Rinehart and Winston, Publishers, New York, 1985.

H. Slesnick, Irwin L.; Balzer, Leron; McCormack, Alan J.; Newton, David E.; Rasmussen, Fredrick A., *Biology*, Scott, Foresman and Company, Glenview, Illinois, 1985.

I. Stamm, G.W., *Artificial Breeding and Livestock Improvement*. Windsor Press, Chicago, n.d.

J. Zemjanis, R. *Diagnostic and Therapeutic Techniques in Animal Reproduction*. Williams & Wilkins Co., Baltimore, 1970.

BREEDING AND REPRODUCTION

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INFORMATION SHEET

I. Terms and definitions

A. Estrus--Standing heat or time when female will receive the male

B. Estrous cycle--Time elapsing from one heat period to the next

C. Anestrus--Period of time when estrous cycle does not occur

D. Zygote--Cell produced by the union of sperm and ovum at fertilization

E. Embryo--Organism in early stage of development

F. Fetus--Young animal in the uterus from time of complete tissue differentiation until birth

(Note: An animal goes through three stages of development before birth--zygote, embryo and fetus.)

G. Gonad--Primary sex gland; ovary or testis

H. Pregnancy--Carrying a fetus

I. Fimbria--Opening to the fallopian tube which catches the egg as it leaves the ovary

J. Hormone--Internal body secretion that affects reproduction and other bodily functions

K. Fertilization--Uniting of the egg and sperm

L. Conception--Occurrence of fertilization

M. Ejaculation--Sudden movement of sperm from the epididymis through the penis into the female

N. Cryptorchid male--Male animal which is sterile because the testicles did not descend into the scrotum

O. Sterility--Temporary or permanent inability to reproduce

P. Palpation--Examining by feel

Q. Fertility testing--Method of evaluating the breeding soundness of bulls; method for detecting infertility

R. Gestation--Length of time from fertilization until birth

S. Artificial insemination--Placing spermatozoa into the female reproductive tract by means other than natural mating

T. Prostaglandin F_2O--Hormone which can be used to synchronize estrus

U. Inseminating tube--Tube used to place sperm into a female's reproductive tract

II. Types of mating systems

A. Purebred--Member of a breed; animals which possess a common ancestry and distinctive characteristics and are either registered or eligible for registry in the herd book of that breed

B. Inbreeding--Systems of breeding in which closely related animals are mated

Examples: Brother x sister, sire x daughter, son x dam

(Note: Scientists divide inbreeding into various categories according to the closeness of the relationship of the animals mated and the purpose of the mating.)

C. Linebreeding--Mating of animals that are related, but not related as closely as in inbreeding

Example: Grandfather x Granddaughter

D. Outcrossing--Mating of animals that are members of the same breed, but which show no relationship close up in the pedigree

E. Grading up--System of breeding in which purebred sires of a given pure breed are mated to native or grade females

F. Crossbreeding--Mating animals of different breeds

Examples: Hereford x Angus, Simmental x Angus, Hampshire x Suffolk, Duroc x Chester White

III. Estrous cycle

A. Estrus--Period of time when the female is receptive to the male and will stand for mating

B. Metestrus--Follows estrus; period when the corpus luteum (hormone-secreting growth) forms where the egg was released from the ovary

C. Diestrus--Follows metestrus; period when corpus luteum is functional. Hormones released stimulate preparation of uterus for pregnancy

D. Proestrus--Follows diestrus; rapid follicle growth to prepare for next ovulation

IV. Best time to breed

A. Cows

1. First--early in estrus

2. Second--12-20 hours after estrus starts

B. Swine

1. Sows--last half of estrus

2. Gilts--second day of estrus

C. Mares

1. First--third day of estrus

2. Second--three days later (if still in heat)

D. Goats--last half of estrus

V. Components of male reproductive tract

(Note: These components should be examined when fertility testing bulls.)

A. Primary sex organs--Gonads (testes or testicles)

B. Accessory sex organs

1. Epididymis

(Note: This can be up to 500 feet long and is located in the scrotum.)

2. Vesicular glands

3. Prostate

C. Copulatory organ--Penis

(Note: In a boar the penis is shaped like a corkscrew and interlocks with the female reproductive tract. This allows a large volume, 200-300 ml, of semen to be ejaculated.)

VI. Functions of male reproductive organs (Transparency 1)

A. Testes--Produce spermatozoa, the male germ cells and testosterone

B. Epididymis--Collects, stores and allows maturation of sperm

C. Vas deferens--Transports spermatozoa; serves as storage place for spermatozoa until ejaculation

D. Ampulla--May serve as temporary storage for sperm in bulls and rams

E. Penis--Transports sperm from the male to the female

F. Urethra--Transports urine

G. Cowpers gland--Secretes an alkaline material which serves to clean the urethra prior to ejaculation; produces a lubricating substance

(Note: In swine this gland produces a fluid that jells and is the last to be ejaculated. It forms a plug in the sow's cervix.)

H. Prostate gland--Secretions that nourish and stimulate sperm activity

I. Seminal vesicle--Secretes a substance high in simple sugar (fructose) which s erves as a nutrient for spermatozoa transport; neutralizes urine; adds volume

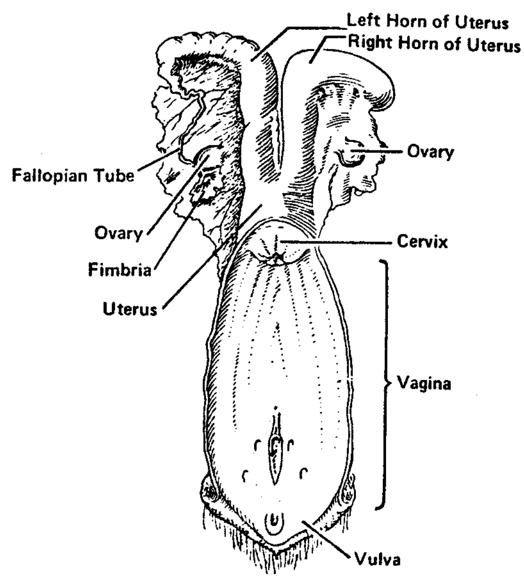
J. Retractor penis muscle--Relaxes to allow copulation and retracts the penis after copulation

K. Scrotum--Maintains the temperature of the testes; serves as protection for the testes

L. Sheath--Provides opening to the male reproductive tract

M. Spermatic cord--Supports the testes

VII. Parts of the female reproductive tract (Transparencies 2, 3, 4, 5)



VIII. Functions of parts of female reproductive tract

A. Vulva--Opening of the female reproductive tract

B. Vagina--Channel for birth of fetus; receives male penis during copulation

C. Cervix--Divider between the vagina and the uterus; secretes a fluid or mucus that forms a plug at end of cervix inside the uterus when pregnancy occurs

D. Uterus--Provides environment for nourishment and development of the fetus

E. Horns of uterus--Part of uterus where fetal development takes place

F. Fallopian tube--Path between ovary and uterus; fertilization occurs here

G. Ovaries--Produce eggs and certain hormones

IX. Effects of hormones produced by the ovaries and testes

A. Ovaries

1. Estrogen--Brings female into heat; aids in moving the sperm and egg together by increasing contractions of the female reproductive tract; stimulates cell growth in the uterus in preparation for the embryo

2. Progesterone--Prevents ovulation and causes heat period to end

B. Testes--Produce testosterone which affects sex drive and causes growth development in the male reproductive tract; also necessary for maturation and survival of sperm

X. Advantages of fertility testing bulls

A. Prevents loss of calf crop

B. Increases calf crop

C. Provides means of selecting bulls

D. Provides means of culling bulls from herd

E. Shortens calving season

F. Increases profit

XI. Causes of sterility and delayed breeding in bulls

A. Poor semen

B. Physical defects and injuries

C. Psychological problems

D. Infection and disease

E. Poor management and feeding

F. Inherited abnormalities

XII. Parts of a sperm cell (Transparency 6)

A. Head

B. Neck

C. Middle piece

(Note: The middle piece of the sperm cell stores energy for the sperm cell.)

D. Tail

(Note: The tail propels the sperm.)

XIII. Types of abnormal sperm

(Note: For a sample to be acceptable these should not exceed ten percent.)

A. Tailless head

B. Two heads

C. Abnormal shaped head

D. Two tails

E. Coiled tail

F. Abnormal middle piece

XIV. Evaluating quality of bovine semen

A. Color--Acceptable color ranges from milky to creamy

(Note: This indicates sperm per cubic millimeter of 500,000 or above. Other colors indicating less than 500,000 sperm/cu. mm. would be opalescent (cloudy) to watery.)

B. Foreign material--Blood or pus in the semen indicates a serious problem and is unacceptable; bedding, dust or fecal material should be disregarded

(Note: Pus may appear as snowflakes around the edges of a tilted vial.)

C. Wave pattern

(Note: This is best determined by placing a thick drop of semen on a slide under a microscope on low power and with reduced light.)

1. Acceptable

a. Very good - 4 - Dark, distinct waves moving rapidly

b. Good - 3 - Waves apparent, but with moderate motion

2. Not acceptable

a. Fair - 2 - Waves barely distinguishable

b. Poor - 1 - No waves, but motile sperm are present

c. Very poor - 0 - No waves and no sperm motility

D. Progressive motility

(Note: Other types of motility which involve circling or jerking without forward motion are undesirable. Motility is best determined by putting a thin, diluted drop of semen on a slide under a microscope on low power, 100X.)

1. Acceptable samples should have a progressive motility exceeding 50 percent

2. Ratings

   a. Very good - 5 - 80-100% motile sperm cells

   b. Good - 4 - 60-80% motile sperm cells

   c. Fair - 3 - 40-60% motile sperm cells

   d. Poor - 2 - 20-40% motile sperm cells

   e. Very poor - 1 - 0-20% motile sperm cells

XV. When to check for bull fertility

A. Just before breeding season

(Note: By testing at this time, you can identify sterile or near-sterile bulls at the time they are expected to settle cows.)

B. Soon after breeding season

(Note: Semen collected at the end of the breeding season should be evaluated carefully because heavy service temporarily lowers the semen quality in most bulls. Checking fertility at this time, however, saves the cost of keeping an infertile bull.)

XVI. Fertility problems

A. Sterility

1. Animals unable to reproduce

2. No remedy

B. Age

1. Fertility levels decrease as age increases

2. Female--Eggs not produced regularly

3. Male--Reduced sperm concentration

C. Deformities--Deformed parts of reproductive tract

Example: Undescended testicles

D. Temperature

1. Male--High temperatures can end sperm production

2. Female--Heat stress reduces size and number of offspring

E. Condition

1. Temporary infertility when animals not in good general condition

2. Abrupt change in nutritional levels, overfeeding and underfeeding can all reduce fertility

F. Freemartin

1. Heifer born twin to a bull

2. 90% infertile

G. Silent heat

1. Shows no signs of estrus

2. Caused by improper hormone release

3. Causes cyst

H. Chronic buller

1. Caused by hormone imbalance

2. Female seems to stay in heat

3. Conception does not occur

I. Disease and infections

1. Can cause death of fetus

2. Can prevent conception

XVII. Gestation periods

(Note: The following gestation periods are based on an average.)

A. Cow--283 days

B. Mare--336 days

C. Sow--114 days

D. Ewe--150 days

XVIII. Advantages of pregnancy testing

A. Cuts winter feed bills

B. Identifies pregnant cows

C. Provides means of culling cows from herd

D. Increases profit

Example: Setting goal of 90 to 95% calf crop within 30 days

(Note: Slaughter cows will bring a higher return if known to be open. Purebred animals will bring more money if known to be safely with calf.)

XIX. Indications of pregnancy (Transparency 7)

A. Palpation of fetus

B. Presence of fluid in uterine horn

(Note: The uterine horn changes in shape and size during different stages of pregnancy.)

C. Presence of "fetal membrane slip"

D. Palpation of amnionic vesicle

(Caution: If this is not done carefully it can result in hemorrhaging and should be avoided unless necessary.)

E. Presence and size of cotyledons

(Note: These can be detected by about the 65th day of pregnancy.)

F. Diameter and pulse rate of uterine artery

G. Location of uterus

(Note: Uterus begins to descend over front of pelvic girdle after 75 days of pregnancy.)

XX. Rule of thumb for estimating fetus size in a cow--Square the month of gestation and divide by two

Example: Cow has been bred 4 months

4 x 4 = 16÷2 = 8
Fetus should be about 8 inches long

XXI. Reasons for using left hand and arm for rectal examinations of cows

A. Most pregnancies occur on right side

(Note: Research shows that most pregnancies occur on the right side in mares also.)

B. Body is positioned in such a manner that the left arm has a tendency to move to the right side of the cow

XXII. Pregnancy testing ewes and sows

A. Ewes

1. Ultra-sonic devices measure fluid in uterus

2. Rectal-abdominal palpation

(Note: The ewe is laid on her back and a plastic tube is placed in her rectum and pushes the fetus to the abdominal wall. The fetus is then palpated through the abdominal wall.)

B. Sows--Ultra-sonic devices measure fluid in uterus

XXIII. Signs of estrus (Transparencies 8, 9, 10)

A. Standing to be ridden

B. Riding others

C. Nervousness; restlessness

D. Clear, thin, wet sticky mucus flowing from vulva

E. Minor indications

1. Dirt or mud on flanks or back

2. Hair standing up on tailhead

3. Bellowing

4. Holding up milk

XXIV. Most important indication of estrus--Standing to be ridden

(Note: Regular observation, 2-4 times daily, is necessary for an effective heat detection program.)

XXV. Normal estrous cycles for cows, mares, sows and ewes

A. Cows, mares and sows--average cycle is 21 days

(Note: Cows vary from 19-23 days, mares vary from 10-37 days and sows vary from 18-24 days.)

B. Ewes--average cycle is 16-17 days

(Note: Ewes may vary from 14-20 days and are normally seasonal breeders--late summer or early fall.)

XXVI. Ovulation of a cow--Occurs 8 to 10 hours after the end of standing heat

(Note: If a cow is noticed in standing heat during the morning, the best time for insemination would be in the afternoon. This depends, however, on the accuracy of the observations and the practicality of breeding at that time.)

XXVII. Factors that contribute to poor conception rates

A. Improper timing of insemination

B. Disease

Examples: Vibriosis, vaginitis, trichomoniasis, Bang's, lepto

C. Poor insemination technique

D. Poor management

Examples: Improper feeding or handling

E. Ovulation failure

F. Poor semen

XXVIII. Reasons why timing of insemination is important

A. Sperm should be in the fallopian tube 6-10 hours before ovulation for optimum conception rates

(Note: If cow is inseminated too early, sperm dies. If done too late, the egg is gone. The sperm will live from 28-30 hours while an egg will last 10 hours before starting to deteriorate.)

B. Cervical reaction or uterine contraction must be present to move sperm to egg

XXIX. Equipment used in inseminating (Transparency 11)

A. Nitrogen chest

B. Thaw box

C. Inseminating tube

D. Disposable gloves

E. Polybulb

F. Ampule

G. Straw

H. Straw clippers

XXX. Methods of thawing semen

A. Straw

1. Hot bath--Place in water bath at 90^{o}F to 95^{o}F for a minimum of 20 seconds

2. Ice bath--Place in water bath at 37^{o}F for 8 to 10 minutes

3. No thaw--Take straight from nitrogen tank without thawing and inseminate

(Caution: Many stud organizations are recommending different methods of thawing semen. However, it appears that all are reporting that the hot bath is the most desirable. Please check with your semen supplier about the correct method.)

B. Ampules

1. Hot bath--Place in water bath at 110^{o}F for 40 seconds

2. Ice bath--Place in water bath at 37^{o}F for 10 minutes

XXXI. Errors in placing inseminating tube (Transparency 12)

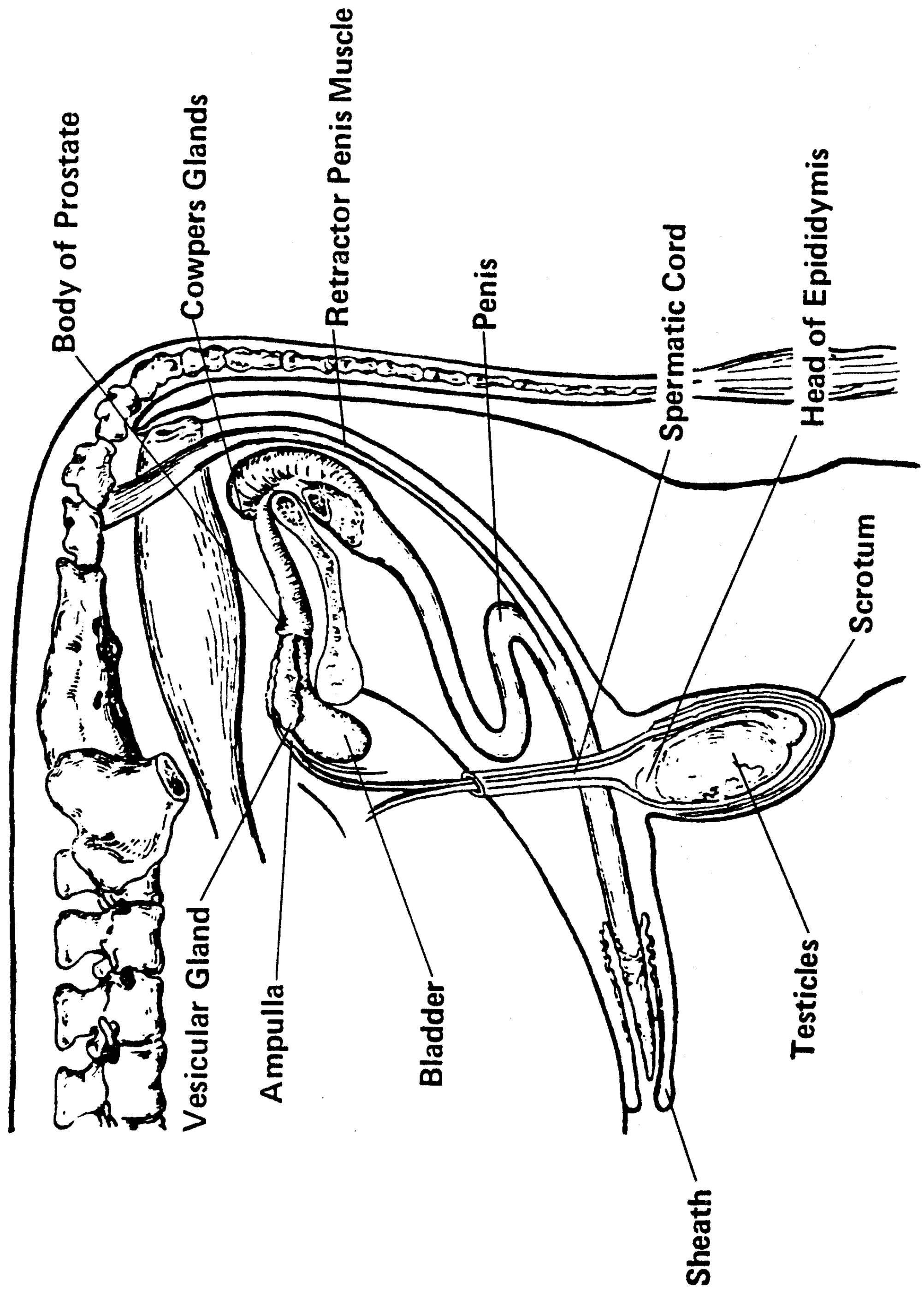
A. Tube placed in blind cavity of cervix

B. Tube placed in urethra

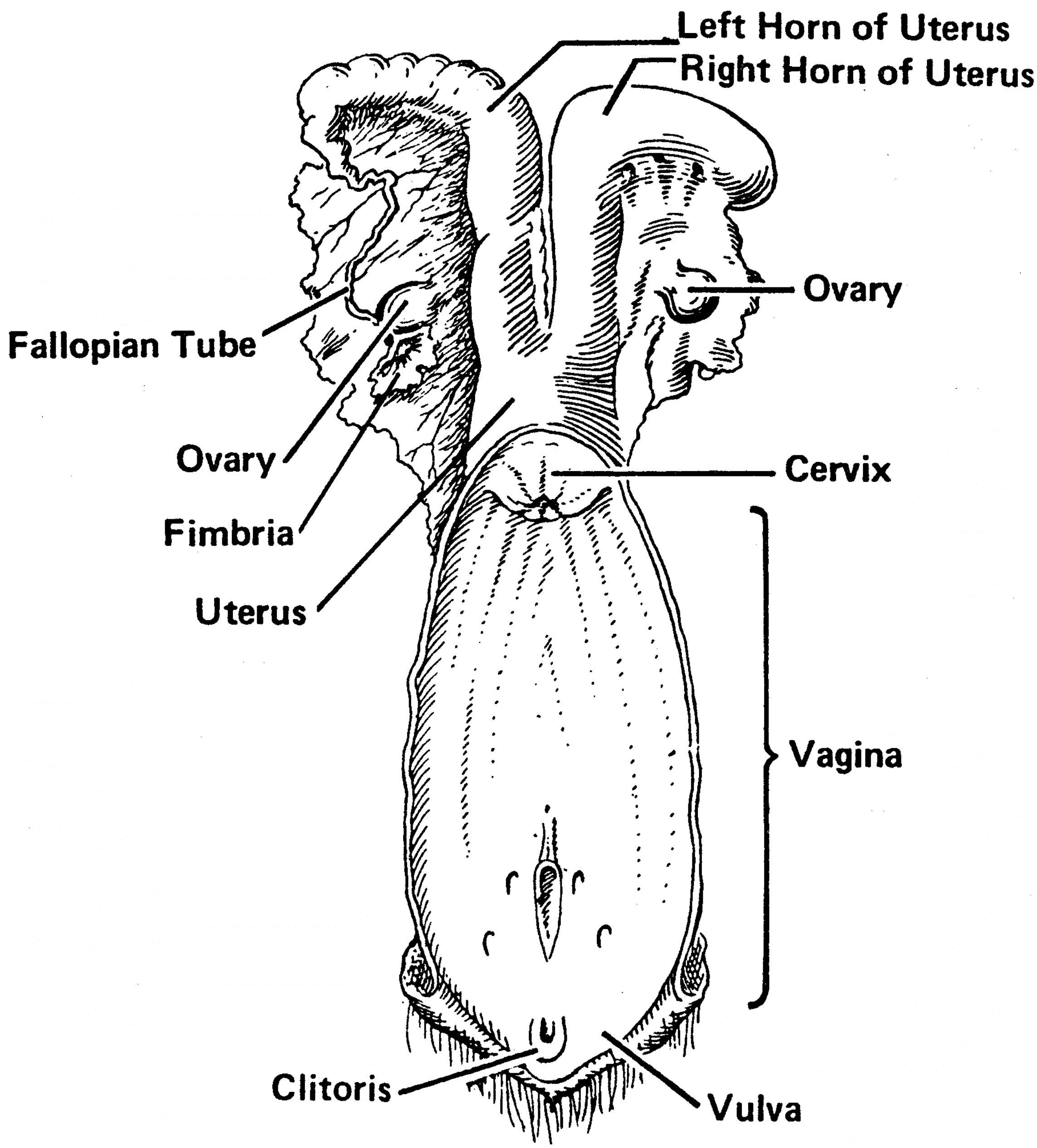
C. Tube placed in fold of vaginal wall

D. Tube placed in prolapsed cervix

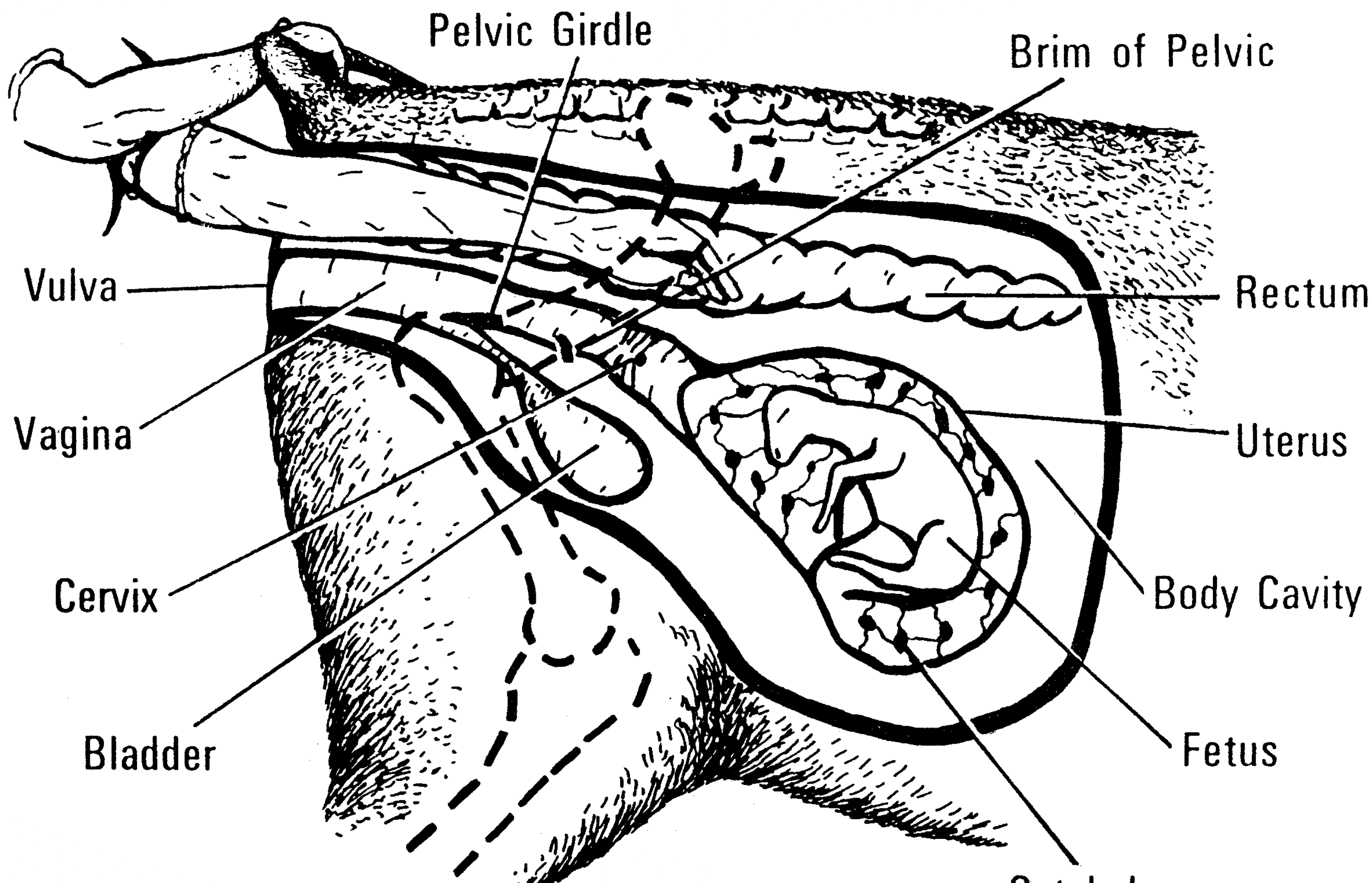
Reproductive Tract of a Bull



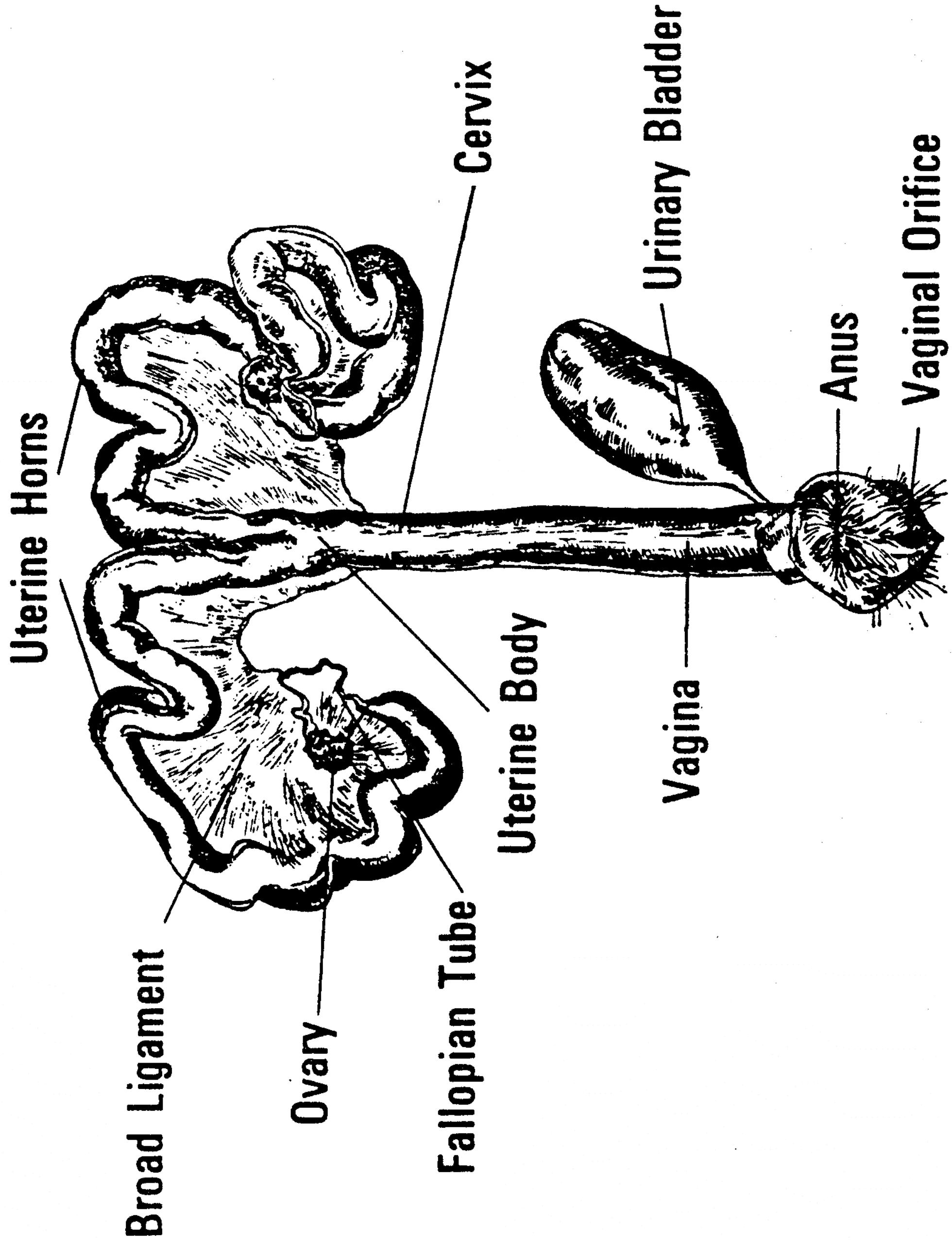
Reproductive Tract of a Cow



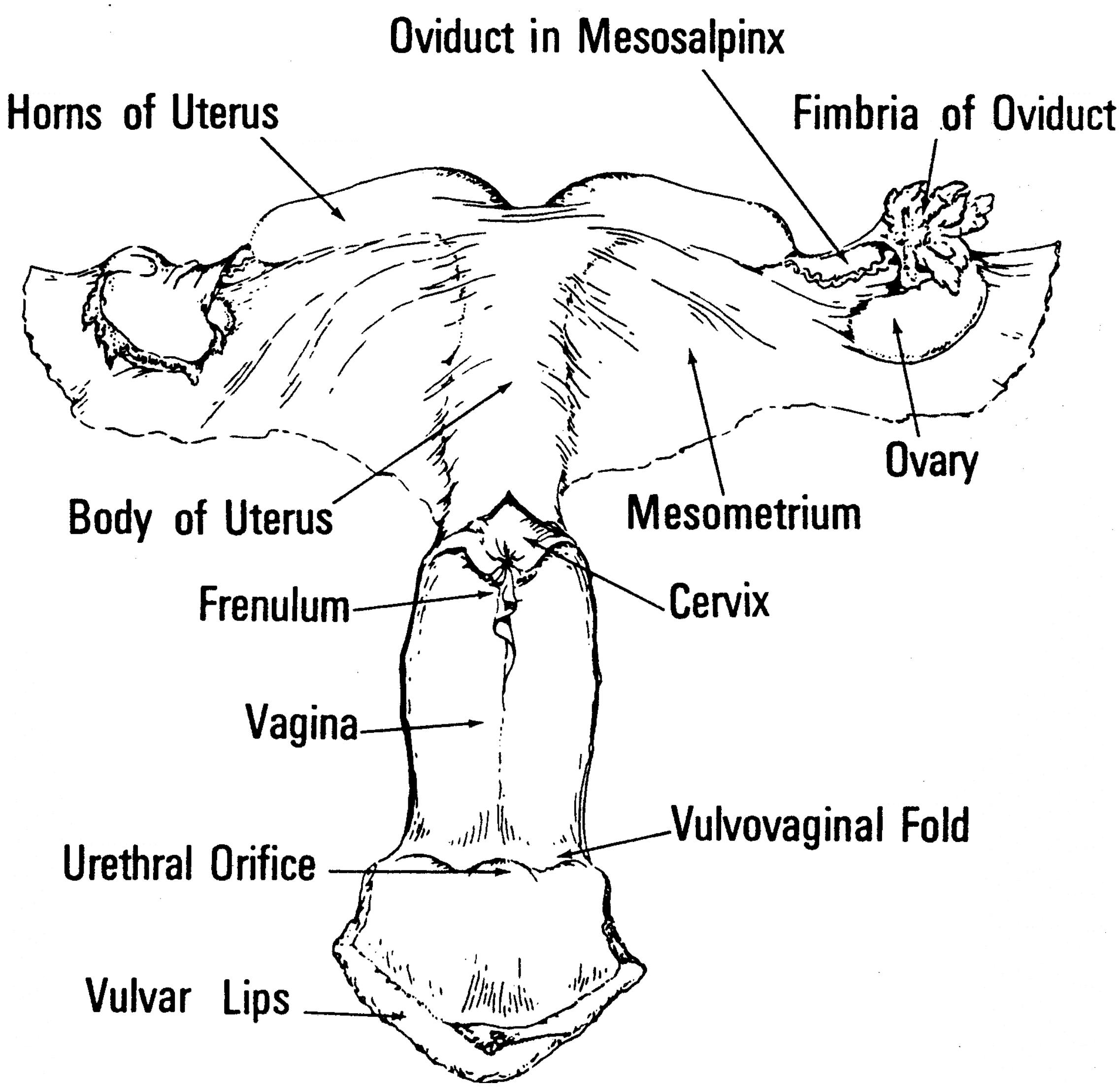
Parts of Reproductive Tract Positioned Within Cow's Body



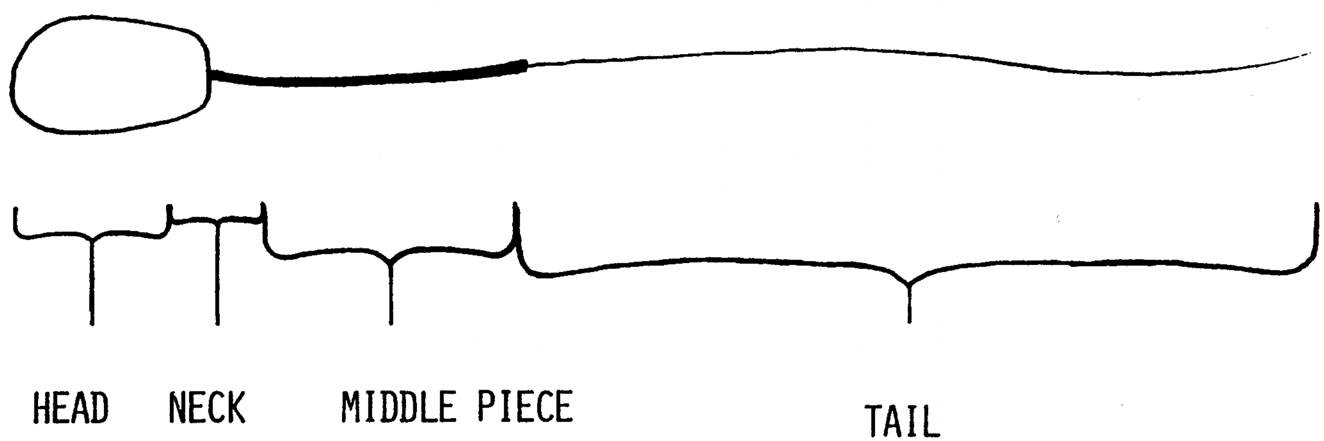
Reproductive Tract of a Sow



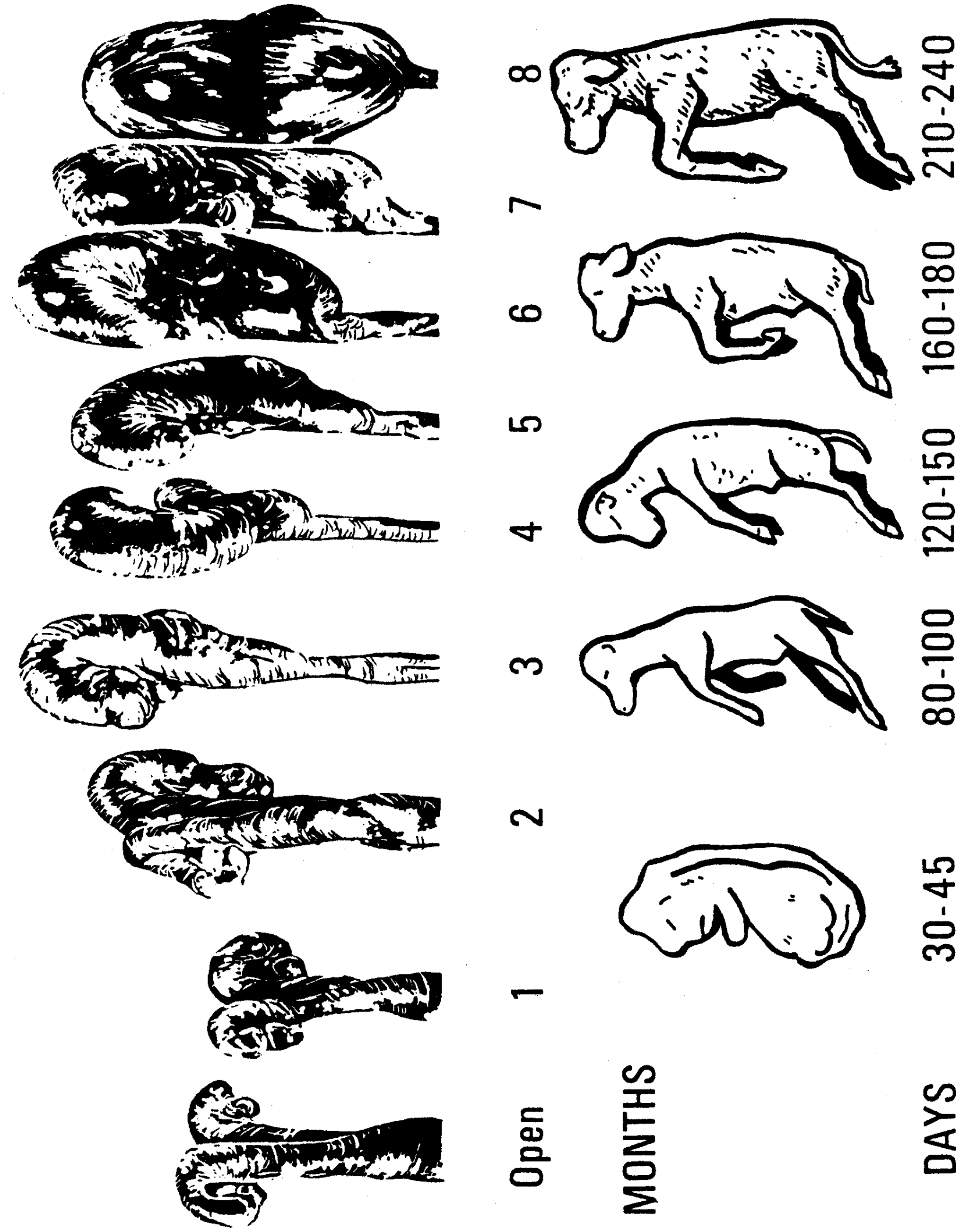
Reproductive Tract of a Mare



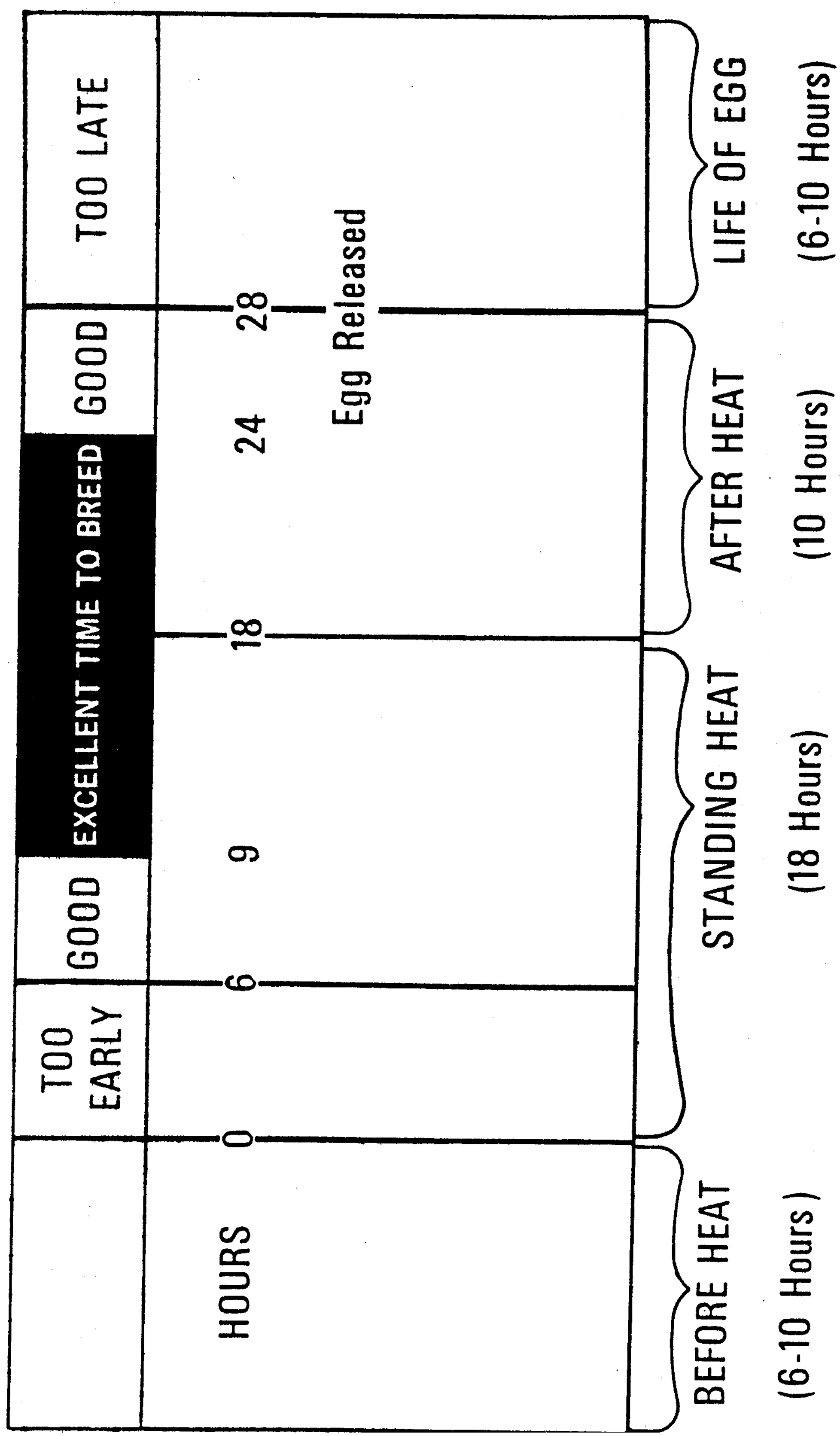
Parts of Sperm Cell



Stages of Pregnancy



Time To Breed (Cow)

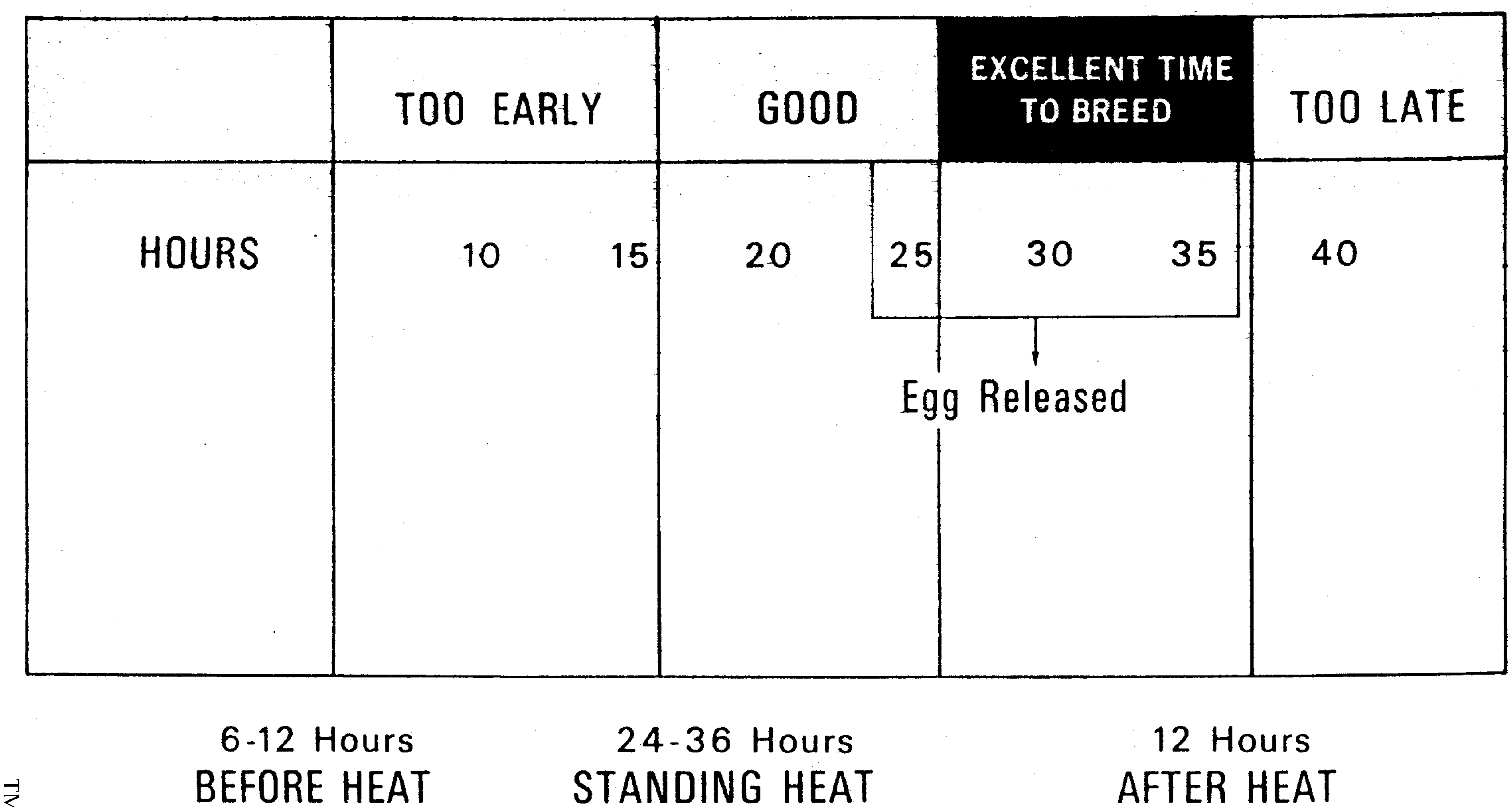


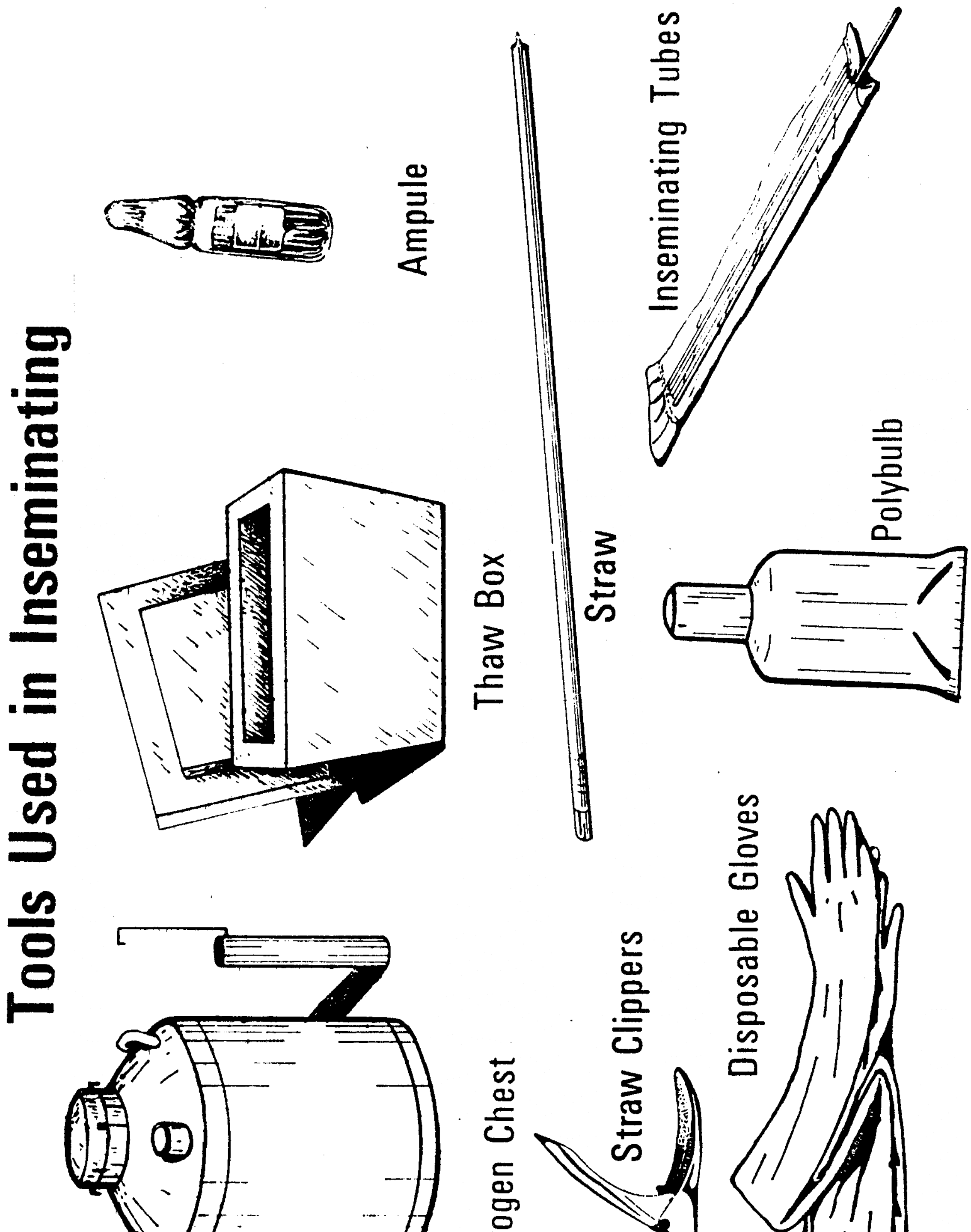
Time of Insemination and Conception Rate (Mare)

	Days Before Ovulation						Day Of Ovulation			Days After Ovulation		
	−5	−4	−3	−2	−1		0			1		3
NUMBER OF MARES INSEMINATED	30	20	89	124	164		256			13		1
CONCEPTION RATE %	10	40	52	65	60		60			54		0

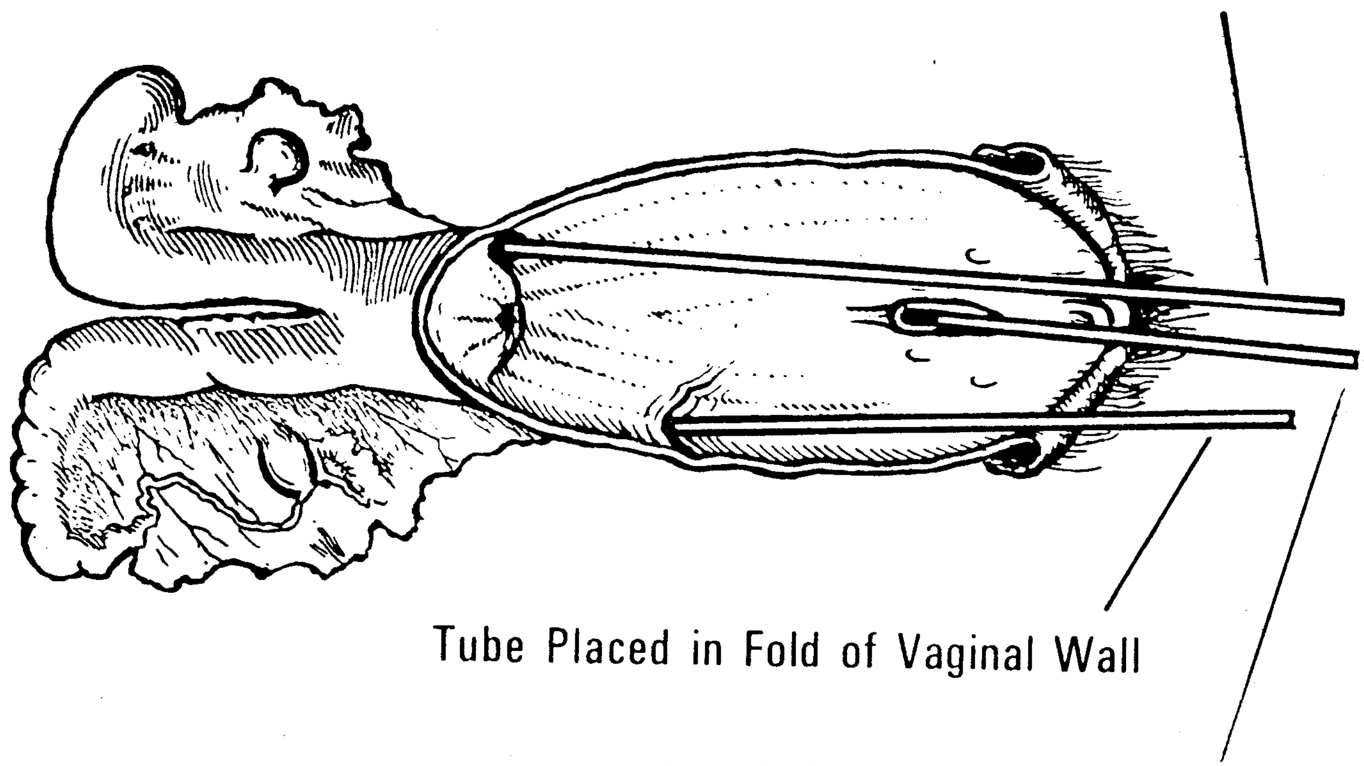
Note: It Appears That The Conception Rate Was The Highest Two Days Before Ovulation, With One Day Before Ovulation And The Day Of Ovulation Being The Same.

Time To Breed (Sow)




Tools Used in Inseminating
Nitrogen Chest
Thaw Box
Ampule
Straw
Straw Clippers
Disposable Gloves
Polybulb
Inseminating Tubes

Errors in Placing Inseminating Tube



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ASSIGNMENT SHEET #1--EVALUATE SEMEN BASED ON COLOR, FOREIGN MATERIAL, WAVE PATTERN, MOTILITY AND ABNORMAL SPERM

Name ______________________________ Score ______________________________

Color and foreign material can be observed without a microscope. Only blood or pus are considered important foreign material. Wave pattern should be observed under low power (100X) using a fairly thick drop of sperm on the slide. Progressive motility or movement in a forward direction is best determined by placing a small drop of semen on a slide and then diluting it with physiological saline or buffered 2.9 percent sodium citrate solution. A cover slip should then be placed over the diluted sperm and the light reduced so the sperm cells are distinct. Circling or jerky motility should also be observed and estimated.

LAB SHEET FOR SEMEN EVALUATION

Semen sample no. ______________________________

Color of semen ______________ Estimated sperm concentration ____________________

Foreign material ______________ (yes or no) If yes, then describe ______________________________

____

Wave pattern (rate from 0 to 4) ____________________

Abnormal motility (estimate percentage of abnormal motility) __________________

Progressive motility (estimate percentage and rate from 1 to 5)

Percentage ________________

Rating ____________________

Abnormal sperm (estimate percentage of abnormal sperm) ____________________

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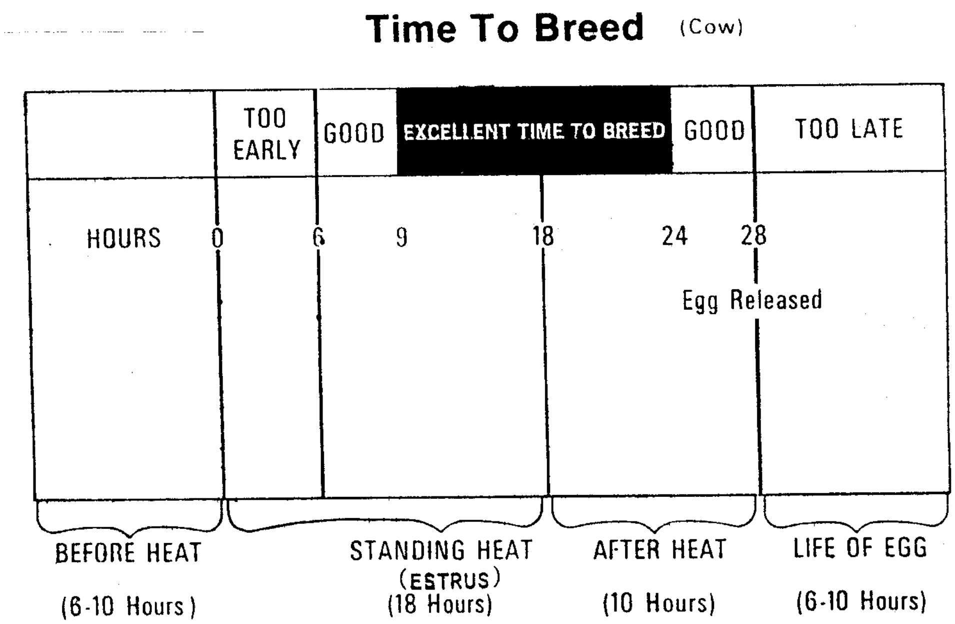
ASSIGNMENT SHEET #2--IDENTIFY EVENTS FROM AN ESTROUS CYCLE CHART

Name ______________________________ Score ______________________________

From the chart below identify the different events associated with estrus in the cow. Answer each of the questions by using the chart.



1. With respect to the beginning of standing heat:

   a. When is the best time to breed? ______________________________

   b. When is the egg released? ______________________________

2. How long does the egg last after ovulation? ______________________________

3. With respect to the information on the chart, describe when you would inspect the herd for heat and explain why. ______________________________

____

____

____

____

BREEDING AND REPRODUCTION

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ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1--Evaluated to the satisfaction of the instructor.

Assignment Sheet #2

1. a. Nine to twenty-four hours after the beginning of standing heat

   b. Twenty-eight hours after the beginning of standing heat

2. Six to ten hours after ovulation

3. Answer should include inspection from two to four times per day in order to breed during a period of time from 9 to 24 hours after standing heat begins.

BREEDING AND REPRODUCTION

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LABORATORY EXERCISE #1--PREGNANCY TEST A COW USING RECTAL EXAMINATION

I. Tools and equipment

A. Chute

B. Plastic gloves

C. Lubricant

D. Cow showing indications of pregnancy

II. Procedure

(Caution: A person trained in pregnancy testing should be on hand to assist with instruction.)

A. Place cow in chute

B. Place plastic glove on left hand

(Note: Be sure to remove any jewelry that you might be wearing.)

C. Wet plastic glove with water and apply lubricant

D. Grasp the cow's tail with right hand and move the tail to the left side of the cow

E. Insert left hand and arm into the cow's rectum to a depth of approximately six inches

(Caution: This should be done carefully to prevent damage to the cow or the fetus.)

F. Remove feces as necessary in order to be able to palpate with fingers

F. Locate the cervix and position hand in the same manner as in artificial insemination

H. Notice position of cervix in relation to pelvic cavity

(Note: If cervix is not found on pelvic floor at an approximate depth of six inches, it is a good indication that the cow could be pregnant. If this is the case, while holding the cervix in the hand, attempt to pull the cervix back up on the floor of the pelvic girdle for easier palpation.)

I. Move hand slowly down the tract to the separation of the uterus where the two uterine horns lead off, without turning loose of reproductive tract

J. Palpate each horn in order to determine if one horn is larger than the other

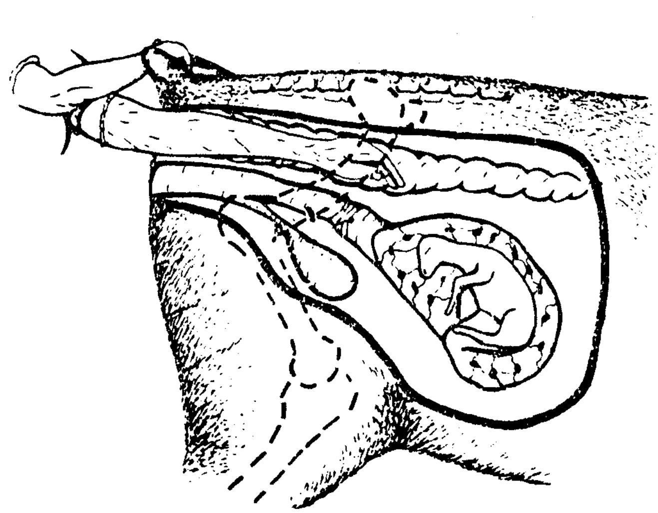
(Note: Remember, do not turn loose of the tract because you might forget which horn you are palpating.)

(Caution: Do not squeeze the horns, simply rub or palpate each one.)

K. Rely on the different stages and indications of pregnancy and determine if the cow you are examining is pregnant

L. Reveal your findings to the instructor for evaluation

III. Diagram of procedure



BREEDING AND REPRODUCTION

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LABORATORY EXERCISE #2--INSEMINATE REPRODUCTIVE TRACT ACQUIRED FROM SLAUGHTERHOUSE

I. Equipment and materials

- A. Disposable glove
- B. Inseminating tube
- C. Polybulb or syringe
- D. Bottle of dye
- E. Scissors
- F. Paper towels
- G. Cow reproductive tract

II. Procedure

- A. Place glove on left arm

  (Note: Place glove on right arm if you are left-handed.)

- B. Depress polybulb, place in dye, and slowly release bulb to fill
- C. Place left hand over cervix as if in cow
- D. Insert tube into the vulva with right hand, guiding tube through the three rings of the cervix
- E. Deposit dye by depressing the polybulb when past the third ring on the cervix

  (Note: Count slowly to ten while depressing the polybulb)

- F. Remove tube
- G. Cut open the dead tract to locate the point of deposit or dye

  (Note: The dye should be deposited somewhere between the third and fourth rings of the cervix.)

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LABORATORY EXERICISE #3--INSEMINATE A COW

I. Tools and equipment

A. Nitrogen chest

B. Ampule/straw of semen

C. Thaw box

D. Disposable glove

E. Inseminating tube

F. Polybulb or syringe

G. Lubricant

H. Paper towels

II. Procedure

A. Place cow in chute

B. Remove ampule/straw from nitrogen chest

C. Place ampule/straw in thaw box

D. Place disposable glove on left arm

(Note: Place glove on right arm if you are left-handed.)

E. Place polybulb or syringe on end of inseminating tube

F. Open ampule/straw of semen

G. Depress polybulb or syringe, place in ampule, and slowly release to draw semen into tube

(Note: Cut open the top of ampule by scribing knife blade around top on the etch mark.)

H. Place syringe in mouth with tube in horizontal position

(Note: This will leave both hands free.)

I. Lubricate glove

(Note: K-Y jelly is the best lubricant to use, but mild soap will work.)

J. Insert left hand into rectum for removal of feces

K. Clean exterior of the vulva with paper towels

L. Locate cervix with left hand in rectum and hold in palm of hand

(Note: If cow is straining to expel your arm, relax a minute and the cow will also relax. The cervix will be a firm, cylindrical structure.)

M. Insert tube into the vulva with right hand; locate cervical guide tube opening and gently insert through the three rings of the cervix

(Note: Tube should be inserted at a slight upward incline to reduce chance of entering urethra.)

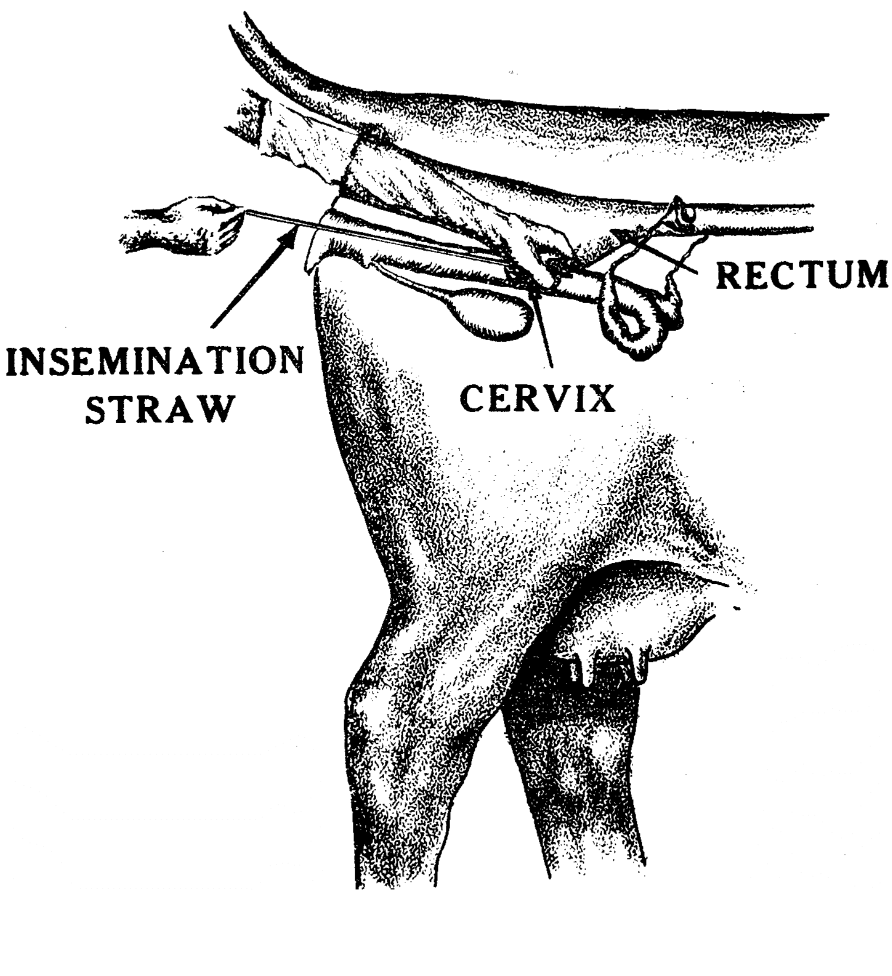
N. Deposit semen at the end of the cervix by pressing the polybulb between the thumb and finger of the right hand; squeeze slowly

O. Remove tube from vagina; remove hand from rectum

P. Locate and squeeze clitoris between thumb and finger

(Note: This improves conception rate by about 5%. The clitoris is located right at the base of the vulva.)

Diagram of procedure



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LABORATORY EXERCISE #4--PLACENTAL AND FETAL DEVELOPMENT

Name ______________________________ Score ______________________________

Materials needed

Excised pregnant cow reproductive tracts of various gestational ages

Dissecting kit: scissors, scalpel, probes, forceps
Dissecting trays
Beakers
Graduated cylinders
Rulers, tape measures
Balances

Introduction

Placentation

A *placenta* may be defined as any intimate appostion or fusion of fetal tissue to maternal tissue for the purpose of physiological exchange. The placenta takes on various forms in different species and classification is usually based on its gross anatomy or, preferably, upon its microanatomy and relationship with maternal tissue. The extra-embryonic membranes that form and are associated with the placenta are the amnion, the allantois, and the chorion (Figure 1). The *amnion*, the innermost membrane, surrounds the fetus. The *chorion*, the outermost membrane, is in contact with the endometrium and is the membrane through which maternal-fetal physiologic exchange takes place during gestation. Located between the amnion and chorion, the *allantois* is continuous with the anterior extremity of the bladder by way of the *urachus*, which passes through the umbilical cord. The fetus is surrounded by the *amniotic fluid* contained within the amniotic membrane. Surrounding this membrane is the *allantoid fluid* contained within the allantoic membrane. Considerable variation exists between volumes of these two fluids in different species and within a single species during the course of gestation.

Different families of mammals develop diverse types of placentas, depending on litter size, internal structure of the uterus, and the degree of fusion between maternal and fetal tissues. There are several criteria that can be used to classify mammalian placentas. In one method, four major categories are designated according to the number of tissue layers separating the fetal and maternal vascular systems: *hemoendothelial*, *hemochorial*, *endotheliochorial* and *epitheliochorial*. Farm animals possess the latter type and this laboratory exercise will examine the epitheliochorial type of placenta found in cattle.

The type of placenta in the cow is also referred to as "cotyledonary" and is characterized by the presence of *caruncles*, circular areas of uterine mucosa projecting into the uterine lumen. The number, shape and size of these caruncles varies in different ruminants. *Cotyledons* of the placenta are attached to the caruncles by invasive villi and together they (caruncle and cotyledon) form a *placentome*. In cattle, placentomes start to form 4 to 5 weeks post-conception in the area immediately around the fetus and progress toward the distal limits of the placenta as gestation proceeds.

<u>Fetal Development</u>

With the exception of the pig, studies on prenatal development of farm animals have received very little attention. The need for such studies becomes apparent when one wishes to evaluate normal variations, to make comparisons between species, and to understand better the specific effects of nutritional, physiological and environmental factors in the development of the fetus *in utero*. In these studies, it is often necessary to estimate accurately the age of fetuses even though fertilization time may not be known.

Following fertilization, a series of predictable events follow in an orderly sequence which culminates in a fully formed organism characteristic of its parental species. As the fetus develops, a number of structural arrangements occur, both in the fetus and in the placenta, which could be used to characterize each period of development. However, if one were to classify each stage of development according to each morphological change, the number of stages would become nearly infinite and thus be of little value to the investigator. Given then that a satisfactory method for classifying embryos or fetuses of domestic animals as to age or stage of development has not yet been derived, a number of linear, circumferential, and volumetric measurements on fetuses and their related membranes have been made in an attempt to describe prenatal growth. These measurements will be performed, summarized, and evaluated in this laboratory exercise.

Diagram of the fetal membranes of the 150-day fetal calf.

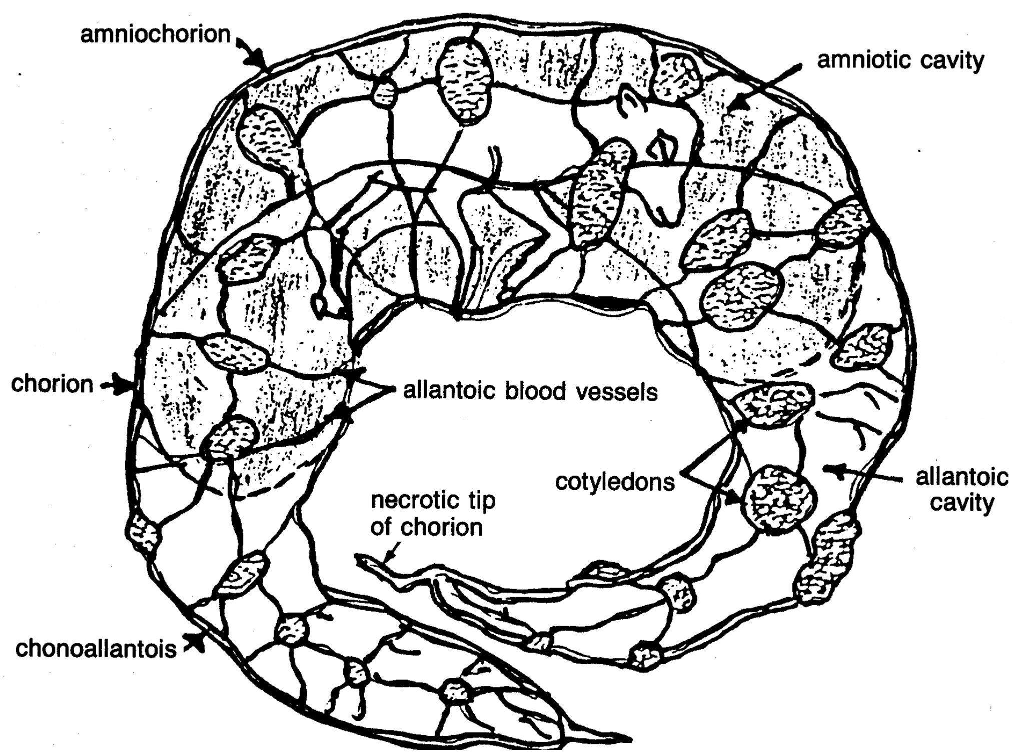

Figure 1

Part I: Procedure

1. Carefully inspect the excised cow reproductive tracts. The tracts provided for this laboratory are of varying gestational ages and the differences in size are obvious.

2. Evaluate the number of corpora lutea present on each ovary. Record this information in the data table.

3. Carefully dissect the fetal membranes and the fetus out of the uterus. Be careful not to puncture either the amnion or the allantois.

4. Drain the allantoic fluid into a pan and record the volume. Do the same for the amniotic fluid.

5. Dissect the fetus(es) away from the fetal membranes and record the number of normal or degenerating fetuses present, fetal sex and weight and crown-rump length (Figure 2). Crown-rump length is proportional to gestational age and can be used to estimate the breeding date (Figure 3).

6. Weigh the fetal membranes, collectively, and record the weight.

7. Weigh the uterus without any of its attachments (attachments include the oviduct, cervix, membranes, fetus, etc.). Count the number of caruncles in the gravid uterine horn (horn with the fetus) and in the non-gravid horn. Dissect the largest caruncle from the gravid uterine horn, weigh it and measure its diameter.

Diagram illustrating measurement of the crown (C)-rump (R) length.

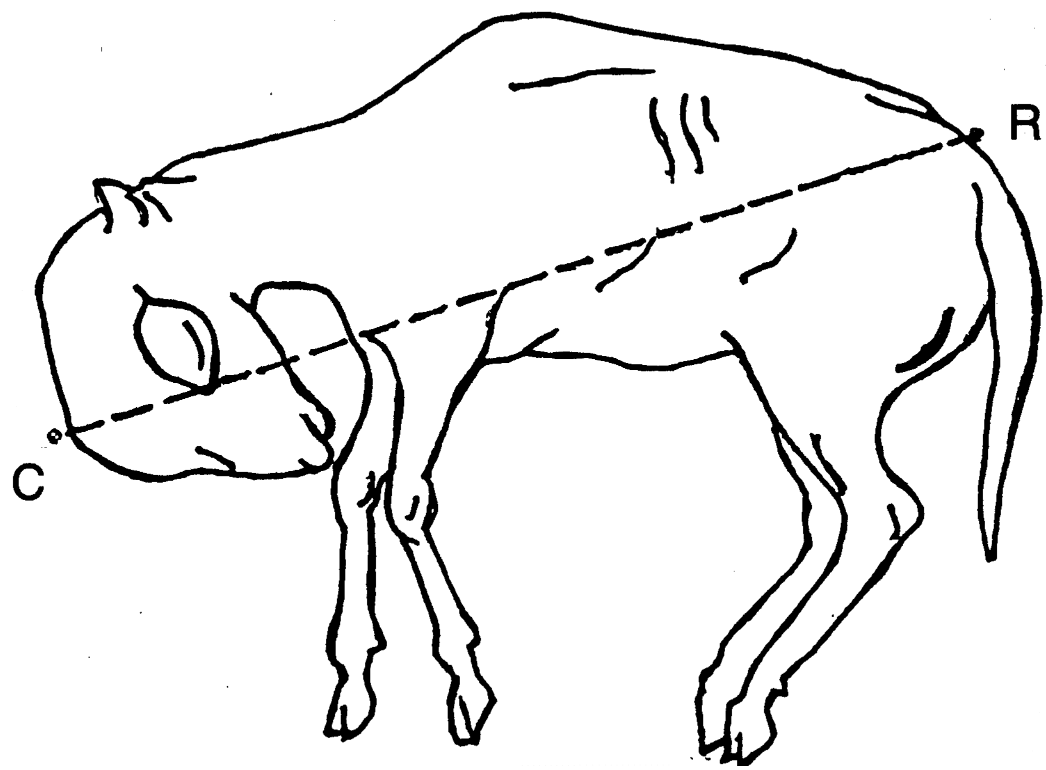

Figure 2

Fetal growth in the cow.

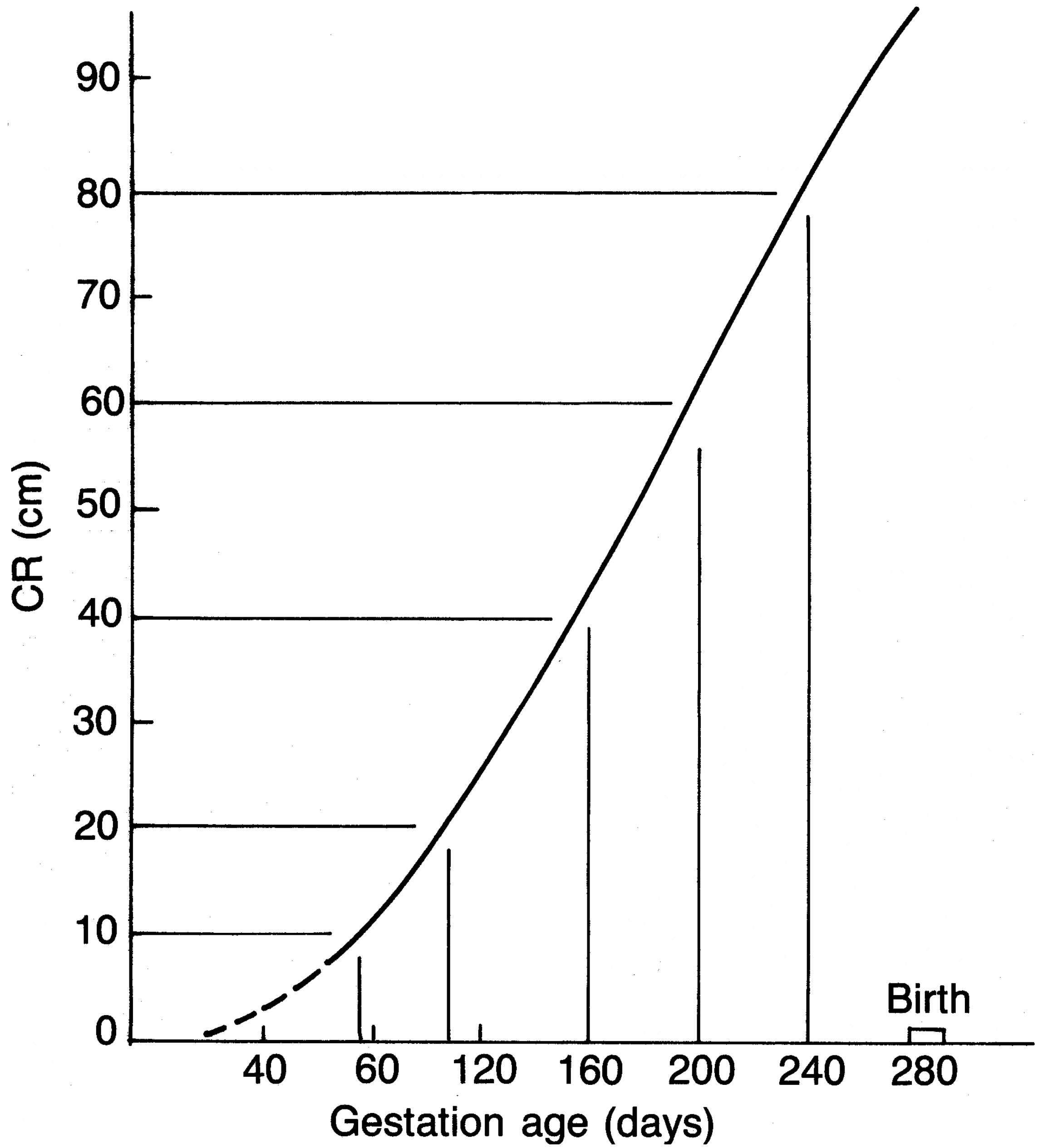

Figure 3

Results:

Placental and Fetal Data

Tract #	1	2	3	4	5	6
Corpora lutea no. L R						
Allantois volume ml.						
Amnion volume ml.						
Fetuses no. L R						
Degenerating fetuses no. L R						
Fetuses weight g						
Crown-rump length cm.						
Fetuses age estimated days						
Breeding date estimated da/mo						
Fetuses sex						
Fetal membranes wt. g						
Uterus weight w/o attachment g						
Caruncles gravid horn no.						
Caruncles non-gravid horn no.						

Tract #	1	2	3	4	5	6
Wt. of largest caruncle g						
Largest caruncle diameter mm.						

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LABORATORY EXERCISE #5--ANATOMY OF THE FEMALE REPRODUCTIVE TRACT

Name ____ Score ______________________________________

Materials needed

Specimens:
- Excised cow reproductive tract
- Excised sow reproductive tract

Dissecting kits: scissors, scalpel, probes, forceps
Dissecting trays
Hypodermic needle, 23 gauge
Syringe, 1 ml
Tissue culture dish
Stereomicroscope
Physiologic saline

Introduction

Female Reproductive Tract

The female reproductive tract is composed of ovaries, oviducts, uterus, vagina and external genitalia. The female reproductive tract of the cow will be examined in this exercise.

Ovary

The ovary consists of the *medulla* and the *cortex*. The ovarian medulla consists of irregularly arranged fibro-elastic connective tissue and an extensive nerve and blood vessel system which enters the ovary by way of the hilus. The *hilus* is the place of attachment between the ovary and the *mesovarium* or supporting ligament.

The ovarian cortex contains the *follicles*, *corpora hemorrhagica*, *corpora lutea* and *corpora ablicantia*. Follicles are involved in ova formation and estrogen production, whereas corpora lutea are involved in progesterone production.

Oviduct

The oviduct is divided into the *fimbriae, infundibulum*, *ampulla* and *isthmus*. The fimbriae are irregular processes adjacent to the ovary and extending from the funnel-shaped infundibulum. The diameter of the oviduct decreases progressively though the consecutive infundibular, ampullar and isthmic portions. The ampulla comprises about half of the oviductal length. The isthmus is connected directly to the uterine horn.

<u>Uterus</u>

The uterus consists of two *horns*, a *body* and a *cervix*. The uterine horns of the sow are long in comparison to the uterine body and are examples of the *bicornuate* type of uterus. The *bipartite* type of uterus is represented by the cow, where a septum divides the uterine body allowing for a larger ratio of length of uterine body to length of uterine horns. The cervix is the constricted posterior portion of the uterus which opens into the vagina. Dissection of the cow uterus will allow for observation of button shaped structures located on the inner wall known as *caruncles*. Caruncles are maternal sites of fetal membrane attachment.

<u>Vagina</u>

The *vagina* is the site of semen deposition in the cow, whereas semen is deposited in the cervix of the sow. The *fornix* in the vagina is the arch formed by the projecting cervix. The fornix is absent in the sow where the cervix is continuous with the vagina.

<u>External Genitalia</u>

The external genitalia is composed of the *vestibule, vulva* and *clitoris*. The external *urethral orifice* opens into the ventral surface of the vestibule.

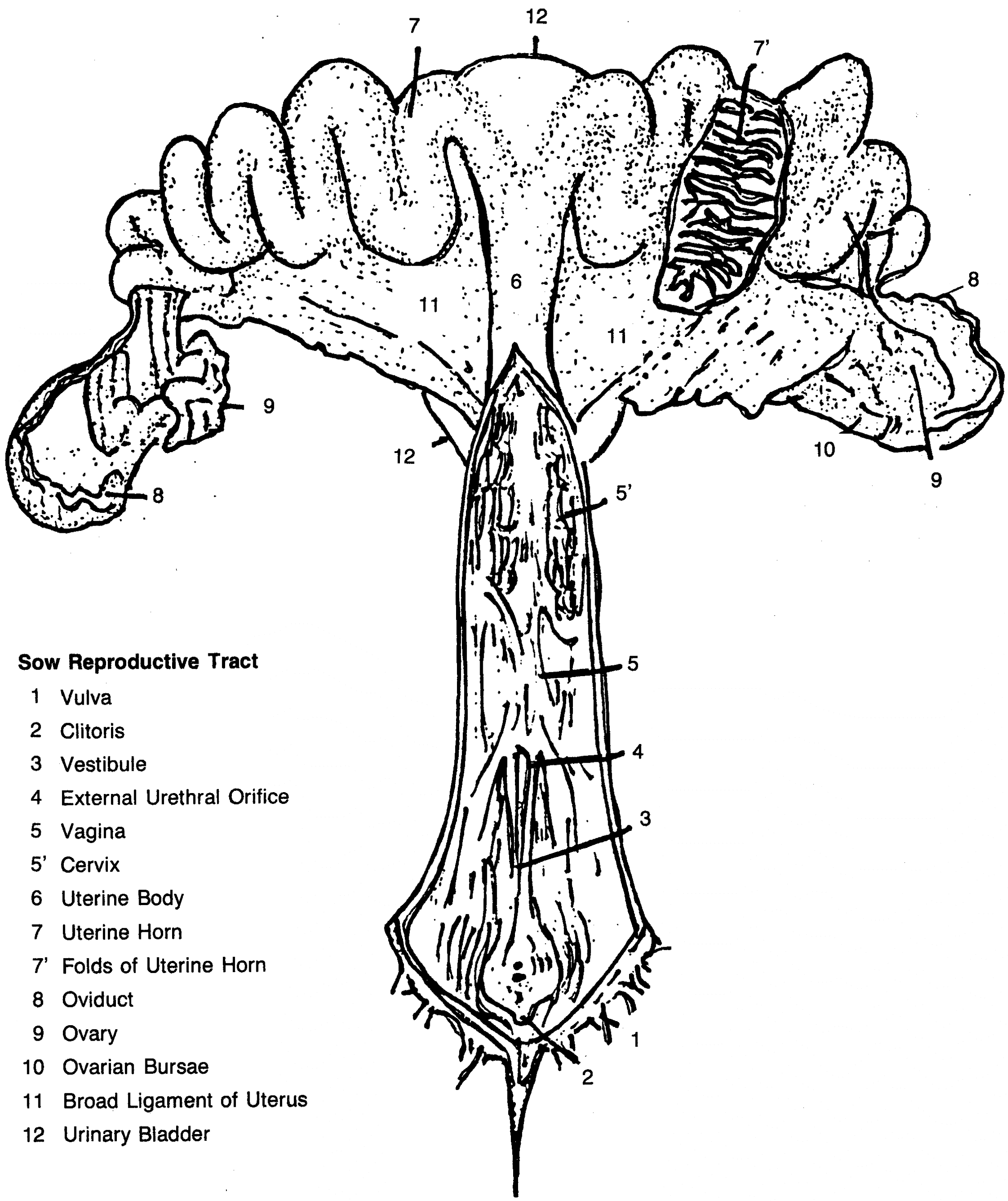
Note the *suburethral diverticulum* in the cow tract. *Gartner's tubules*, remnants of the embryonic structures known as the Wolffian ducts, appear as two small papilla in the vestibule.

<u>Part I: Procedure</u>

1. Examine the excised reproductive tracts of the cow and sow.

2. Know the structures cited in the introduction and in Figures 1 and 2.

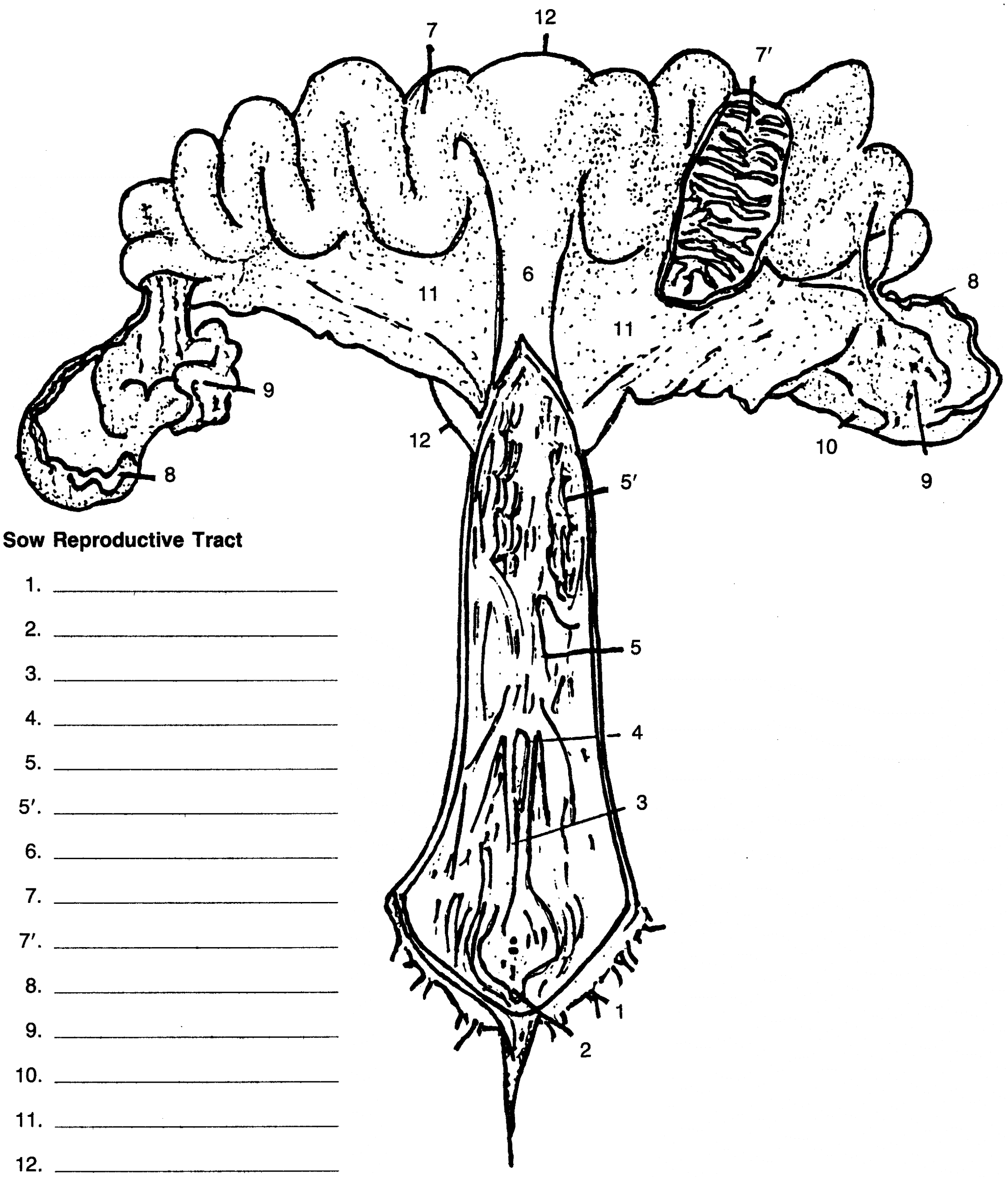
3. Your teacher will aspirate ovarian follicles with the hypodermic needle and syringe using a sub-surface approach through the cortex. The follicular fluid will be transferred to a tissue culture dish containing physiologic saline and scanned using the stereomicroscope to locate an ovum.



Sow Reproductive Tract

Figure 1

Name ______________________________

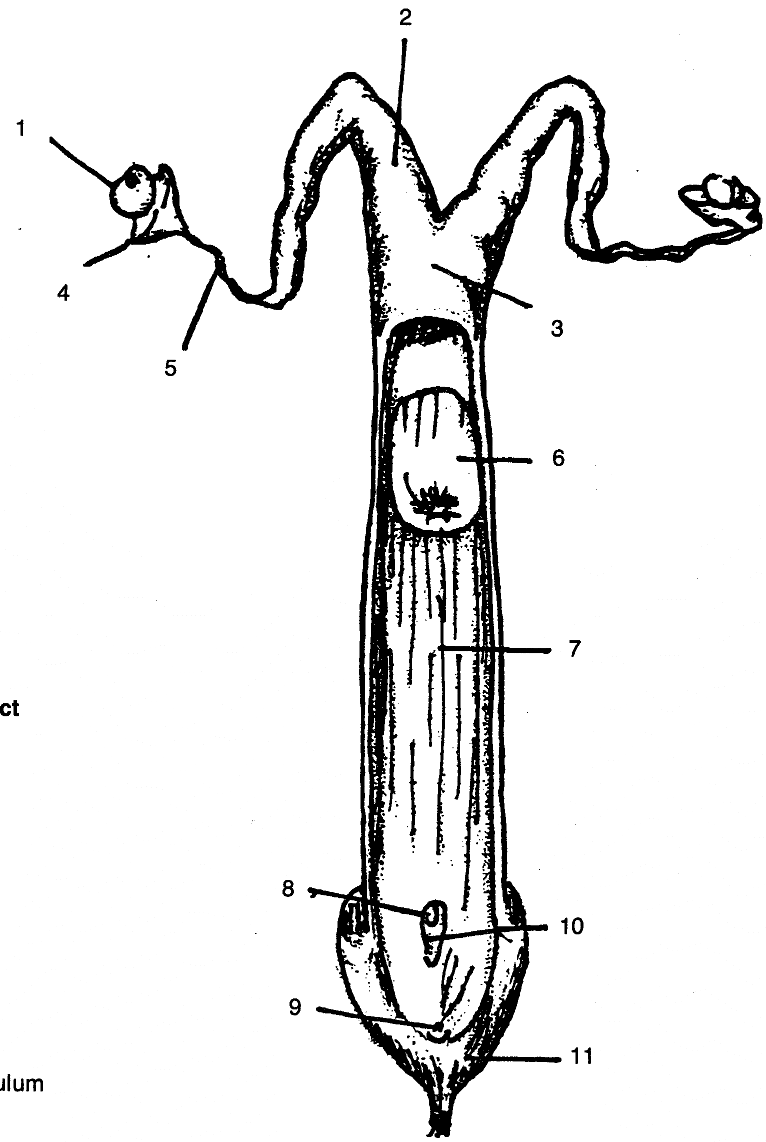


Sow Reproductive Tract

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
5′. ______________________
6. ______________________
7. ______________________
7′. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________

Sow Reproductive Tract

Figure 1



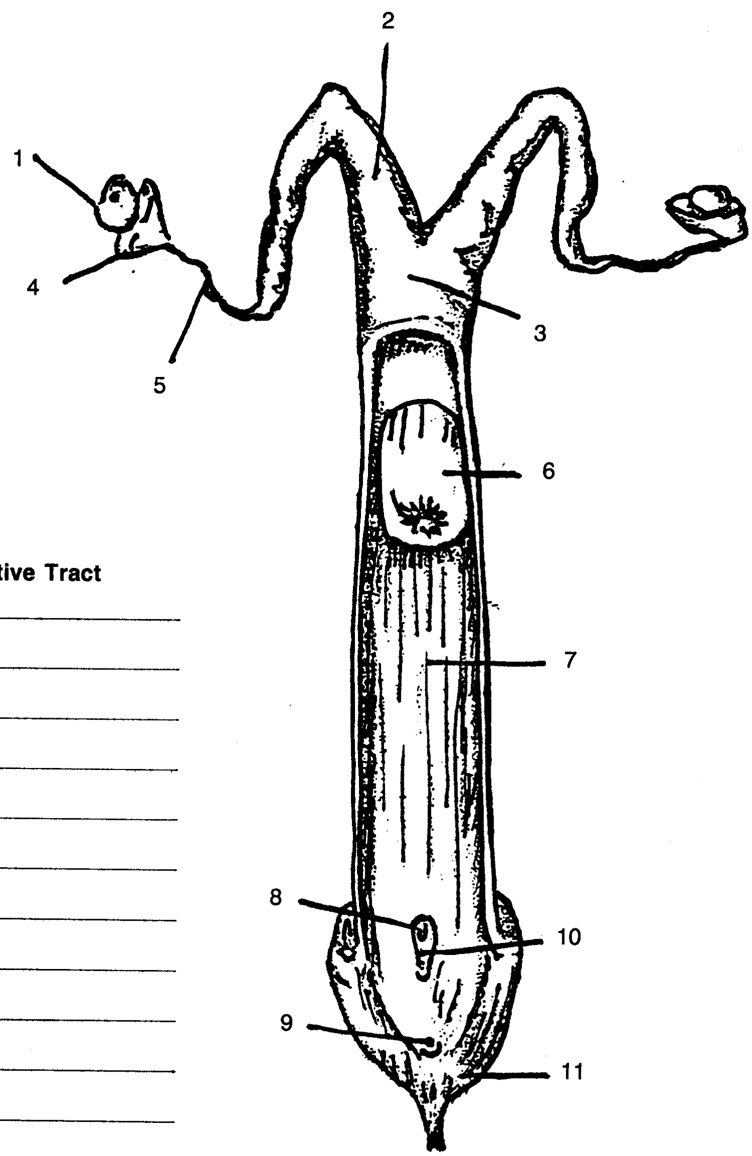
Cow Reproductive Tract

1 Ovary
2 Uterine Horn
3 Uterine Body
4 Infundibulum
5 Oviduct
6 Cervix
7 Vagina
8 Utrethra
9 Clitoris
10 Suburethral Diverticulum
11 Vulva

Cow Reproductive Tract

Figure 2

Name ______________________________



Cow Reproductive Tract

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________

Cow Reproductive Tract

Figure 2

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ANSWERS TO LABORATORY EXERCISES

Lab #1

Evaluated to the satisfaction of the instructor.

Lab #2

Evaluated to the satisfaction of the instructor.

Lab #3

Evaluated to the satisfaction of the instructor.

Lab #4

Evaluated to the satisfaction of the instructor.

Lab #5

Figure 1, Sow Reproductive Tract

1. Vulva
2. Clitoris
3. Vestibule
4. External Urethral Orifice
5. Vagina
6. Cervix
7. Uterine Body
8. Uterine Horn
9. Folds of Uterine Horn
10. Oviduct
11. Ovary
12. Ovarian Bursae
13. Broad Ligament of Uterus
14. Urinary Bladder

Figure 2, Cow Reproductive Tract

1. Ovary
2. Uterine Horn

3. Uterine Body
4. Infundibulum
5. Oviduct
6. Cervix
7. Vagina
8. Urethra
9. Clitoris
10. Suburethral Diverticulum
11. Vulva

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UNIT TEST

Name ______________________________ Score ______________________________

1. Match the terms associated with reproduction to the correct definition.

_____a.	Primary sex gland; ovary or testis	1.	Gonad
_____b.	Uniting of the egg and sperm	2.	Fimbria
_____c.	Time elapsing from one heat period to the next	3.	Fertilization
_____d.	Organism in early stage of development	4.	Ejaculation
_____e.	Standing heat or time when female will receive the male	5.	Sterility
_____f.	Sudden movement of sperm from the epididymis through the penis into the female	6.	Palpation
_____g.	Temporary or permanent inability to reproduce	7.	Estrus
_____h.	Internal body secretion that affects reproduction and other bodily functions	8.	Zygote
_____i.	Occurrence of fertilization	9.	Fetus
_____j.	Young animal in the uterus from time of complete tissue differentiation until birth	10.	Pregnancy
_____k.	Cell produced by the union of sperm and ovum at fertilization	11.	Hormone
_____l.	Male animal which is sterile because the testicles did not descend into the scrotum	12.	Conception
_____m.	Examining by feel	13.	Cryptochid male
_____n.	Method of evaluating the breeding soundness of bulls	14.	Fertility testing
_____o.	Carrying a fetus	15.	Estrous cycle
_____p.	Opening to the fallopian tube which catches the egg as it leaves the ovary	16.	Embryo

_____q.	Length of time from fertilization until birth	17.	Inseminating tube
_____r.	Placing spermatozoa into the female reproductive tract by means other than natural mating	18.	Artificial insemination
_____s.	Hormone which can be used to synchronize estrus	19.	Gestation
_____t.	Tube used to place sperm into a female's reproductive tract	20.	Prostaglandin $\alpha_2$0
_____u.	Period of time when estrous cycle does not occur	21.	Anestrus

2. List and describe six types of mating systems.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

f. ____

____

3. List and define the four parts of the estrous cycle.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

4. Identify the best time to breed:

   a. Sows ____

   b. Gilts____

   c. Mares____

   d. Cows ____

   e. Goats ____

5. Select the components of the male reproductive tract from the following list.

   _____a. Epididymis

   _____b. Gonads (testes or testicles)

   _____c. Ovaries

   _____d. Vesicular glands

   _____e. Prostate

   _____f. Embryo

6. Match the male reproductive organs on the right to the correct functions.

_____a. Transports sperm from the male to the female	1. Testes
_____b. Secretes a substance high in simple sugar (fructose) which serves as a nutrient for spermatozoa transport; neutralizes urine; adds volume	2. Epididymis
	3. Vas deferens
	4. Ampulla
_____c. Supports the testes	5. Penis
_____d. Produces spermatozoa, the male germ cells and testosterone	6. Urethra
_____e. Provides opening to the male reproductive tract	7. Cowpers gland
	8. Prostate gland
_____f. May serve as temporary storage for sperm in bulls and rams	9. Seminal vesicle
_____g. Secretes an alkaline material which serves to clean the urethra prior to ejaculation; produces a lubricating substance	10. Retractor penis muscle
	11. Scrotum

_____h. Collects, stores and allows maturation of the sperm

_____i. Relaxes to allow copulation and retracts penis after copulation

_____j. Transports urine

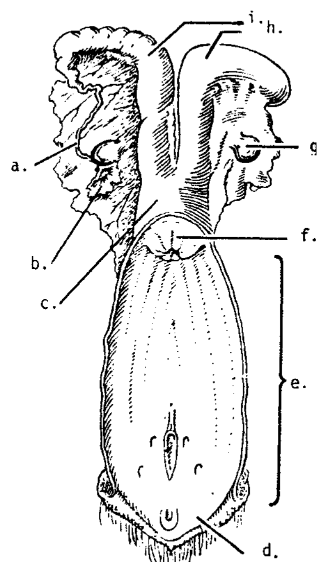
_____k. Transports spermatozoa; serves as a storage place for spermatozoa until ejaculation

_____l. Maintains the temperature of the testes; protects the testes

_____m. Secretions that nourish and stimulate sperm activity

12. Sheath
13. Spermatic cord
14. Ovaries
15. Embryo

7. Identify the parts of the female reproductive tract below by writing the correct names in the blanks provided.



a.____________________ d.____________________ g.____________________

b.____________________ e.____________________ h.____________________

c.____________________ f.____________________ i.____________________

8. Match the female reproductive organs on the right to the correct function.

_____a. Channel for birth of fetus; receives male penis during copulation

_____b. Opening of the female reproductive tract

_____c. Provides environment for nourishment and development of the fetus

_____d. Produce eggs and certain hormones

1. Fallopian tube
2. Uterus
3. Vagina
4. Vulva

_____e.	Divider between vagina and uterus; secretes a fluid or mucus that forms a plug at end of cervix inside the uterus when pregnancy occurs	5. Ovaries
		6. Horns of uterus
_____f.	Path between ovary and uterus; fertilization occurs here	7. Cervix
		8. Glans uterus
_____g.	Part of the uterus where fetal development takes place	

9. Describe the effects of estrogen and progesterone produced by the ovaries and testosterone produced by the testes.

    a. Estrogen ____

    ____

    ____

    b. Progesterone ____

    ____

    ____

    c. Testosterone ____

    ____

    ____

10. Select advantages of fertility testing bulls by placing an "X" in the spaces provided.

    _____a. Provides means of selecting bulls

    _____b. Helps determine heritability factors

    _____c. Increases length of calving season

    _____d. Increases profit

    _____e. Prevents loss of calf crop

    _____f. Provides means of culling bulls from herd

    _____g. Helps eliminate problems such as dwarfism by eliminating carriers

11. Select the causes of sterility and delayed breeding in bulls by placing an "X" in the spaces provided.

    _____a. Psychological problems

    _____b. Testosterone

_____c. Physical defects and injuries

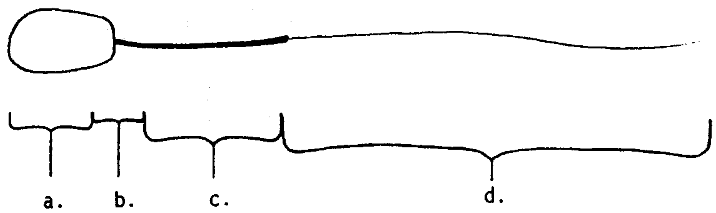
_____d. Infection and disease

_____e. Retractor muscle relaxing during copulation

_____f. Inherited abnormalities

_____g. Poor management

12. Name the parts of the sperm cell below.



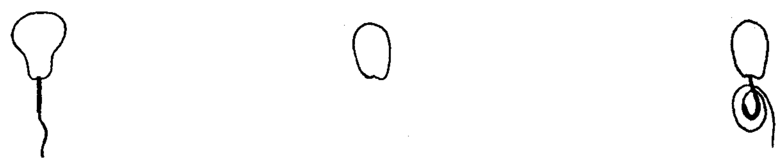
a.______________________

b.______________________

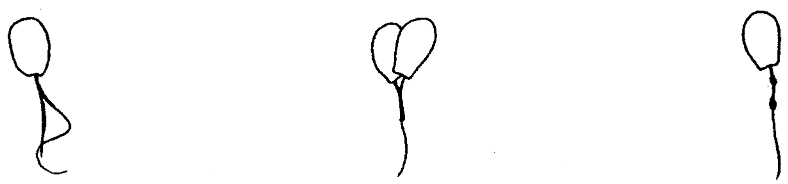
c.______________________

d.______________________

13. Label the types of abnormal sperm below.



a.____________________ b.____________________ c.______________________



d.____________________ e.____________________ f.______________________

14. Describe the quality of the following semen sample by putting "acceptable" or "unacceptable" by each area.

Semen sample #3 has 35% progressive motile sperm cells, 8% abnormal sperm cells, a barely noticeable wave pattern, several specks of bedding material and a milky color.

a. Color ____

b. Foreign material____

c. Wave pattern ______________________________

d. Progressive motility ______________________________

e. Abnormal sperm ______________________________

15. Name the two best times to check for fertility in bulls.

a. ______________________________

b. ______________________________

16. List and describe nine factors causing infertility.

a. ______________________________

____

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

e. ______________________________

____

f. ______________________________

____

g. ______________________________

____

h. ______________________________

____

i. ______________________________

____

17. Match the animals on the right to the correct gestation periods.

_____a.	150 days	1.	Cow
_____b.	283 days	2.	Sow
_____c.	114 days	3.	Ewe
_____d.	336 days	4.	Mare

18. Select advantages of pregnancy testing by placing an "X" in the spaces provided.

_____a. Helps eliminate genetic defects

_____b. Identifies pregnant cows

_____c. Provides means of culling cows from herd

_____d. Spreads calving time out to relieve labor crunch

_____e. Cuts winter feed bills

_____f. Increases profit

19. Name three distinct indications of pregnancy detectable in rectal examination.

a.____

b. ____

c.____

20. Calculate the estimated size of a fetus in a cow pregnant for 3 months.

____

21. Describe the reason for using the left hand in rectal examinations.

____

____

____

22. Name the techniques used in pregnancy testing of ewes and sows.

<u>Ewes</u>

a.____

b. ____

Sows____

23. Describe the signs of estrus in cows.

____

____

____

____

____

____

24. State which sign of estrus is the most important with regard to time of insemination.

____

____

25. List the average estrous cycles for the following:

a. Cows, mares and sows____

b. Ewes____

26. Name the time when a cow ovulates with respect to standing heat.

____

27. Select the factors that contribute to poor conception rates by placing an "X" in the spaces provided.

_____a. Improper timing of insemination

_____b. Disease

_____c. Placing sperm in the uterine body

_____d. Poor management

_____e. Ovulation failure

_____f. Using sperm thawed in less than 45 seconds

28. Select the reasons why timing is important when using artificial insemination.

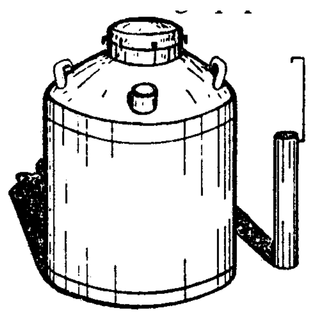
_____a. Sperm must be in the fallopian tube six to ten hours before ovulation for optimum conception rates

_____b. Too early insemination will prevent the cow from coming into heat

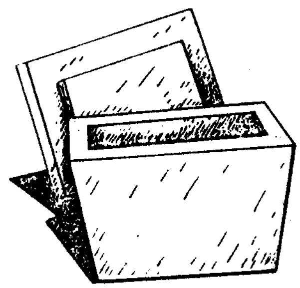
_____c. Cervical reaction or uterine contraction must be present

_____d. Late insemination might cause the cow to stop producing estrogen

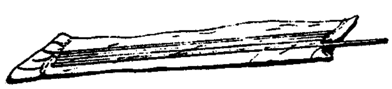
29. Label the following equipment necessary for artificial insemination.



a.___________________________________



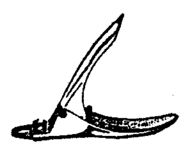
b.___________________________________



c.___________________________________

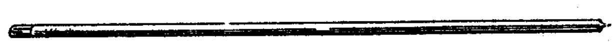
d.___________________________________

e.___________________________________



f.___________________________________

g.___________________________________

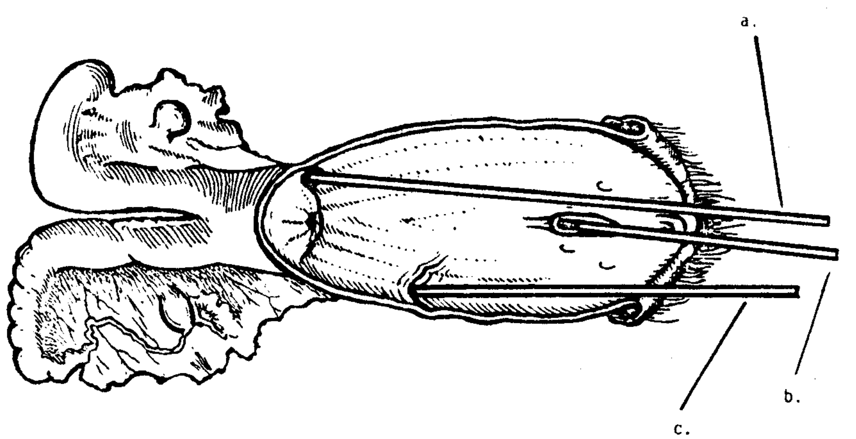


h.___________________________________

30. Match the methods of thawing semen on the right to the correct procedures by placing the correct number in the blanks provided.

_____a.	Place in water bath at 37°F for 8 to 10 minutes	1.	Hot bath (straw)
_____b.	Place in water bath at 37°F for 10 minutes	2.	No-thaw (straw)
_____c.	Place in water bath at 90°F to 95°F for a minimum of 20 seconds	3.	Hot Bath (Amuple)
_____d.	Take straight from Nitrogen tank without thawing and inseminate	4.	Ice Bath (Straw)
_____e.	Place in water bath at 110°F for 40 seconds	2.	Ice Bath (Ampule)

31. Label the three common errors in inseminating a cow with relationship to the misplacement of the inseminating tube.



a.____

b. ____

c.____

BREEDING AND REPRODUCTION

AG 530 - G

ANSWERS TO TEST

1.

a.	1	h.	11	o.	10
b.	3	i.	12	p.	2
c.	15	j.	9	q.	19
d.	16	k.	8	r.	18
e.	7	l.	13	s.	20
f.	4	m.	6	t.	17
g.	5	n.	14	u.	21

2.
   a. Purebred--Member of a breed; animals which possess a common ancestry and distinctive characteristics and are either registered or eligible for registry in the herd book of that breed
   b. Inbreeding--Systems of breeding in which closely related animals are mated
   c. Linebreeding--Mating of animals that are related, but not related as closely as in inbreeding
   d. Outcrossing--Mating of animals that are members of the same breed, but which show no relationship close up in the pedigree
   e. Grading up--System of breeding in which purebred sires of a given pure breed are mated to native or grade females
   f. Crossbreeding--Mating animals of different breeds

3.
   a. Estrus--Period of time when the female is receptive to the male and will stand for mating
   b. Metestrus--Follows estrus; period when the corpus luteum (hormone-secreting growth) forms where the egg was released from the ovary
   c. Diestrus--Follows metestrus; period when corpus luteum is functional. Hormones released stimulate preparation of uterus for pregnancy
   d. Proestrus--Follows diestrus; rapid follicle growth to prepare for next ovulation

4.
   a. Last half of estrus
   b. Second day of estrus
   c. First--third day of estrus; Second--three days later (if still in heat)
   d. First--early in estrus; Second--12-20 hours after estrus starts
   e. Last half of estrus

5. a, b, d, e

6.

a.	5	f.	4	k.	3
b.	9	g.	7	l.	11
c.	13	h.	2	m.	8
d.	1	i.	10		
e.	12	j.	6		

7.

a.	Fallopian tube	f.	Cervix
b.	Fimbria	g.	Ovary
c.	Uterus	h.	Right horn of uterus
d.	Vulva	i.	Left horn of uterus
e.	Vagina		

8. a. 3 d. 5 g. 6
   b. 4 e. 7
   c. 2 f. 1

9. a. Brings females into heat; aids in moving egg and sperm together by increasing contractions of female reproductive tract; stimulates cell growth in uterus
   b. Prevents ovulation; causes heat period to end
   c. Affects sex drive of male; causes growth and development in male reproductive tract; necessary for sperm maturation and survival

10. a, d, e, f

11. a, c, d, f, g

12. a. Head c. Middle piece
    b. Neck d. Tail

13. a. Abnormally shaped head d. Two tails
    b. Tailless head e. Two heads
    c. Coiled tail f. Abnormal middle piece

14. a. Acceptable
    b. Acceptable
    c. Unacceptable
    d. Unacceptable
    e. Acceptable

15. Just before breeding season; Soon after breeding season

16. a. Sterility--Animals unable to reproduce; No remedy
    b. Age--Fertility levels decrease as age increases; Female--Eggs not produced regularly; Male--Reduced sperm concentration
    c. Deformities--Deformed parts of reproductive tract such as undescended testicles
    d. Temperature--High temperatures in male can end sperm production; Heat stress in female reduces size and number of offspring
    e. Condition--Temporary infertility when animals not in good general condition; Abrupt change in nutritional levels, overfeeding and underfeeding can all reduce fertility
    f. Freemartin--Heifer born twin to a bull; 90% infertile
    g. Silent heat--Shows no signs of estrus; Caused by improper hormone release; Causes cyst
    h. Chronic buller--Caused by hormone imbalance; Female seems to stay in heat; Conception does not occur
    i. Disease and infections--Can cause death of fetus; Can prevent conception

17. a. 3
    b. 1
    c. 2
    d. 4

18. b, c, e, f

19. Answer could include: Palpation of fetus; Fluid in uterine horn; Presence and size of cotyledons; Diameter and pulse rate of uterine artery; Location of uterus; Palpation of the amnionic vesicle; Presence of fetal membrane slip

20. 4 1/2 inches

21. Most pregnancies occur on the right side and body position causes left arm to move to the right

22. Ewes--Ultra-sonic devices measure fluid in uterus; Rectal-abdominal palpation
    Sows--Ultra-sonic devices measure fluid in uterus

23. Discussion should include: Standing to be ridden; Riding others; Nervousness, restlessness; Clear, thin, wet, sticky mucus flowing from vulva; Dirt or mud on flanks or back; Hair standing up on tailhead; Bellowing; Holding up milk

24. Standing to be ridden

25. a. 21 days
    b. 16-17 days

26. 8 to 10 hours after standing heat

27. a, b, d, e

28. a, c

29. a. Nitrogen chest
    b. Thaw box
    c. Inseminating tubes
    d. Disposable glove
    e. Polybulb
    f. Straw clippers
    g. Ampule
    h. Straw

30. a. 4
    b. 5
    c. 1
    d. 2
    e. 3

31. a. Tube placed in blind cavity of cervix
    b. Tube placed in urethra opening
    c. Tube placed in fold of vaginal wall

LIVESTOCK NUTRITION

AG 530 - H

UNIT OBJECTIVE

After completion of this unit, students should be able to describe a ruminant digestive system and distinguish among animals according to their digestive system. Students should also be able to list the classes of nutrients and match nutrients to their functions. This knowledge will be demonstrated by completion of an assignment sheet, laboratory exercise and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with livestock nutrition to their correct definitions.
2. Match the primary parts of a monogastric's digestive system to their functions.
3. Describe the unique characteristics of a ruminant's digestive system.
4. Match the four compartments in the stomach of a ruminant to their functions.
5. Distinguish among animals according to their digestive system.
6. List the six major classes of nutrients.
7. Match nutrients to their functions.
8. Describe one function and one deficiency symptom of selected vitamins.
9. Distinguish between major and trace minerals.
10. Match minerals to the correct deficiency symptoms.
11. Describe the advantages and limitations of feeding growth stimulants.
12. Describe three effects of feeding antibiotics.
13. Compile information on livestock nutrient deficiencies in the local area.
14. Dissect a fetal pig to explore the digestive system.

LIVESTOCK NUTRITION

AG 530 - H

SUGGESTED ACTIVITIES

I. Suggested activities for the instructor

A. Make transparencies and necessary copies of materials.

B. Provide students with objectives.

C. Provide students with information and discuss.

D. Provide students with assignment sheet and laboratory exercise.

E. Obtain some experimental mice or baby chicks and do some actual nutrition experiments.

F. Alert local veterinarians and ranchers that you are looking for animals with nutritional deficiencies and arrange for your students to see them.

G. Show the filmstrip *Nutritional Deficiencies in Livestock* developed by the University of Idaho through funding from the State Board of Vocational Education.

(Note: All agriculture departments in Idaho should have a copy of this filmstrip.)

H. Have a veterinarian speak on nutritional deficiencies in the local area.

I. Discuss and demonstrate assignment sheet and laboratory exercise.

J. Review and give test.

K. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Simple Monogastric Digestion System

2. TM 2--Ruminant Digestion System

E. Assignment sheet

1. AS 1--Complete Information on Livestock Nutrient Deficiencies in the Local Area

F. Laboratory exercise

1. LE 1--Digestive Systems in Swine

G. Answers to laboratory exercise

H. Test

I. Answers to test

III. Unit references

A. *Agricultural Education Curriculum*, College of Agriculture, University of Illinois, Urbana, Illinois, 1989.

B. Barrick, R. Kirby, Harmon, Hobart L., *Animal Production and Management*. McGraw-Hill Book Company, 1988.

C. Blakely, James and Bade, David H., *The Science of Animal Husbandry*, Reston Publishing Company, Reston, Virginia, 1976.

D. Campbell, John R. and Lasley, John F., *The Science of Animals That Serve Mankind*. McGraw-Hill Book Company, 1975.

E. Ensminger, M.E., *Animal Science*. The Interstate Printers and Publishers, Danville, Illinois, 1977.

F. Gillespie, James R., *Animal Nutrition and Feeding*. Delmar Publishers, Inc., 1987.

G. Otto, James H., Towle, Albert, *Modern Biology*, Holt, Rinehart and Winston, Publishers, New York, 1985.

H. Slesnick, Irwin L.; Balzer, Leron; McCormack, Alan J.; Newton, David E.; Rasmussen, Fredrick A., *Biology*, Scott, Foresman and Company, Glenview, Illinois, 1985.

LIVESTOCK NUTRITION

AG 530 - H

INFORMATION SHEET

I. Terms and definitions

A. Digestion--Process of breaking down and dissolving feeds so that the body can absorb them

B. Absorption--Passing of food materials from the digestive system into the body after they are digested and dissolved

C. Enzyme--Protein compound which brings about changes in other organic compounds without being changed or broken down itself

D. Hormone--Internal body secretion that regulates various body processes

E. Mastication--Grinding or chewing of food to aid in digestion

F. Metabolism--Sum of all physical and chemical changes which take place within an organism

(Note: This process includes both material and energy changes.)

G. Excretion--Removal of water and waste material from the body

H. Regurgitation--Process by which food eaten by a ruminant is carried from the second stomach and the rumen into the gullet, and then forced up to the mouth for chewing

I. Feces--Manure; undigested material and wastes expelled at the end of the digestive tract

J. Pancreatic juice--Clear, watery fluid with an alkaline reaction secreted by the pancreas; aids in feed breakdown

K. Bile--Thin, yellowish brown or greenish liquid secreted by the liver

L. Ruminant--Animal with four stomach compartments

M. Monogastric--Animal with one stomach compartment

N. Rumination--Regurgitating and rechewing previously swallowed food

O. Nutrient--Single class of foods or group of like foods that aids in the support of life; actually becomes a part of the body cells

P. Growth stimulant--Increases growth rate and feed efficiency, but does not become a part of the body cell

Q. Antibiotic--Substance which helps prevent or control certain diseases in animals

R. Cellulose--Carbohydrate portion of the cell walls; livestock cannot digest cellulose unless it is first broken down by microorganisms

S. Thrifty--Vigorous and healthy

II. Primary parts of the monogastric system (Transparency 1)

A. Mouth--Grinds food and mixes it with saliva

B. Esophagus--Moves food from mouth to stomach

C. Stomach--Produces hydrochloric acid and enzymes which begin the digestion of carbohydrates, fats and proteins and dissolve minerals; some absorption occurs

D. Small intestine--Finishes digestion process and allows absorption of nutrients

E. Caecum--Place where microorganisms digest cellulose in horses

(Note: The caecum is non-functional in most monogastrics.)

F. Large intestine--Allows absorption of water

III. Unique characteristics of a ruminant's digestive system

A. Four compartments to the stomach

B. Large rumen containing microorganisms allows digestion of large amounts of roughage and manufacture of animo acids and some vitamins

C. Food is regurgitated and rechewed after first being consumed in large quantities and stored in the rumen

(Note: A horse is a non-ruminant, but can still utilize large amounts of roughages because of an enlarged caecum in which microorganisms digest the fiber. A horse, however, can only digest about half as much cellulose as a ruminant).

IV. Compartments of a ruminant's stomach (Transparency 2)

A. Rumen

1. Microorganisms digest cellulose and convert it into usable food

(Note: These microorganisms are later digested by the ruminant.)

2. Microorganisms manufacture all essential amino acids

3. Microorganisms manufacture B-complex vitamins

4. Sixty to ninety percent of total digestion occurs here

(Note: A large amount of gas is also produced in the rumen and is usually eliminated by belching. Bloat occurs if this does not take place.)

B. Reticulum

(Note: This is sometimes called the hardware stomach.)

1. Forms cud out of feed from the rumen

2. Collects hardware

C. Omasum--Removes most of the water

D. Abomasum--True stomach

V. Types of digestive systems

A. Simple monogastric (one stomach)

1. Man

2. Pig

3. Poultry

(Note: Since poultry have no teeth to grind the food, they have some additional parts to their digestive system that soften and grind the food.)

B. Ruminants

1. Cow

2. Sheep

3. Goat

C. Monogastric with functional caecum

1. Horse

2. Rabbit

VI. Classes of nutrients

A. Carbohydrates

Examples: Corn, oats, barley, milo, wheat

B. Proteins

Examples: Soybean meal, cottonseed meal, tankage and meat scraps, fish meal

C. Fats

D. Minerals

Examples: Calcium, phosphorus, potassium, salt

E. Vitamins

Examples: Vitamin A, vitamin B complex, vitamin D, vitamin E, vitamin K

F. Water

VII. Functions of nutrients

A. Water

1. Primary nutrient in the body--Farm animals are 50% to 60% water

2. Transports nutrients and waste materials

3. Regulates body temperature

B. Protein

1. Makes up muscle, skin, hair, wool, horns, hooves, internal organs and bone marrow

2. Repairs worn-out tissue

C. Carbohydrates--Supplies heat and energy

D. Fat

1. Stores energy

2. Provides 2.25 times as much energy as carbohydrates per unit weight when broken down for body use

E. Minerals

1. Aid in skeletal development

2. Maintain proper pressures for transfer of nutrients through cell walls

3. Provide chemical balance for proper body function

VIII. Vitamin functions and deficiency symptoms

A. Vitamin A

1. Functions

a. Aids in disease resistance

b. Necessary for building new cells

c. Prevents night blindness

2. Deficiency symptoms

a. Slow growth

b. Night blindness

c. Poor reproductive efficiency

d. Rough hair coat

B. Vitamin D

1. Functions

a. Necessary for animal to be able to use calcium and phosphorus

b. Aids in skeletal development

2. Deficiency symptoms

a. Rickets--Bone deformities

b. Swelling of joints

C. Vitamin E

1. Function--Necessary for reproduction

2. Deficiency symptoms

a. Infertility

b. Stiffening of muscles

(Note: This is called white muscle disease in cattle.)

D. Vitamin K

(Note: Vitamin K deficiency normally only occurs in poultry.)

1. Function--Necessary for blood clotting

2. Deficiency symptom--Hemorrhages

E. B Vitamins including B_1, B_2, niacin, pantothenic acid and biotin

1. Function--Helps in the release of energy from foods

2. Deficiency symptoms

   a. Retarded growth

   b. Diarrhea, vomiting and goose stepping in swine

F. Vitamin B_6

1. Functions

   a. Helps form red blood cells

   b. Helps break down protein into usable form for the body

2. Deficiency symptoms

   a. Convulsions

   b. Retarded growth

G. Vitamin B_{12}

1. Function--Helps form red blood cells

2. Deficiency symptoms

   a. Retarded growth

   b. Reproductive failure

H. Vitamin C

1. Functions

   a. Aids in iron absorption

   b. Helps form substances between the body cells in teeth, bones and soft tissue

   c. Aids in healing

2. Deficiency symptoms
    a. Loss of appetite
    b. Loose teeth
    c. Swollen and bleeding gums

IX. Minerals

A. Major minerals

1. Calcium (Ca)
2. Phosphorus (P)
3. Sodium (Na)
4. Chlorine (Cl)
5. Potassium (K)
6. Sulfur (S)
7. Magnesium (Mg)

B. Minor or trace minerals

1. Iron (Fe)
2. Copper (Cu)
3. Zinc (Zn)
4. Iodine (I)
5. Cobalt (Co)
6. Manganese (Mn)
7. Molybdenum (Mo)
8. Selenium (Se)
9. Silicon (Si)
10. Fluorine (F)
11. Chromium (Cr)

X. Deficiency symptoms of minerals

A. Calcium

(Note: The calcium-phosphorus ratio in the feed must be kept between 1:1 to 3:1 for proper utilization of both minerals.)

1. Rickets
2. Broken bones
3. Slow growth
4. Milk fever

B. Phosphorus

1. Lameness
2. Stiffness of joints
3. Lowered appetite
4. Reduced rate of gain
5. Breeding problems

C. Sodium chloride (salt)

1. Lack of appetite
2. Unthrifty appearance

D. Sodium

1. Reduced growth
2. Lowered reproduction
3. Eating soil

E. Potassium

1. Slow growth
2. Reduced feed consumption
3. Muscle weakness
4. Diarrhea

F. Sulfur--Unthriftiness

G. Iron--Anemia

H. Iodine

1. Hairless pig

2. Goiter (enlarged thyroid gland)

3. Weak young and stillbirths

I. Magnesium

1. Muscle spasms and convulsions

2. Hyperirritability

XI. Feeding growth stimulants

A. Advantages--Increase feed efficiency and speed growth

B. Limitations

1. Some kinds have been banned because of disease linked to them

(Note: Carcinogenic growth stimulants such as DES have received the most publicity and are currently banned.)

2. Have not proven effective in swine

XII. Feeding antibiotics

Examples: Aureomycin, terramycin, penicillin, streptomycin

A. Increase feed efficiency and rate of gain

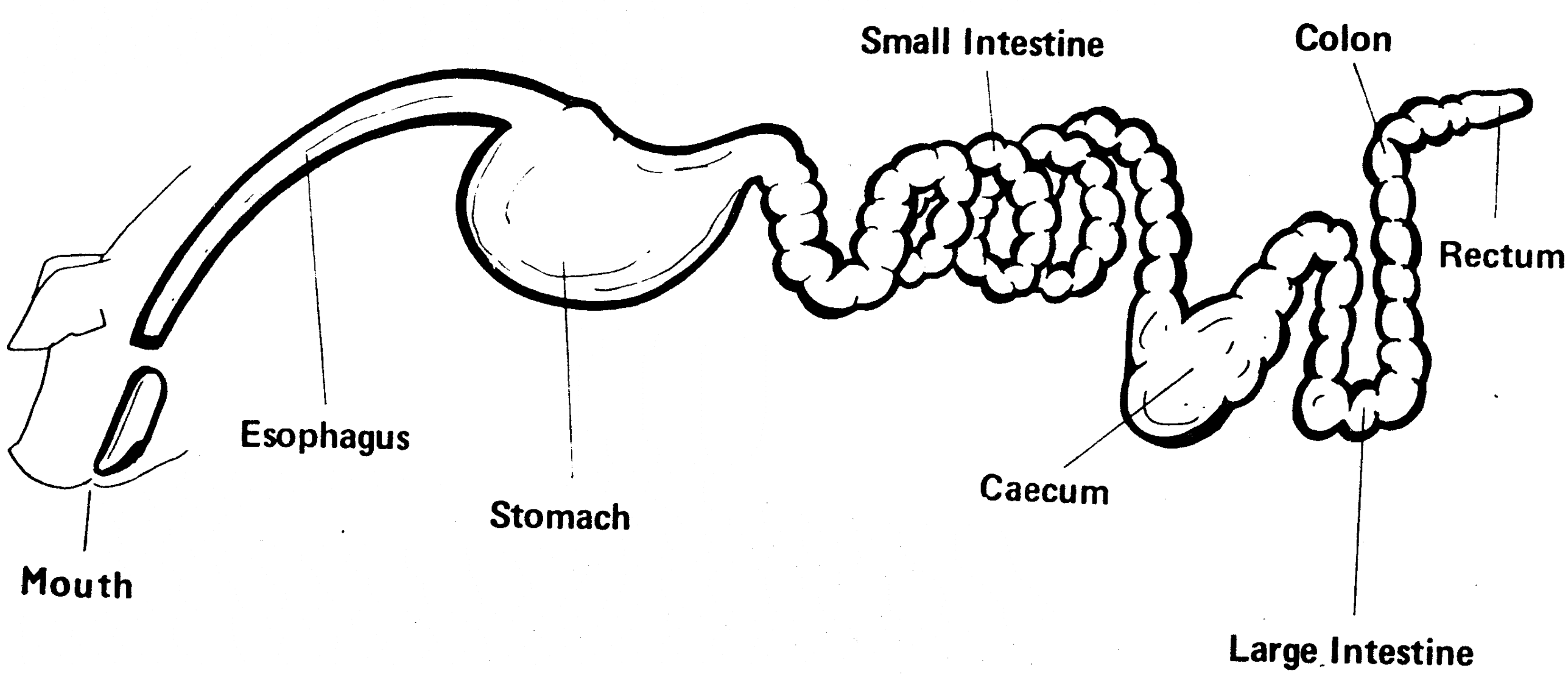
B. Stimulate appetite

C. Stimulate enzyme activity

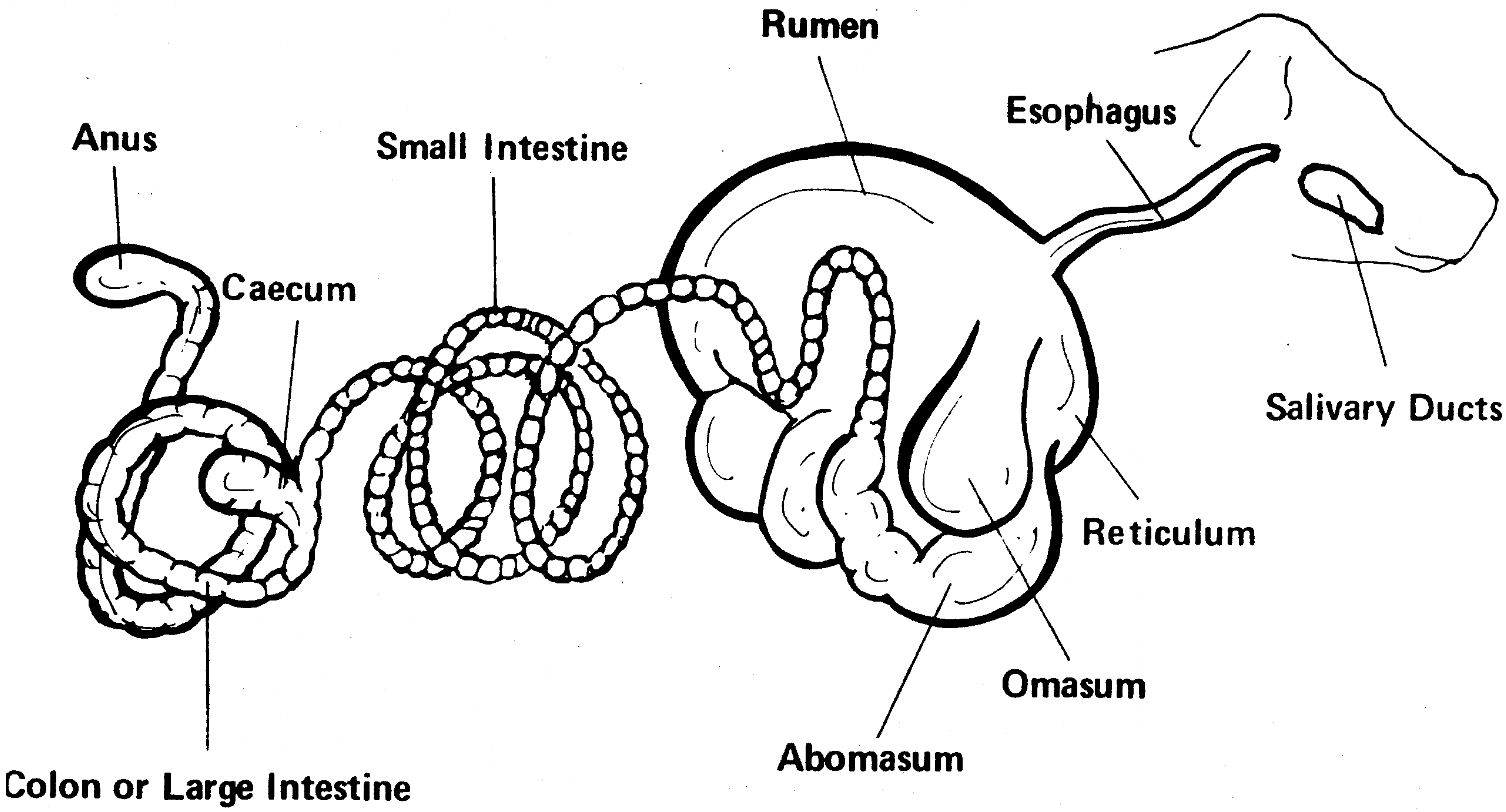
D. Reduce bacterial infections

E. Reduce diarrhea in young animals

Simple Monogastric Digestion System



Ruminant Digestion System



LIVESTOCK NUTRITION

AG 530 - H

ASSIGNMENT SHEET #1--COMPILE INFORMATION ON LIVESTOCK NUTRIENT DEFICIENCIES IN THE LOCAL AREA

Name ______________________________ Score ______________________________

Nutrients in feeds vary from one area to the next because of climate, soil and management differences. Knowing which nutrients may be deficient in your area is important for successful livestock feeding and ration formulation.

Using local resource people such as farmers and ranchers, feed store personnel and county extension agents, determine which nutrients are most likely to be deficient for the various types of livestock in your community. List these nutrients and then list the most likely sources for supplementing them. Finally, write the symptoms which would indicate a deficiency in that nutrient.

Livestock species:_________________________

Nutrients that may be deficient	Sources	Deficiency Symptoms

Livestock species:_________________________

Nutrients that may be deficient	Sources	Deficiency Symptoms

LIVESTOCK NUTRITION

AG 530 - H

LABORATORY EXERCISE #1--EXPLORING THE PIG DIGESTIVE SYSTEM

Name ______________________________________ Score ___________________________________

Introduction

It is not easy to study the digestive organs of a human. However, anatomy of the human digestive system can be studied by examining the digestive system of a pig, an animal similar to a human. A pig resembles a human both internally and externally in many ways.

The pigs you will dissect are called fetal pigs. Fetal pigs have not been born. They were removed from their mother's reproductive tract before birth. Evidence that they are fetal can be seen by examining the stomach area for the attached umbilical cord.

It is important that directions for dissection be followed EXACTLY. Do not remove any organ or structure unless you are directed to do so.

Before beginning the dissection, let's discuss the function of the parts of the digestive system we'll be studying. The *salivary glands* produce the enzyme amylase which converts carbohydrates to double sugars. The *esophagus* carries food from the throat to the stomach. The *stomach* begins protein digestion; produces pepsin, hydrochloric acid and rennin. The *liver* produces bile. The *gall bladder* stores bile for the liver. The *pancreas* produces several enzymes (trypsin for protein digestion, lipase for fat digestion, and amylase for carbohydrate digestion) and insulin. The *small intestine* allows for the transfer of digested food to the bloodstream and produces enzymes. The *large intestine* reabsorbs water from food and returns it to the bloodstream.

Materials needed

Fetal pig	Plastic bag
Scissors	Water
Razor blade (single-edge)	Dissecting pan

Part I: Procedure

NOTE: Although this investigation is designed to examine the digestive system parts, structures from other systems will be identified in the process. The parts which belong to the digestive system are in italics.

1. Determine if your pig is male or female. Both sexes have a double row of nipples along the ventral body surface. Therefore, these structures will not help you determine sex. A male pig has a small genital opening on the ventral (stomach) body surface below the area where the umbilical cord enters. A female pig has a vaginal opening next to the *anus*. These two openings are found under the pig's tail. A male pig has only the anal opening.

   The sex of our pig is ____

2. With scissors, remove the skin in the neck and head region of your pig as shown in Figure 1.

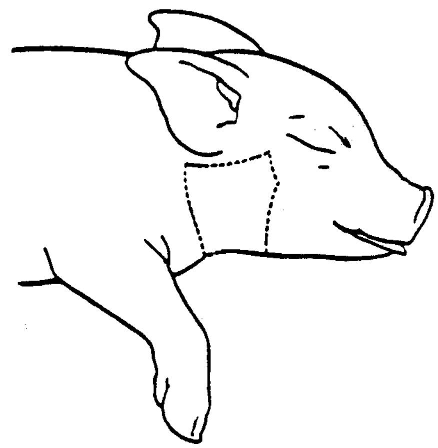


Figure 1

Be sure to remove only skin tissue. Push aside or remove the muscle and connective tissue if necessary.

Use the diagram titled Figure 2 and the directions below to locate the *parotid salivary gland*, the *submaxillary salivary gland* and *Wharton's duct.*

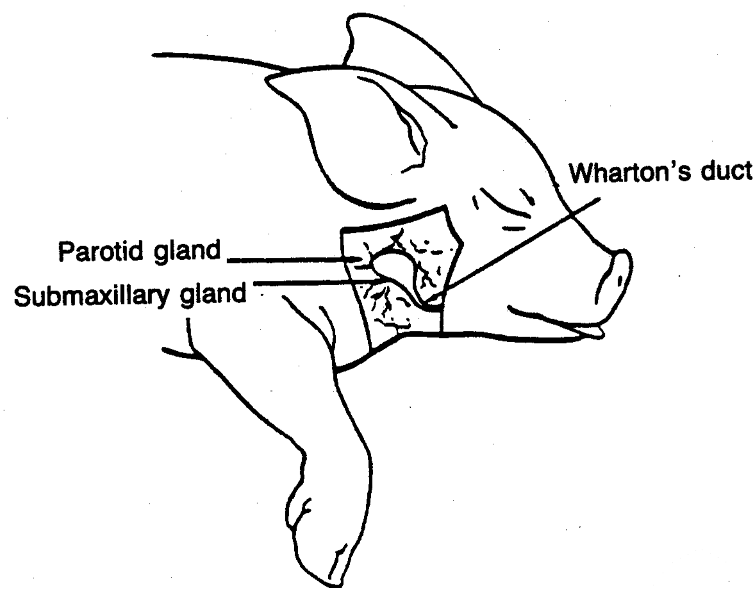


Figure 2

Under the muscle are rough or coarse flat tissues. The larger of the tissues is the *parotid salivary gland.* This gland is very difficult to locate; it is okay if you cannot find it.

A smaller, more compact triangular salivary gland lies beneath the parotid. This gland is the *submaxillary salivary gland.* A third gland is also present, but is not easily observable.

Salivary ducts lead from the glands toward the animal's mouth. One main duct is *Wharton's duct.* It carries saliva from the salivary glands to the mouth.

3. Open the pig's mouth. The mouth region, or oral cavity, has structures associated with digestion.

   The *tongue* is used to mix food and push it into the pharynx. The surface of the tongue is rough because of the presence of taste buds. Taste buds are sometimes called papillae.

   The roof of the mouth is called the palate. The front portion is the hard palate. The portion toward the back of the mouth is the soft palate.

   The pharynx joins the *esophagus* at the rear of the mouth. It is the tube that connects the throat to the stomach. Do not worry if you cannot see the esophagus at this time, we will observe it again later in the experiment.

   Teeth may or may not be evident in your pig. Rub your finger along the pig's gums to determine if teeth are beginning to emerge through the gum. You may or may not find *teeth* depending upon the age of your pig.

   Does your pig have teeth? ____

4. Position your pig so that its ventral surface (stomach) is up and its head away from you. See Figure 3.

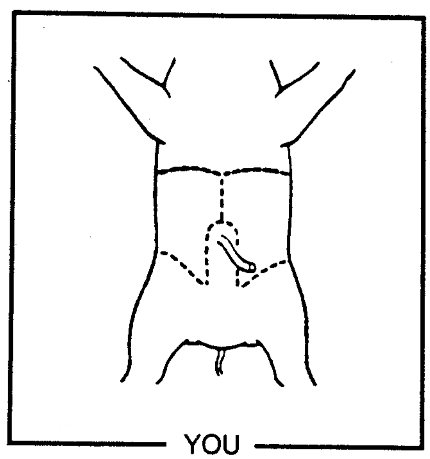


Figure 3

5. Using scissors, cut through the skin and muscle along the lines designated in Figure 3. DO NOT remove the umbilical cord. Now, open the abdominal cavity by pulling the ribs up and out (like opening the shutters of a window).

   If your pig has a brown liquid within the abdominal cavity, rinse out the cavity with tap water over a sink.

6. From the descriptions which follow and what you view on your fetal pig, label the liver, large intestine, small intestine, diaphragm, umbilical cord, umbilical blood vessels, and the urinary bladder on the diagram titled Figure 4.

   The *liver* is a large, lobed, brown organ occupying the top portion of the abdominal caity.

   The tightly coiled mass of thick, dark greenish, tubelike tissue is the *large intestine.*

   The *small intestine* is the less tightly coiled mass of thin tubelike tissue which can be spread apart more easily.

   Above the pig's liver is a thin muscle called the diaphragm. It separates the abdominal cavity from the thoracic (chest) cavity.

7. Pull the umbilical cord down between the hind legs of your pig.

   The umbilical cord just after entering the pig's body divides into two blood vessels. These two vessels are called the umbilical blood vessels. They lie on each side of a flat structure called the urinary bladder.

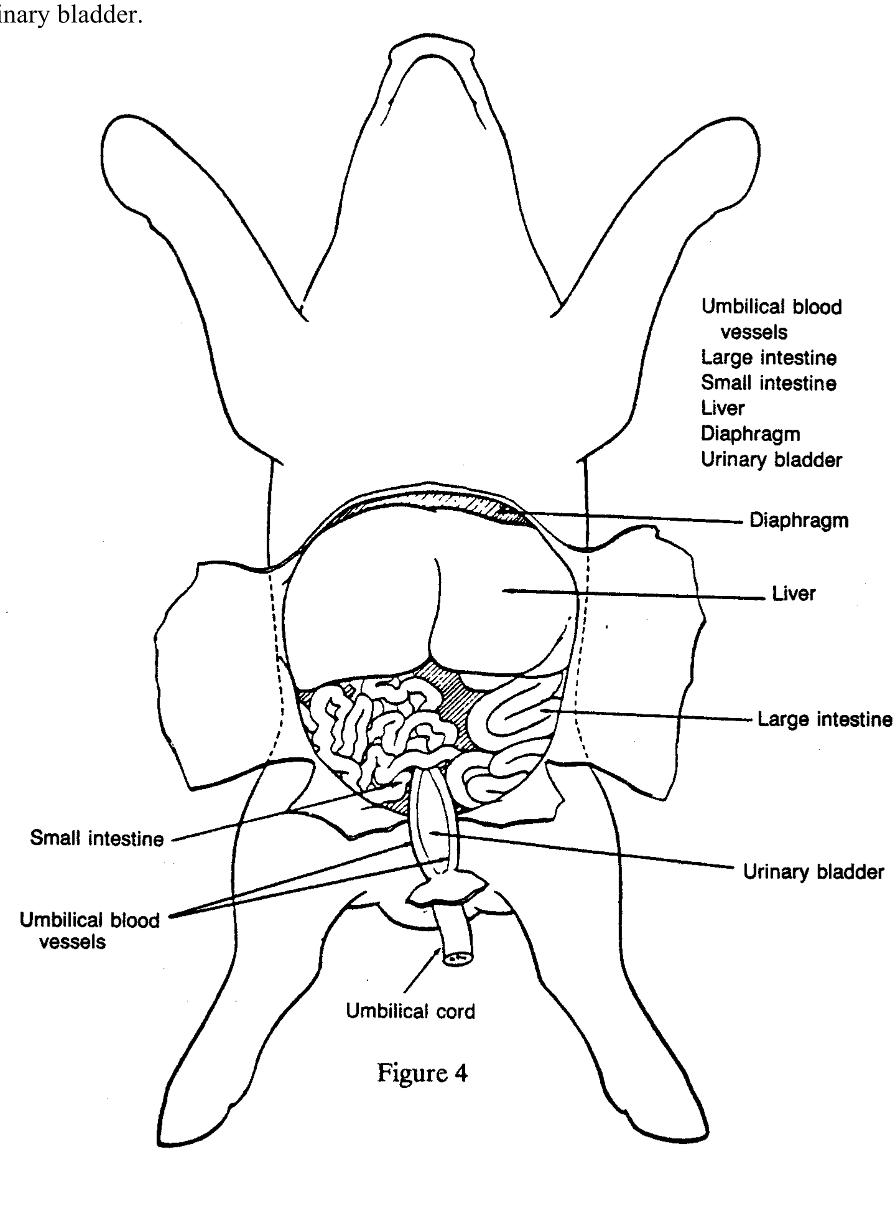


Figure 4

8. From the descriptions which follow and what you view on your fetal pig, label the gall bladder, bile duct, stomach, esophagus, spleen, pancreas, duodenum, caecum, rectum and anus on the diagram titled Figure 5.

9. Raise your pig's liver and push the intestines toward the left with your fingers. Organs not previously visible should now be revealed.

   A saclike structure attached to the underside of the liver is the *gall bladder.* It is usually green and is partly embedded in the liver.

   Leading from the gall bladder and extending along the underside of the liver is a thin tube called the *bile duct*.

   Directly below the liver on the right (the pig's left side) is a large pouch. This is the *stomach*.

   Leading into the top portion of the stomach is the *esophagus*. It appears to be rather short because it passes upward behind the liver.

   Attached along the right edge of the stomach is a round, reddish organ. It is the *spleen*.

   A rough or coarse organ lying directly below and extending along the underside of the stomach is the *pancreas*.

   Extending from the stomach toward the left side (pig's right) is a tube which is the beginning section of the small intestine. This is the *duodenum*. Both the pancreas and the gall bladder empty digestive chemicals into this structure. The bile duct which leads from the gall bladder to the duodenum should be visible. The duct leading from the pancreas is small and difficult to locate.

   At the junction between the small and large intestine is a small, fingerlike projection. This structure is the *caecum*.

10. Push the intestines as far to your left as possible. Also pull the urinary bladder and umbilical cord down.

    A tube leading from the large intestine out of the abdominal cavity toward the pig's tail is the *rectum*.

    The opening of the rectum to the outside of the animal's body is the *anus*.

11. Locate the *anus* directly under the pig's tail. (Remember that female pigs have a vaginal opening in the same area as the anus.)

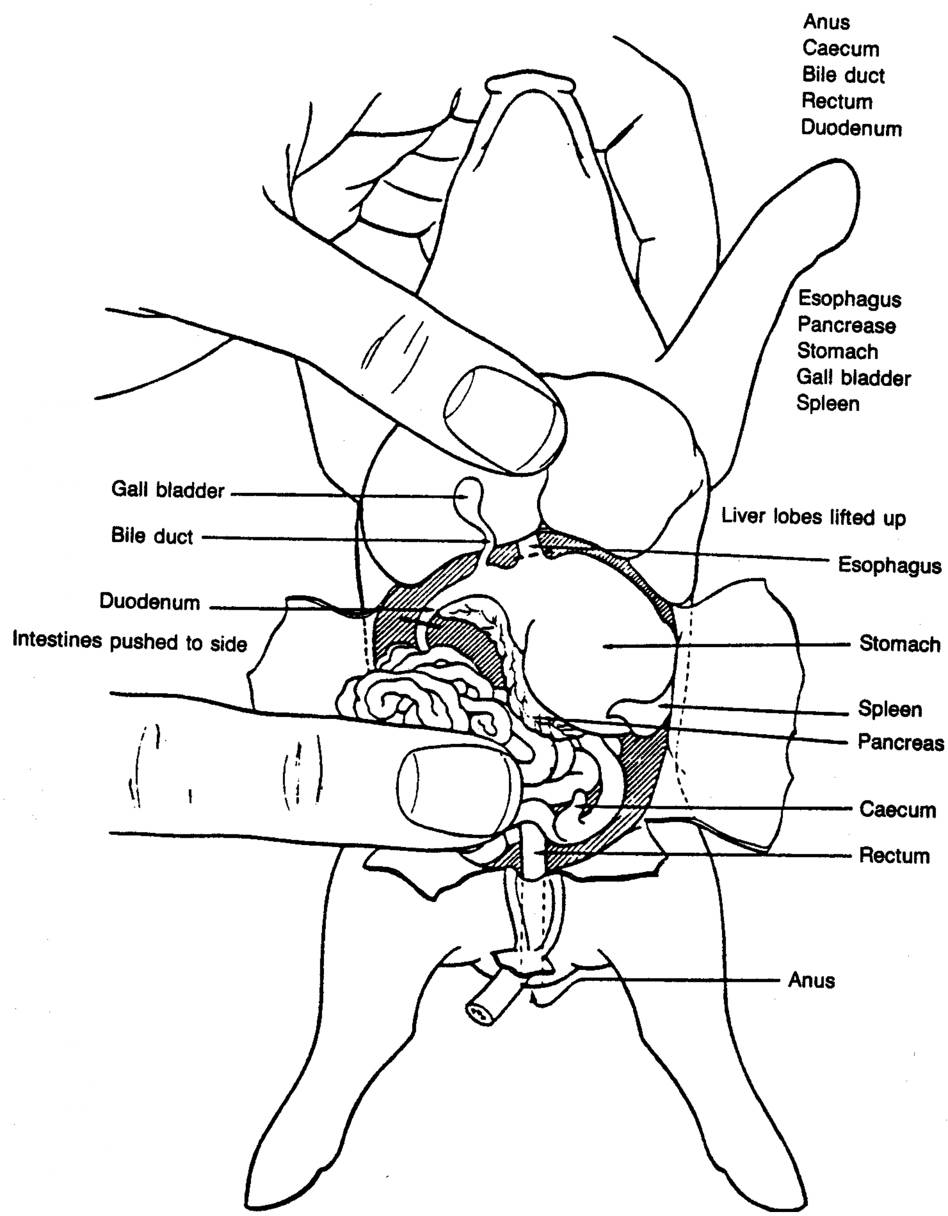


Figure 5

12. Place your pig in a plastic bag and put it where your teacher directs. DO NOT allow the pigs to dry out. Retain any liquid which collects or is found in the bag.

Part II: Analysis

1. The parts of the digestive system which food passes through are listed below. A one was placed ` next to the mouth and a nine next to the anus. Place the number which corresponds to the order in which the food travels through the system next to the remaining parts.

_1___Mouth

_____Small intestine

_____Stomach

_____Throat

_____Rectum

_____Duodenum

_____Large intestine

_____Esophagus

_9___Anus

2. Match the part of the digestive system to its function.

_____Esophagus	a.	Produces bile
_____Stomach	b.	Reabsorbs water from food to blood
_____Liver	c.	Carries food from throat to stomach
_____Pancreas	d.	Produces insulin
_____Large intestine	e.	Begins protein digestion

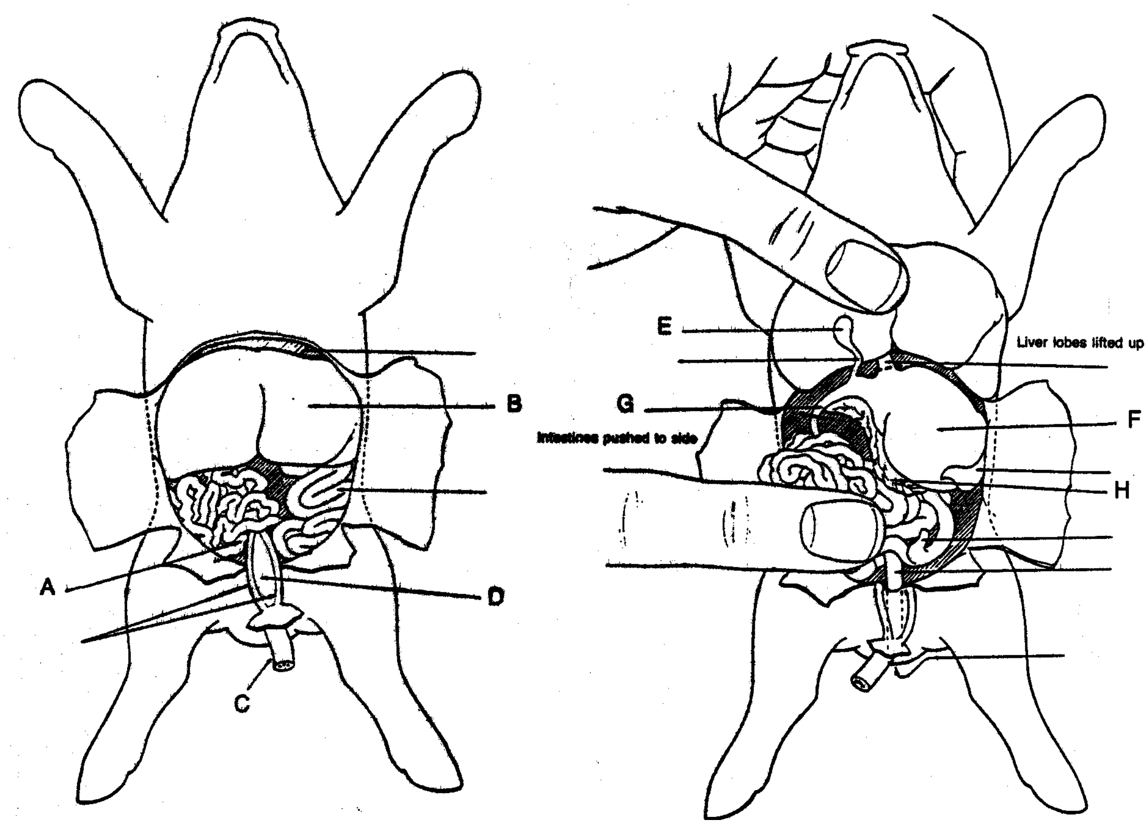
3. Using the diagrams on the next two pages, identify the parts labelled A through H.

A. ______________________ B. ______________________

C. ______________________ D. ______________________

E. ______________________ F. ______________________

G. ______________________ H. ______________________



LIVESTOCK NUTRITION

AG 530 - H

ANSWERS TO LABORATORY EXERCISE

Part II: Analysis

1. 1, 6, 4, 2, 8, 5, 7, 3, 9

2. c, e, a, d, b

3.
   A. Small intestine
   B. Liver
   C. Umbilical Cord
   D. Urinary bladder
   E. Gall bladder
   F. Stomach
   G. Duodenum
   H. Pancreas

LIVESTOCK NUTRITION

AG 530 - H

UNIT TEST

Name ______________________________________ Score ___________________________________

1. Match the terms on the right to the correct definitions.

_____a. Protein compound which brings about changes in other organic compounds without being changed or broken down itself

_____b. Carbohydrate portion of the cell walls; livestock cannot digest this unless it is first broken down by microorganisms

_____c. Manure; undigested material and wastes expelled at the end of the digestive tract

_____d. Grinding or chewing of food to aid in digestion

_____e. Thin, yellowish brown or greenish liquid secreted by the liver

_____f. Sum of all physical and chemical changes which take place within an organism

_____g. Process of breaking down and dissolving feeds so that the body can absorb them

_____h. Process by which food eaten by a ruminant is carried from the second stomach and the rumen into the gullet, and then forced up to the mouth for chewing

_____i. Internal body secretion that regulates various body processes

_____j. Removal of water and waste material from the body

_____k. Clear, watery fluid with an alkaline reaction secreted by the pancreas; aids in feed breakdown

_____l. Passing of food materials from the digestive system into the body after they are digested and dissolved

_____m. Animal with four stomach compartments

_____n. Animal with one stomach compartment

1. Digestion
2. Absorption
3. Enzyme
4. Hormone
5. Mastication
6. Metabolism
7. Excretion
8. Regurgitation
9. Feces
10. Pancreatic juice
11. Bile
12. Ruminant
13. Thrifty
14. Rumination
15. Nutrient

_____o.	Substance which helps prevent or control certain diseases in animals	16. Growth stimulant
_____p.	Regurgitating and rechewing previously swallowed food	17. Antibiotic
_____q.	Increases growth rate and feed efficiency, but does not become a part of the body cell	18. Cellulose
_____r.	Single class of foods or group of like foods that aid in the support of life; actually becomes a part of the body cells	19. Monogastric
_____s.	Vigorous and healthy	

2. Match the primary parts of monogastric's digestive system on the right to their functions.

_____a.	Place where microorganisms digest cellulose in horses	1. Mouth
_____b.	Moves food from mouth to stomach	2. Esophagus
_____c.	Allows absorption of water	3. Stomach
_____d.	Finishes digestion process and allows absorption of nutrients	4. Small intestine
_____e.	Produces hydrochloric acid and enzymes which begin the digestion of carbohydrates, fats and proteins and dissolve minerals; some absorption occurs	5. Caecum
_____f.	Grinds food and mixes it with saliva	6. Large intestine

3. Describe the unique characteristics of a ruminant's digestive system.

a. ____

____

____

b. ____

____

____

c. ____

____

____

4. Match the four compartments in the stomach of a ruminant to their functions. (Note: Some compartments will be used more than once.

_____a. Forms cud out of feed from rumen	1.	Rumen
_____b. Sixty to ninety percent of total digestion occurs here	2.	Reticulum
_____c. Removes most of the water	3.	Omasum
_____d. Microorganisms manufacture all essential amino acids		
_____e. Microorganisms digest cellulose and convert it it into useable food	4.	Abomasum
_____f. Collects hardware		
_____g. Microorganisms manufacture all B-complex vitamins		
_____h. True stomach		

5. Distinguish among the following animals according to their digestive system by placing an SM (simple monogastric), R (ruminant), or MC (monogastric with functional caecum) by the appropriate animal.

_____a. Horse
_____b. Rabbit
_____c. Man
_____d. Sheep
_____e. Poultry
_____f. Cow
_____g. Pig
_____h. Goat

6. List the six major classes of nutrients

a.____________________________________
b. ____________________________________
c.____________________________________
d. ____________________________________
e. ____________________________________
f.____________________________________

7. Match the nutrients on the right to their functions.
(Note: Some nutrients will be used more than once.)

_____a. Supplies heat and energy	1.	Water
_____b. Repairs worn-out tissue	2.	Carbohydrates
_____c. Stores energy	3.	Fats
_____d. Aid in skeletal development	4.	Minerals
_____e. Regulates body temperature	5.	Protein

_____f. Primary nutrient in body

_____g. Provies 2.25 times as much energy as carbohydrates per unit weight when broken down for body use

_____h. Maintain proper pressures for transfer of nutrients through cell walls

_____i. Makes up muscle, skin, hair, wool, horns, hooves, internal organs and bond marrow

_____j. Transports nutrients and waste materials

_____k. Provide chemical balance for proper body function

8. Describe one function and one deficiency symptom for each of the vitamins listed.

a. Vitamin A

(1) Function ____

____

(2) Deficiency symptom ____

____

b. Vitamin D

(1) Function ____

____

(2) Deficiency symptom ____

____

c. Vitamin E

(1) Function ______________________________

____

(2) Deficiency symptom ______________________________

____

d. Vitamin K

(1) Function ______________________________

____

(2) Deficiency symptom ______________________________

____

e. B Vitamins including B_1, B_2, niacin, pantothenic acid and biotin

(1) Function ______________________________

____

(2) Deficiency symptom ______________________________

____

f. Vitamin B_6

(1) Function ______________________________

____

(2) Deficiency symptom ______________________________

____

g. Vitamin B_{12}

(1) Function ______________________________

____

(2) Deficiency symptom ______________________________

____

h. Vitamin C

(1) Function ____

____

(2) Deficiency symptom ______________________________________

____

9. Distinguish between the major and trace minerals listed below by placing an M by the major minerals and a T by the trace minerals.

____a.	Iron	____j.	Copper
____b.	Selenium	____k.	Calcium
____c.	Sulfur	____l.	Fluorine
____d.	Chromium	____m.	Zinc
____e.	Molybdenum	____n.	Sodium
____f.	Chlorine	____o.	Iodine
____g.	Phosphorus	____p.	Potassium
____h.	Manganese	____q.	Silicon
____i.	Cobalt	____r.	Magnesium

10. Match the minerals on the right to the correct deficiency symptoms.

_____a.	Anemia	1.	Calcium
_____b.	Muscle spasms and convulsions; hyperirritability	2.	Magnesium
_____c.	Unthriftiness	3.	Sodium
_____d.	Hairless pigs; goiter; weak young and stillbirths	4.	Phosphorus
_____e.	Slow growth rate; reduced feed consumption; muscle weakness; diarrhea	5.	Potassium
_____f.	Reduced growth; lowered reproduction; eating soil	6.	Sulfur
_____g.	Lack of appetite; unthrifty appearance	7.	Iron
_____h.	Rickets; broken bones; slow growth; milk fever	8.	Iodine
_____i.	Lameness; stiffness of joints; lowered appetite; reduced rate of gain; breeding problems	9.	Sodium-chloride

11. Describe the advantages and limitations of feeding growth stimulants.

____

____

____

____

12. Describe three effects of feeding antibiotics.

a.____

b. ____

c.____

LIVESTOCK NUTRITION

AG 530 - H

ANSWERS TO TEST

1.

a.	3	f.	6	k.	10	p.	14
b.	18	g.	1	l.	2	q.	16
c.	9	h.	8	m.	12	r.	15
d.	5	i.	4	n.	19	s.	13
e.	11	j.	7	o.	17		

2.

a.	5	d.	4
b.	2	e.	3
c.	6	f.	1

3. a. Four compartments to the stomach

   b. Large rumen containing microorganisms allows digestion of large amounts of roughage and manufacture of amino acids and some vitamins

   c. Food is regurgitated and rechewed after first being consumed in large quantities and stored in the rumen

4.

a.	2	e.	1
b.	1	f.	2
c.	3	g.	1
d.	1	h.	4

5.

a.	MC	e.	SM
b.	MC	f.	R
c.	SM	g.	SM
d.	R	h.	R

6.

a.	Carbohydrates	d.	Minerals
b.	Proteins	e.	Vitamins
c.	Fats	f.	Water

7.

a.	2	d.	4	g.	3	j.	1
b.	5	e.	1	h.	4	k.	4
c.	3	f.	1	i.	5		

8. Answers should include one function and one deficiency symptom for each vitamin:

   a. (1) Aids in disease resistance; Necessary for building new cells; Prevents night blindness
      (2) Slow growth; Night blindness; Poor reproductive efficiency; Rough hair coat

   b. (1) Necessary for animal to be able to use calcium and phosphorus; Aids in skeletal development
      (2) Rickets; Swelling of joints

   c. (1) Necessary for reproduction
      (2) Infertility; Stiffening of muscles (white muscle disease)

d.	(1)	Necessary for blood clotting
	(2)	Hemorrhages
e.	(1)	Helps in the release of energy from foods
	(2)	Retarded growth; Diarrhea, vomiting and goose stepping in swine
f.	(1)	Helps form red blood cells; Helps break down protein into usable form for the body
	(2)	Convulsions; Retarded growth
g.	(1)	Helps form red blood cells
	(2)	Retarded growth; Reproductive failure
h.	(1)	Aids in iron absorption; Helps form substances between the body cells in teeth, bones and soft tissue; Aids in healing
	(2)	Loss of appetite; Loose teeth; Swollen and bleeding gums

9.

a. T	g. M	m. T
b. T	h. T	n. M
c. M	i. T	o. T
d. T	j. T	p. M
e. T	k. M	q. T
f. M	l. T	r. M

10.

a. 7	d. 8	g. 9
b. 2	e. 5	h. 1
c. 6	f. 3	i. 4

11. Growth stimulants can help increase feed efficiency and speed growth. Some kinds, however, have been linked to disease and have been banned. Growth stimulants have not proven effective in swine.

12. Answer should include 3 of the following: Increase feed efficiency and rate of gain; Stimulate appetite; Stimulate enzyme activity; Reduce bacterial infections; Reduce diarrhea in young animals

FEEDING LIVESTOCK

AG 530 - I

UNIT OBJECTIVE

After completion of this unit, students should be able to describe the procedure for determining dry matter content of a feed and distinguish between concentrates and roughages. Students should also be able to calculate feed costs and balance rations. This knowledge will be demonstrated by completion of assignment sheets and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with feeding livestock to their appropriate definitions.
2. Complete a chart showing composition of feed.
3. List three methods used to determine value of feed.
4. Describe the procedure for determining dry matter content of a feed.
5. Distinguish between concentrates and roughages.
6. List four factors that affect the feeding value of feeds.
7. Match the most common feed grains to their characteristics.
8. Name the three most common methods of preparing grains.
9. List four common sources of protein.
10. Compare plant and animal protein.
11. Describe three considerations concerning feeding minerals to livestock.
12. List four pieces of information found on feed tags.
13. Describe two advantages and two limitations of using computers for balancing rations.
14. Calculate feed cost per cwt of TDN and per cwt of protein.
15. Convert values from a dry-matter basis to an as-fed basis and vice-versa.
16. Balance a ration for protein using the Pearson's Square method.
17. Balance a ration using the trial-and-error method.

FEEDING LIVESTOCK

AG 530 - I

SUGGESTED ACTIVITIES

I. Suggested activities for the instructor

A. Make transparencies and necessary copies of materials.

B. Provide students with objectives.

C. Provide students with information and discuss.

D. Provide students with assignment sheets.

(Caution: Check assignments to determine if they are the appropriate difficulty for the students the lesson will be presented to. Some are simple while others require some advanced thinking.)

E. Develop additional assignments appropriate for the students the lesson will be presented to.

F. Obtain additional feed nutrient charts from the National Research Council, Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue N.W., Washington, D.C. 20418 or from other appropriate sources.

(Note: The feed composition table listed in this unit is very limited.)

G. Obtain samples of various kinds and forms of feed for students to see.

H. Arrange a demonstration of computer ration formulation by an extension agent, local post-secondary school or private computer company.

I. Obtain samples of feed tags for the students to see.

J. Arrange a tour of a feed plant or a local feed store.

K. Make visual aids to help students with the concepts of ration balancing.

L. Review and give test.

M. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Feed Composition

2. TM 2--Classification of Concentrates

3. TM 3--Classification of Roughages

4. TM 4--Commercial Feed Tag

5. TM 5--Using Pearson's Square

6. TM 6--Pearson's Square

E. Handout

1. HO 1--Average Composition of Common Feeds

F. Assignment sheets

1. AS 1--Convert Values From a Dry Matter Basis to an As-Fed Basis and Vice-Versa

2. AS 2--Balance a Ration for Protein Using the Pearson's Square Method

3. AS 3--Balance as Ration Using the Trial-And-Error Method

G. Answers to assignment sheets

H. Test

I. Answers to test

III. Unit references:

A. Barrick, R. Kirby, Harmon, Hobart L., *Animal Production and Management*. McGraw-Hill Book Company, 1988.

B. Campbell, John R. and Lasley, John F., *The Science of Animals That Serve Mankind*. McGraw-Hill Book Company, 1975.

C. *Cow-Calf Management Guide, Cattleman's Library*. University of Idaho Cooperative Extension Service, 1980.

D. Ensminger, M.E., *Animal Science*. The Interstate Printers and Publishers, Danville, Illinois, 1977.

E. Gillespie, James R., *Animal Nutrition and Feeding*. Delmar Publishers, Inc., 1987.

F. Jurgens, Marshall H., *Applied Animal Feeding and Nutrition*. Kendall/Hunt Publishing Company, Dubuque, Iowa, 1974.

G. Patton, Westley R., Cassard, Daniel W., and Juergenson, Elwood M., *Approved Practices in Feeds and Feeding*. The Interstate Printers and Publishers, Danville, Illinois, 1977.

FEEDING LIVESTOCK

AG 530 - I

INFORMATION SHEET

I. Terms and definitions

A. Ration--Feed allowed an animal for a 24 hour period

B. Balanced ration--Ration which supplies nutrients in the proper amounts

C. Composition--The way something is made up or put together

D. Concentrates--Feed high in total digestible nutrients and low in fiber

E. Roughages--Feed high in fiber and low in total digestible nutrients

F. TDN--Total digestible nutrients; percentage of all digestible matter in a feed except minerals

G. NFE--Nitrogen-free extract; contains the sugars and starches

(Note: NFE is what is left in the feed after water, ash, fiber, crude protein and fat have been removed.)

H. Ash--Non-organic part of the feed; minerals

I. Protein--Nutrient made up of chains of amino acids which contain nitrogen; "building blocks" of muscles

J. Amino acids--Basic unit of protein; protein quality is determined by what kind and how many amino acids it contains

K. Essential amino acid--Amino acid which an animal cannot manufacture in large enough amounts to meet its needs; must be supplied in feed

L. Crude protein--Calculated protein based on nitrogen content

M. Digestible protein--Amount of protein that actually can be digested by an animal

(Note: Most digestion trials have been performed on ruminants and digestible protein information is therefore not as valid for monogastrics.)

N. Tankage--Ground meat and bone by-products; used as a protein supplement

O. Carbohydrate--Nutrient that supplies most of the energy needs; easily digested and absorbed, but is not stored in the body

P. Fat--Stored energy

Q. Lignin--Indigestible component of fiber

R. Feed grains--Grains used in animal feeds as opposed to food grains which are used for humans

S. As-fed--Feed containing the amount of water it usually contains when fed to the animal

(Note: Nutrient content is calculated as a percentage of the feed containing the water, as-fed, or as a percentage of the feed minus the water, dry matter.)

T. Dry matter--Feed left after the water has been removed

U. Organic matter--Substance from living organisms

V. Palatability--Flavor of the feed

W. Maintenance level--Level at which nutrients are meeting an animal's basic needs, but does not provide any energy for production or weight gain

X. Silage--Feed that is stored without drying and becomes fermented; usually stored with 60% to 67% moisture content

Y. CWT--Hundred weight or 100 pounds

II. Composition of feed (Transparency 1)

(Note: The amounts of the following may change drastically from one feed to the next.)

A. Water

B. Dry matter

1. Ash--Minerals

2. Organic matter

a. Protein

(Note: All protein contains nitrogen and is made up of chains of amino acids.)

b. Carbohydrates

(1) Crude fiber (cellulose)

(2) Nitrogen-free extract

(a) Simple sugar

(b) Compound sugar

(c) Starch

c. Vitamins

d. Fat

III. Methods used to determine value of a feed

A. Cost per unit weight

B. Cost per unit weight of TDN

C. Cost per unit weight of protein

IV. Determining dry matter content of a feed

A. Finely grind a feed sample and weigh

B. Dry sample in oven

C. Weigh sample again, divide by the first weight and multiply by 100; this answer is the percentage dry matter of the feed

(Note: Do not forget to subtract the weight of the container each time the sample is weighed.)

Example:	4.1	lb	Original weight of feed and container
	- .1	lb	Weight of container
	4.0	lb	Original weight of feed
	3.5	lb	Weight of feed and container after drying
	- .1	lb	Weight of container
	3.4	lb	Weight of feed after drying

(3.4   4) x 100 = 85% dry matter in feed

V. Differences between concentrates and roughages (Transparencies 2, 3)

A. Concentrates (Transparency 2)

1. High in energy (TDN and NFE)

2. Low in crude fiber

3. Include the following: cereal grains; soybean and cottonseed meal; corn gluten; wheat bran

4. May be high or low in protein content

(Note: Concentrates high in protein are usually called protein supplements or protein concentrates.)

B. Roughages (Transparency 3)

1. High in crude fiber (over 18%); bulky

2. Low in energy (40% NFE)

3. Include the following: hay, pasture, silage

4. May be high or low quality

   (Note: A high quality hay has less than 30% fiber and more than 15% protein.)

VI. Factors affecting feeding value of feeds

A. Time of harvest

(Note: Forages are more nutritious when harvested early.)

B. Harvesting and storage conditions

(Note: Silage preserves more of the plant nutrients than other forms of feed.)

C. Soil conditions

D. Palatability

E. Fiber and lignin content

F. Form

(Note: Finer feeds are consumed more readily, but are usually not as digestible since they stay in the digestive tract a shorter time.)

G. Type of animal

Example: Ruminants can use roughages much more effectively than non-ruminants

H. Amount being fed

(Note: An animal's ability to effectively utilize feeds is best at maintenance levels and decreases as the animal approaches full feed.)

VII. Characteristics of major feed grains

A. Corn

1. Most important livestock grain

2. High in TDN

3. Low in protein

B. Barley

1. Most commonly used in the western United States

2. Comparable to corn in feed value

C. Oats

1. Lower in TDN but higher in protein than corn

2. Bulkier than corn

(Note: This bulk helps keep digestive systems working properly.)

D. Wheat

1. Similar in TDN to corn with more protein

2. Usually more expensive than other grains

3. Should not be over 50% of ration for cattle as it ferments faster in the rumen than other grains

E. Grain sorghums

1. Slightly lower in energy but higher in protein than corn

2. Must be ground for maximum digestibility

F. Rye

1. Least palatable of all grains

2. Should be limited to not over 25% of ration

VIII. Common methods of preparing grains

A. Grinding

B. Rolling

C. Pelleting

IX. Common sources of protein

A. Oil seed meals

Examples: Soybean meal, cottonseed meal, linseed meal, peanut meal, sunflower seed meal

B. Whole soybeans and cottonseeds

C. Meat scraps and tankage

D. Fish meal

E. Milk products

F. Urea

(Note: Urea is a non-protein nitrogen source that ruminants can use in limited quantities to manufacture protein.)

X. Animal versus plant protein

A. Plant protein--Generally of lower quality, meaning it does not contain all of the essential amino acids

(Note: Soybeans are of relatively high quality, containing most of the essential amino acids.)

B. Animal protein

1. High quality, meaning they contain the essential amino acids in the proper balance

2. Usually more expensive

XI. Feeding minerals

A. Minerals cannot be manufactured by the animal and therefore must be supplied in the feed

B. Minerals must be balanced in the ration--too much of one mineral can make another mineral unavailable to the animal

C. Calcium, phosphorus and salt are the minerals most commonly fed

(Note: Trace minerals are often supplied through trace mineral salt.)

XII. Information on feed tags (Transparency 4)

A. Minimum of ____________% crude protein

B. Minimum of ____________% crude fat

C. Maximum of ____________% fiber

D. Ash content

E. Mineral content

(Note: This in only included if the feed contains a significant amount of minerals.)

F. Ingredients

(Note: This is not always included.)

XIII. Using computers for balancing rations

A. Advantages

1. Computers can balance rations with many different feeds in a very short time

2. Computers can include feed cost as a consideration when balancing rations with very little extra operator effort

3. Feed and price substitutions can be made quickly

B. Limitations

1. Computers must still be supplied with accurate feed analyses, animal nutrient requirements and limitations on amounts of certain feeds

(Note: Feeds vary widely in nutrient content and animal nutrient requirements will depend on production goals, animal condition, environmental factors, etc.)

2. Computer may not be able to consider other factors which could affect the particular situation

Example: Some feeds may not mix well in certain proportions; feed price may change with amount of feed bought; individual animals may require additional nutrients

XIV. Calculating feed cost (Handout 1 may be useful for the rest of this unit.)

(Note: While a particular feed may be less per pound, it may actually be more expensive than another feed when the price for the nutrients it provides is calculated.)

A. Feed cost per pound of TDN--divide cost of feed by percent of TDN, as-fed basis

Example: Barley has approximately 74% TDN on an as-fed basis.
This barley costs $7.00 per cwt.

$7.00 ÷ .74 = $9.46 per cwt of TDN

B. Feed cost per pound of protein--divide cost of feed by percent of protein, as-fed basis

Example: Cottonseed meal has approximately 41% protein on an as-fed basis.
The cottonseed meal costs $25.00 per cwt.

$25.00 ÷ .41 = $60.98 per cwt of protein

XV. Converting between dry matter and as-fed values

(Note: Nutrient values will either be on a dry matter or as-fed basis. Before balancing a ration all values must be converted to either one or the other. It is often easier to balance the ration using dry matter figures and only convert to an as-fed basis after the ration is balanced. Part "C" explains how to do this.)

A. Converting dry matter nutrient values to an as-fed basis--multiply nutrient percentage by the percentage of dry matter in the feed

Example: Hay = 85% dry matter (15% moisture)
Hay = 19% crude protein on a dry matter basis

.19 x .85 = .1615 or 16.15% protein on an as-fed basis

B. Converting as-fed nutrient values to a dry matter basis--divide percentage of nutrient by percentage of dry matter in the feed

Example: Hay = 85% dry matter (15% moisture)
Hay = 16.15% protein on an as-fed basis

.1615÷.85 = .19 or 19% protein on a dry matter basis

C. Converting dry matter weight of a feed to an equivalent as-fed weight--divide the dry matter weight of the feed by the feed's normal percentage of dry matter

Example: You have calculated that your heifers need 9 pounds of dry matter. You are feeding them hay and grain which have a dry matter content of 86%.

9÷.86 = 10.47 lbs

You would need to feed 10.47 lbs of feed to provide them with sufficient dry matter

XVI. Using Pearson's Square to balance rations for protein (Transparencies 5, 6)

(Note: This method does not balance the other nutrients needed in the ration and is therefore most valuable when used for making substitutions of protein concentrates when formulating rations.)

A. Determine percentage of protein required in ration

B. Place in center of square

C. Place protein supplement and its percent protein in the lower left-hand corner

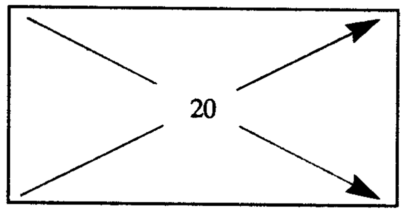
D. Place the other feed and its percent protein in the upper left-hand corner

E. Subtract diagonally, the smaller number from the larger

F. Resulting answers are the parts of feed and parts of supplement needed in ration

Example: Parts

Barley 11.5% 21 barley



Cottonseed meal 41% 8.5 cotton seed meal
29.5 total

G. Determine percentage of each by dividing the parts of each by the total parts and multiplying by 100

Example:

	Parts		Total Parts		Percent in Ration
Barley	21	÷	29.5 x 100	=	71.2%
Cottonseed	8.5	÷	29.5 x 100	=	28.8%

XVII. Trial-and-error method of balancing rations

A. Look up nutrient requirements of the animal

B. Write down an estimated ration; provide necessary dry matter

(Note: This will become easier with experience. Knowledge of feeds available and an idea of what is reasonable is important.)

C. Calculate levels of digestible protein and TDN provided by the ration

D. Alter ration to correct deficiencies; adjust for TDN first

(Note: Remember that grains can help bring up TDN content and protein supplements can be substituted to increase protein content.)

E. Recalculate and continue changing ration until it meets the necessary requirements

Example: You want to balance a ration for a 550 lb beef heifer to gaining 1.5 lbs per day. Nutrient requirements and feeds available are listed in the tables below.

(Note: All feed nutrients are on a dry matter basis unless otherwise noted.)

Animal Requirements

Dry matter	14.25	lb
Crude protein	1.36	lb
TDN	9.10	lb
Calcium	.037	lb
Phosphorus	.033	lb

Chemical composition - dry matter basis

Feed	Dry matter	Crude protein	TDN	Cal-cium	Phos-phorus
	%	%	%	%	%
Orchardgrass hay	89.7	9.7	57	.45	.37
Corn silage	27.9	8.4	70	.28	.21
Corn	89.0	10.0	91	.02	.35
Soybean meal	89.0	51.5	81	.36	.75
Limestone	----	----	----	38.00	----

You decide to try an all-roughage ration to get by as cheaply as possible. You decide you have enough silage to feed about 4 lbs a day per animal (dry matter basis). You therefore decide on the following:

Orchardgrass	10.25 lbs (Dry matter requirement of 14.35 lbs - 4 lbs silage)
Silage	4 lbs

Make calculations:

	Dry matter--lbs	Protein--lbs	TDN--lbs
Orchardgrass	10.25	.99	5.84
Silage	4.00	.34	2.80
Totals	14.25	1.44	8.64
Requirements	14.25	1.36	9.10

Add corn and decrease hay to raise TDN

	Dry matter--lbs	Protein--lbs	TDN--lbs
Orchardgrass	8.85	.86	5.04
Silage	4.00	.34	2.80
Corn	1.40	.14	1.27
Totals	14.25	1.34	9.11
Requirements	14.25	1.36	9.10

Substitute soybean meal for a small amount of the corn to raise protein level

	Dry matter--lbs	Protein--lbs	TDN--lbs
Orchardgrass	8.85	.86	5.04
Silage	4.00	.34	2.80
Corn	1.34	.13	1.22
Soybean meal	.06	.03	.05
Totals	14.25	1.36	9.11
Requirements	14.25	1.36	9.10

Check calcium and phosphorus content to insure a 1 to 1 or greater ratio

	Calcium	Phosphorus
Orchardgrass	.04	.033
Silage	.011	.008
Corn	--	.005
Soybean meal	--	--
Totals	.051	.046
Requirements	.037	.033

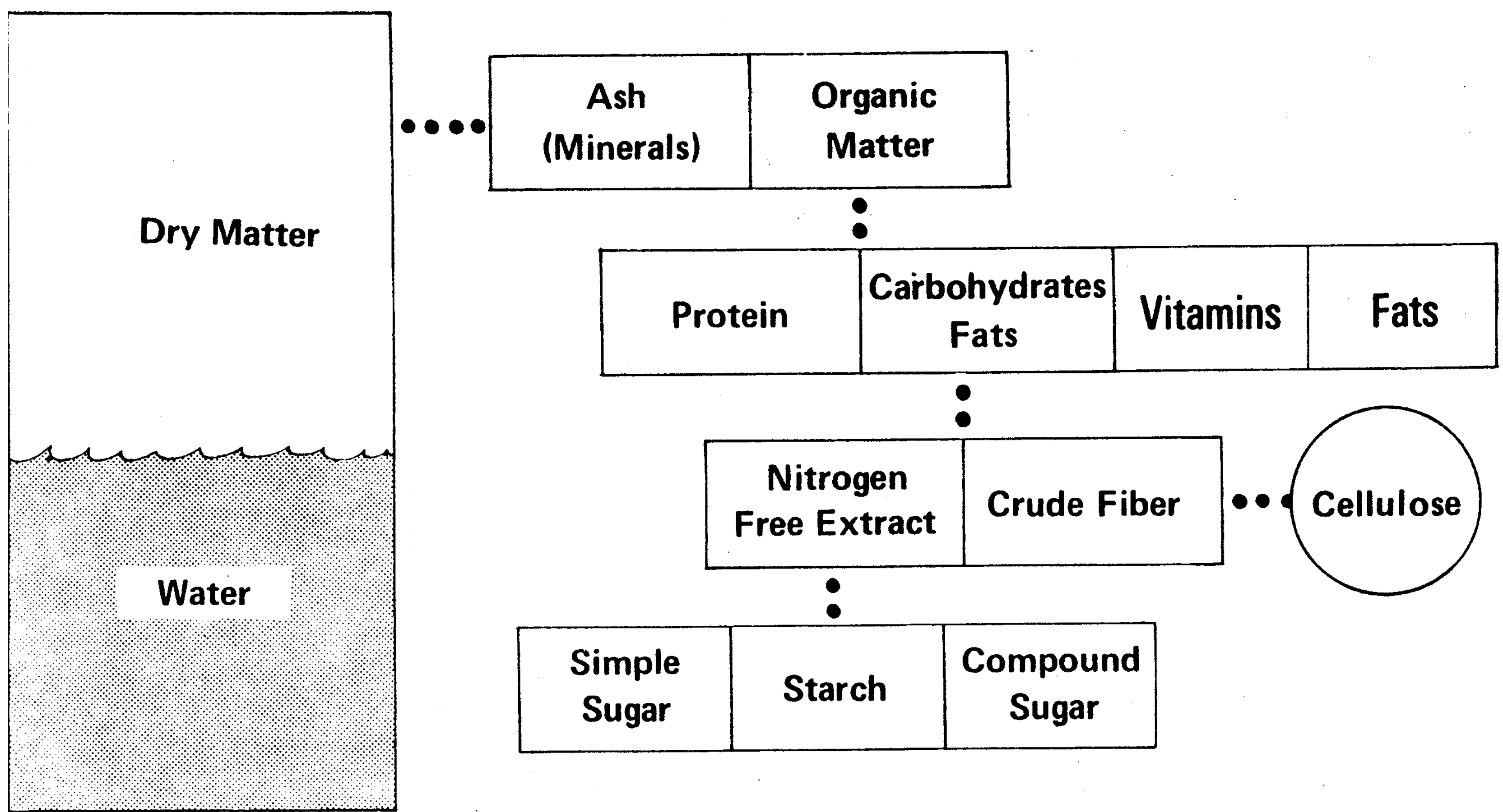
Ratio is 1.1 to 1 and is okay; limestone does not need to be added

Convert to actual feed needed

	Dry Matter %	Dry Matter lbs	Feed lbs
Orchardgrass	89.7	8.85	9.90
Silage	27.9	4.00	14.30
Corn	89.0	1.34	1.50
Soybean meal	89.0	.06	.067

(Note: The trial-and-error method can be very tedious and time consuming, especially as more feeds are added to the ration. One way to speed up the process is to calculate the amount the nutrient needs to be increased and divide it by the net gain made by the substitution. For example, orchardgrass has 57% TDN and corn has 91%. In our first ration we had 8.64 lbs of TDN and needed 9.1 lbs or an addition of .46 lbs (9.1 - 8.64). By dividing .46 by 34% we get 1.35 lbs which is the amount of corn we must substitute for orchardgrass to get the desired TDN. Use of computers is another way to greatly speed this process.)

Feed Composition



TM 1

Classification Of Concentrates

OIL MEALS

Soybean
Cottonseed
Linseed
Peanut

MOLASSES

Cane
Beet

GRAIN BY-PRODUCTS

Wheat bran
Wheat standard middlings

ANIMAL PRODUCTS

Meat scraps
Tankage
Fish meal
Dried dairy products

GRAINS

Barley
Wheat
Corn
Milo
Oats

Classification Of Roughages

GREEN ROUGHAGES

Roots

Grasses

Tubers

DRY ROUGHAGES

Hays—
Grass and Legume

Hulls—
Peanut and Cottonseed

Straw—
Oat, Wheat,
Barley, and Rice

SILAGE

Corn

Sorghum

Grass

Commercial Feed Tag

50 Pounds (Net) B & D BRAND SPECIAL CATTLE CUBES

GUARANTEED ANALYSIS

Crude Protein not less than	20.00 Percent
Crude Fat not less than	2.50 Percent
Crude Fiber not more than	14.00 Percent

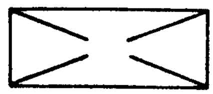
INGREDIENTS: Composed of grain products, plant protein products, processed grain by-products, animal protein products, dehydrated alfalfa meal (preserved with ethoxyquin), mixed screenings 10%, rice mill by-products 10%, cane molasses, calcium carbonate, defluorinated phosphate salt, and TRACES of manganous oxide, zinc oxide, ferrous sulphate, copper sulphate, calcium iodate, and cobalt carbonate. (Total added mineral ingredients less than 5%.)

Manufactured by

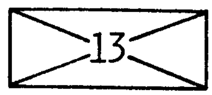
FEEDING DIRECTIONS: A cattle supplement for winter range.

Using Pearson's Square

STEP NO. 1

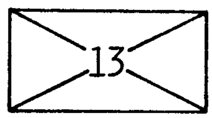


STEP NO. 2



MILO 8.5

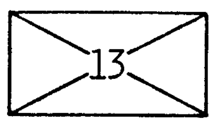
STEP NO. 3 AND 4



C.S.M. 32.2

MILO 8.5 — 19.2 PARTS OF MILO

STEP NO. 5



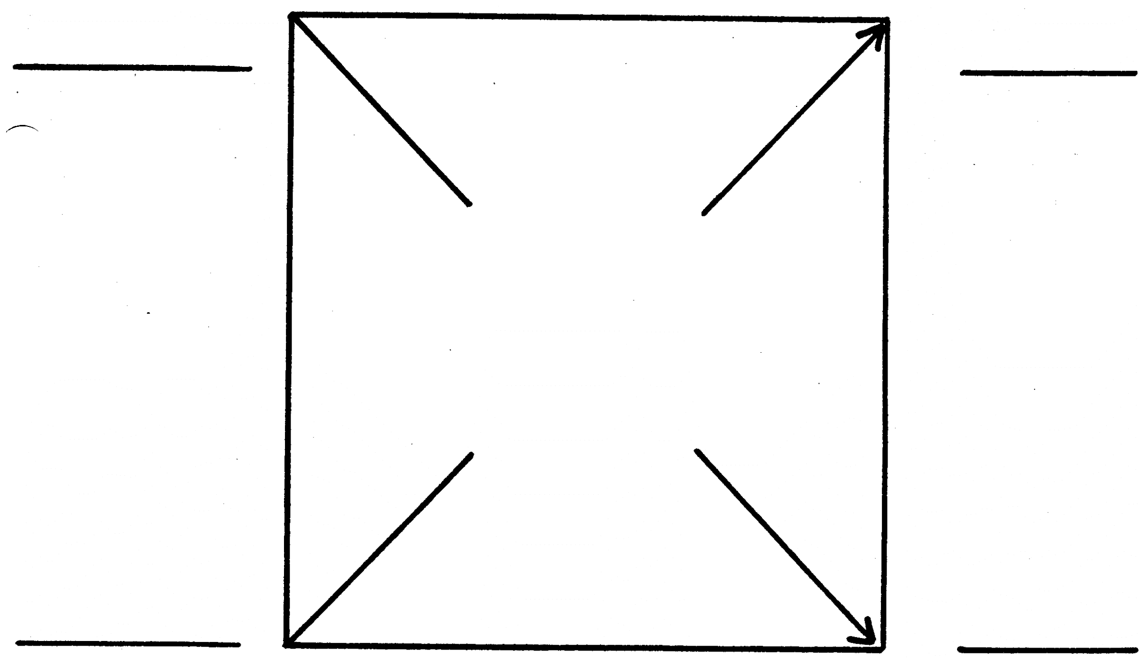
C.S.M. 32.2 — 4.5 PARTS OF C.S.M.

TOTAL PARTS IN MIXTURE 23.7

STEP NO. 6 MILO 19.2 ÷ 23.7 = .81 x 100 = 81%

COTTONSEED MEAL 4.5 ÷ 23.7 = .19 x 100 = 19%

Pearson's Square



Average Composition Of Common Feeds

Dry Basis

The following tables list average nutrient and mineral values for some common feedstuffs. To convert dry matter values in the tables to as-fed values, multiply the nutrient value (dry basis) by the percent dry matter (oats 12.4% crude protein on a dry basis x .89% dry matter = 11% crude protein on an as-fed basis). Adapted by David A. Yates, Extension Animal Scientist, University of Wyoming.

		Dry matter basis							
	Dry	Crude	Energy			Crude			
Feedstuffs	matter	protein	TDN	NE_m	NE_g	fiber	Ca	P	IU/lb.
	(%)	(%)	(%)	Mcal/lb.		(%)	(%)	(%)	
Low protein concentrates									
Barley grain	89.0	13.0	83	.97	.64	5.6	.09	.47	—
Beet pulp	91.0	10.0	72	.73	.47	20.9	.75	.11	—
Beet pulp w/ molasses	92.0	9.9	74	.92	.61	17.4	.61	.11	—
Beet molasses	77.0	8.7	89	.93	.62	—	.21	.04	—
Brewers dried grains	92.0	28.1	66	.64	.38	16.3	.29	.54	—
Corn distillers grains	92.0	29.5	84	.90	.60	13.0	.10	.40	—
Corn, dent, #2	89.0	10.0	91	1.04	.67	2.2	.02	.35	360
Ground ear corn	87.0	9.3	90	1.01	.63	9.2	.05	.31	—
Milo	89.0	12.4	80	.84	.56	2.2	.04	.33	—
Oats	89.9	13.2	76	.79	.52	12.4	.11	.39	—
Rye	89.0	13.4	85	.93	.62	2.2	.07	.38	—
Sugar cane molasses	75.0	4.3	72	.87	.54	—	1.19	.11	—
Turnip roots	9.3	14.0	84	.89	.60	11.8	.64	.22	—
Wheat	89.0	14.3	88	.98	.64	3.4	.06	.41	—
Wheat bran	89.0	18.0	70	.70	.44	11.2	.16	1.32	—
High protein concentrates									
Cottonseed meal									
Expeller	94.0	43.6	78	.82	.54	12.8	.17	1.28	—
Solvent	91.5	44.8	75	.77	.50	13.1	.17	1.31	—
Linseed meal									
Expeller	91.0	38.8	81	.86	.58	9.9	.48	.98	—
Solvent	91.0	38.6	76	.79	.52	9.9	.44	.91	—
Meat and bone meal	94.0	53.8	72	.73	.47	2.0	11.25	5.39	—
Rapeseed meal									
Expeller	93.6	39.6	74	.76	.50	14.6	.64	1.04	—
Solvent	90.3	43.6	69	.69	.43	15.3	.44	1.00	—
Safflower									
Expeller	91.0	21.7	57	.55	.25	34.1	.25	.78	—
Solvent	91.8	23.3	55	.53	.22	35.2	.37	.92	—
Soybean meal									
Expeller	90.0	48.7	85	.94	.62	6.7	.30	.70	—
Solvent	89.0	51.5	81	.88	.59	6.7	.36	.75	—
Sunflower									
Expeller	93.0	44.1	70	.70	.44	14.0	.46	1.12	—
Solvent	93.0	50.3	65	.64	.38	11.8	—	—	—

Average Composition Of Common Feeds (cont.)

Feedstuffs	Dry matter	Crude protein	TDN	NEm	NEg	Crude fiber	Ca	P	IU/lb.
		Dry matter basis							
			Energy						
	(%)	(%)	(%)	(Mcal/lb.)		(%)	(%)	(%)	
Dry roughages									
Alfalfa hay									
Late vegetative	84.5	19.4	59	.57	.28	28.5	1.43	.26	31,600
Early bloom	90.0	18.4	57	.55	.25	29.8	1.25	.23	23,200
Mid-bloom	89.2	17.1	55	.53	.22	30.9	1.35	.22	6,000
Full bloom	87.7	15.9	53	.51	.18	33.9	1.28	.20	6,800
Mature	91.2	13.6	50	.49	.13	37.5	—	—	—
Alfalfa dehydrated									
20% protein	92.0	21.8	61	.60	.36	23.0	1.79	.31	40,000
17% protein	93.0	19.2	62	.60	.31	26.0	1.43	.26	32,000
15% protein	93.0	16.3	61	.60	.29	28.0	1.32	.24	20,000
Barley hay	87.3	8.9	57	.56	.26	26.4	.21	.30	—
Barley straw	88.2	4.1	41	.46	.06	42.4	.34	.09	—
Bluegramma hay	90.0	4.1	47	—	—	34.0	.21	.08	—
Bluegrass hay	93.4	11.6	55	.53	.22	28.9	.30	.29	—
Bluestem-mature	71.3	4.5	46	.45	.05	34.0	.40	.11	—
Bromegrass hay	89.7	11.8	52	.50	.16	32.0	—	—	—
Clover hay									
Alsike	87.9	14.7	60	.59	.30	29.4	1.31	.25	34,000
Landino	91.2	23.0	61	.60	.31	19.2	1.38	.40	29,200
Red	87.7	14.9	59	.57	.28	30.1	1.61	.22	6,800
Ground corn cobs	90.4	2.8	47	.48	.11	35.8	.12	.04	—
Cottonseed hulls	90.3	4.3	41	.47	.09	47.5	.16	.10	—
Fescue hay, meadow	88.5	10.5	54	.52	.20	31.2	.50	.36	—
Intermountain native hay	92.9	9.1	51	.50	.14	30.1	.57	.17	—
Oat hay	88.2	9.2	61	.60	.32	31.0	.26	.24	18,400
Oat straw	90.1	4.4	52	.50	.16	41.0	.83	.10	—
Orchardgrass hay	88.3	9.7	57	.55	.25	34.0	.45	.37	6,000
Rye straw	88.9	3.0	31	.34	.00	47.6	.29	.10	—
Sagebrush big (stem cured)		9.4	—	—	—	—	.67	.18	2,800
Sagebrush fringed									
Mid-bloom	43.2	8.5	62	.60	.33	26.5	—	—	—
Mature	50.0	6.0	53	.51	.18	31.7	—	—	—
Saltgrass desert (grazed)	75.0	5.9	64	.63	.36	29.7	.16	.09	—
Sedge hay	90.2	10.3	50	.49	.13	30.9	—	—	—
Sorghum sudangrass hay	88.9	12.7	59	.57	.29	28.9	.56	.31	—
Sweetclover hay	87.2	16.3	57	.55	.25	32.2	1.77	.26	—
Timothy hay									
Late vegetative	88.6	12.3	62	.61	.33	32.9	.66	.34	—
Early bloom	87.7	8.7	59	.57	.28	33.2	.60	.26	—
Mid-bloom	88.4	8.5	57	.56	.26	33.5	.41	.19	9,600
Late bloom	88.0	8.3	55	.53	.22	32.4	.38	.18	1,600
Wheat									
Hay	85.9	7.5	66	.65	.39	27.8	—	—	20,400
Straw	90.1	3.6	48	.47	.09	41.5	.77	.08	400
Wheatgrass, crested									
Early vegetative	31.0	23.6	67	.66	.40	34.0	.46	.35	78,850
Early bloom	42.0	11.0	58	.56	.27	30.0	—	—	—
Full bloom	50.0	9.8	55	.53	.22	30.0	.39	.28	27,900
Mature	60.0	5.7	52	.50	.16	36.0	.29	.17	13,700
Silages									
Alfalfa									
Immature	35.0	21.5	63	.62	.35	26.0	1.79	.30	12,000
Early bloom	35.0	18.4	57	.61	.28	30.0	1.45	.23	8,000
Mid-bloom	35.0	15.9	57	.55	.25	34.0	1.28	.20	5,000
Full bloom	35.0	13.6	55	.53	.21	38.0	1.25	.20	2,000
Beet, sugar (tops)	21.0	12.7	54	.52	.19	13.0	2.32	.20	—
Corn, well-eared	28.0	8.4	70	.71	.45	26.0	.28	.21	—
Oats	32.0	9.7	59	.58	.29	32.0	.37	.30	21,727
Milo	29.0	7.3	57	.55	.26	26.0	.25	.18	—
Sorghum, sudangrass	23.0	10.2	59	.58	.29	34.0	.64	.22	—

Average Composition Of Common Feeds (cont.)

Average mineral content of selected foodstuffs on an as-fed basis.

Feedstuff	As-fed basis			
	Calcium (%)	Phosphorus (%)	Magnesium (%)	Potassium (%)
	Minerals			
Bone meal steamed	30.5	14.0	.67	.19
Limestone	34.0	—	2.06	.12
Magnesium carbonate	—	—	25.20	—
Magnesium oxide	—	—	60.30	—
Magnesium sulfate	—	—	10.00	—
Oyster shell	38.0	—	—	.09
Phosphate, deflourinated rock	34.0	16.0	—	.09
Phosphate, diammonium	—	20.0	—	—
Phosphate, dicalcium	24.0	19.0	—	—
Phosphate, monocalcium	16.0	25.0	—	—
Phosphate, monosodium	—	22.5	—	—
Phosphate, sodium tripoly	—	30.0	—	—
Phosphoric acid	—	32.0	—	—
Potassium sulfate	—	—	—	45.00
Potassium chloride	—	—	—	50.00

*Table values are from National Research Council's "Nutrient Requirements of Beef Cattle" No. 4, fifth revised edition, 1976, and Nebraska Neb Guide G74-145 "Average Composition of Common Feeds (Dry Basis)" by Paul Q. Guyer.

FEEDING LIVESTOCK

AG 530 - I

ASSIGNMENT SHEET #1--CONVERT VALUES FROM A DRY MATTER BASIS TO AN AS-FED BASIS AND VICE VERSA

Name ______________________ Score ______________________

Complete the following chart by converting the values as needed.

Feed	Dry Matter	Dry Matter Basis		As-Fed Basis	
	%	%C.P.	%TDN	%C.P.	%TDN
Beet pulp	91	10	____	____	65.5
Rye	89	____	____	11.9	75.7
Wheat	89	14.3	88	____	____
Linseed meal	91	____	81	35.3	____
Alfalfa hay	91.2	13.6	____	____	45.6
Alfalfa silage	35	____	57	5.6	____

Feed	Dry Matter %	Pounds of Dry Matter	Pounds of Actual Feed Needed
Corn silage	28	3	____________
Beet molasses	77	2	____________
Barley straw	88.2	8	____________
Dent corn	89	13	____________

FEEDING LIVESTOCK

AG 530 - I

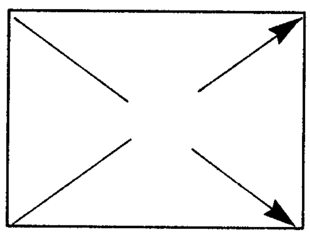
ASSIGNMENT SHEET #2--BALANCE A RATION FOR PROTEIN USING THE PEARSON'S SQUARE METHOD

Name ______________________ Score ______________________

Balance the following rations for protein by calculating the parts of the feeds needed and the percentage of the ration they would make up.

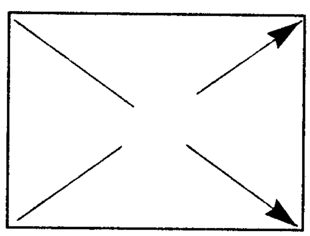
(Note: All figures are given on an as-fed basis.)

1. You want 25% protein in the ration. Your feeds are tankage -- 50.6% protein and barley-- 11.6% protein.



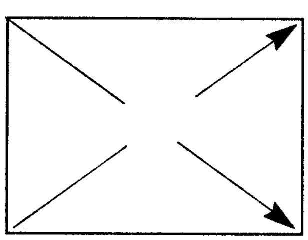
	Parts	Percentage
Barley	______	______
Tankage	______	______
Totals	______	______

2. You want 17% protein in the ration. Your feeds are milo -- 11 % protein and soybean meal -- 43.8% protein.



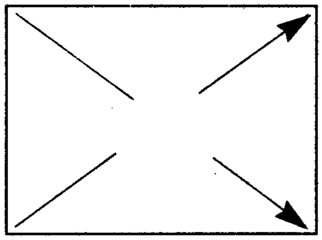
	Parts	Percentage
Milo	______	______
Soybean meal	______	______
Totals	______	______

3. You want 20% protein in the ration. Your feeds are alfalfa hay -- 16.6% protein and sunflower -- 41% protein.



	Parts	Percentage
Alfalfa hay	______	______
Sunflower	______	______
Totals	______	______

4. You want 14.2% protein in the ration. Your feeds are sweetclover hay -- 14.2% protein and sunflower -- 41% protein.



	Parts	Percentage
Sweetclover hay	________	__________
Sunflower	________	__________
Totals	________	__________

FEEDING LIVESTOCK

AG 530 - I

ASSIGNMENT SHEET #3--BALANCE A RATION USING THE TRIAL-AND-ERROR METHOD

Name ______________________ Score ______________________

Using the feeds listed, balance a ration for dry matter, protein and total digestible nutrients for a dairy cow having the nutrient requirements listed in the chart. Figure nutrient requirements on a dry matter basis and then convert them to an as-fed basis as the final step after balancing the ration. Limit silage to 5.4 pounds of dry matter.

(Note: As an extra challenge, figure out how much 20-24% Ca-18% P supplement you should add to meet the calcium and phosphorus requirements.)

Requirements for a high producing 1,300-to-1,400 pound cow

Dry Matter	Crude Protein	TDN	Calcium	Phosphorus
42-45 lbs	7.5-7.9 lbs	30-31 lbs	.28-.32 lbs	.21-.22 lbs

Worksheet (dry matter basis--lbs)

Feeds (dry matter basis)	Dry Matter--lbs	Crude Protein--lbs	TDN--lbs
Alfalfa 17% CP, 56% TDN			
Corn silage 8% CP, 91% TDN	5.4		
Corn 10.2% CP, 91% TDN			
Protein supplement 49% CP, 86% TDN			
Totals			

Converting to as-fed basis:

Feeds	Dry Matter Content	Pounds of feed actually needed
Alfalfa	89.2	______________
Corn silage	28	______________
Corn	89	______________
Protein supplement	90	______________

FEEDING LIVESTOCK

AG 530 - I

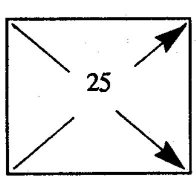
ANSWERS TO ASSIGNMENT SHEETS

Feed	Dry Matter %	Dry Matter Basis %C.P.	Dry Matter Basis %TDN	As-Fed Basis %C.P.	As-Fed Basis %TDN
Beet pulp	91	10	72	9.1	65.5
Rye	89	13.4	85	11.9	75.7
Wheat	89	14.3	88	12.7	78.3
Linseed meal	91	38.8	81	35.3	73.7
Alfalfa hay	91.2	13.6	50	12.4	45.6
Alfalfa silage	35	16	57	5.6	20

Feed	Dry Matter %	Pounds of Dry Matter	Pounds of Actual Feed Needed
Corn silage	28	3	10.7
Beet molasses	77	2	2.6
Barley straw	88.2	8	9.1
Dent corn	89	13	14.6

Assignment Sheet #2

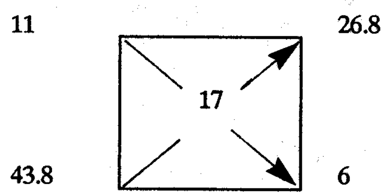
1. 11.6 25.6



50.6 13.4

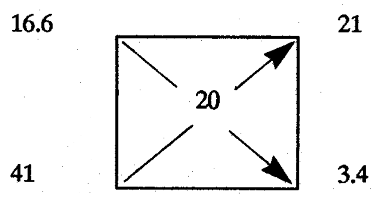
	Parts	%
Barley	25.6	65.6%
Tankage	13.4	34.4%
Totals	39.0	100.0%

2.



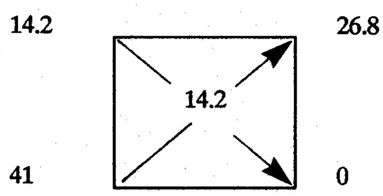
	Parts	%
Milo	26.8	81.7%
Soybean meal	6.0	18.3%
Totals	32.8	100.0%

3.



	Parts	%
Alfalfa hay	21.0	86.1%
Sunflower	3.4	13.9%
Totals	24.4	100.0%

4.



	Parts	%
Sweetclover hay	26.8	100 %
Sunflower	0	0 %
Totals	26.8	100 %

Assignment Sheet #3

Answer should be similar to the following:

	Dry Matter--lbs	Crude Protein--lbs	TDN--lbs
Alfalfa	16.1	2.74	9.0
Corn Silage	5.4	.43	3.6
Corn	15.0	1.53	13.6
Protein Supplement	5.9	2.89	5.1
Totals	42.4	7.59	31.3

As-fed Basis	Pounds of feed actually needed
Alfalfa	18.05
Corn silage	19.3
Corn	16.85
Protein Supplement	6.56

Extra credit:

20-24% Ca-18% P = .47 lbs

FEEDING LIVESTOCK

AG 530 - I

UNIT TEST

Name ______________________________ Score ______________________________

1. Match the terms on the right to the appropriate definition.

_____a. Contains the sugars and starches; What is left in the feed after water, ash, fiber, crude protein and fat have been removed

_____b. Feed high in total digestible nutrients and low in fiber

_____c. Basic unit of protein; protein quality is determined by what kind and how many of these it contains

_____d. Feed high in fiber and low in total digestible nutrients

_____e. Non-organic part of the feed; minerals

_____f. One hundred pounds

_____g. Level at which nutrients are meeting an animal's basic needs, but does not provide any energy for production or weight gain

_____h. Nutrient made up of chains of amino acids which contain nitrogen; "building blocks" of muscles

_____i. Grains used in animal feeds as opposed to food grains which are used for humans

_____j. Calculated protein based on nitrogen content

_____k. Percentage of all digestible matter in a feed except minerals

_____l. Ration which supplies nutrients in the proper amounts

_____m. Amino acid which an animal cannot manufacture in large enough amounts to meet its needs; must be supplied in feed

_____n. Feed left after the water has been removed

1. Tankage
2. Ash
3. Crude protein
4. As-fed
5. Lignin
6. TDN
7. Composition
8. Protein
9. Digestible protein
10. Amino acids
11. Silage
12. Palatability
13. Ration
14. NFE
15. Fat
16. Organic matter
17. Balanced ration
18. Concentrates
19. Roughages
20. Feed grains
21. Carbohydrate
22. CWT

_____o. Feed allowed an animal for a 24 hour period

_____p. Ground meat and bone by-products; used as a protein supplement

_____q. Amount of protein that actually can be digested by an animal

_____r. Nutrient that supplies most of the energy needs

_____s. Feed containing the amount of water it usually contains when fed to the animal

_____t. Substance from living organisms

_____u. Flavor of the feed

_____v. Indigestible component of fiber

_____w. Stored energy

_____x. The way something is made up or put together

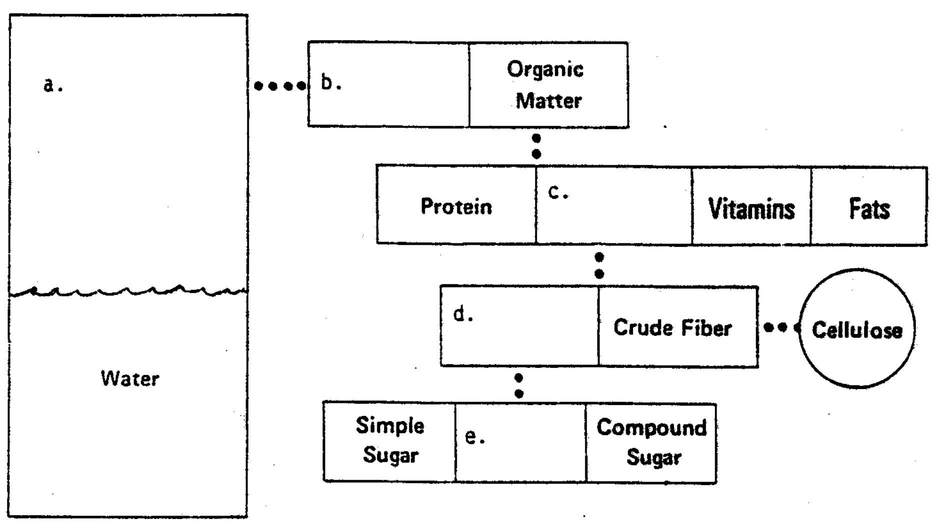
_____y. Feed that is stored without drying and becomes fermented; usually stored with 60% to 67% moisture content

23. Maintenance level

24. Essential amino acid

25. Dry matter

2. Complete the following chart showing the composition of feed.



a. ______________________________ d. ______________________________

b. ______________________________ e. ______________________________

c. ______________________________

3. List three methods used to determine value of feed.

   a.______________________________

   b. ______________________________

   c.______________________________

4. Describe the procedure for determining dry matter content of a feed.

   ____

   ____

   ____

   ____

   ____

   ____

5. Distinguish between concentrates and roughages by placing a "C" by the statements or words indicating concentrates and an "R" by the statements or words indicating roughages.

   _____a. Bulky

   _____b. High in energy

   _____c. Cereal grains

   _____d. 40% NFE

   _____e. Cottonseed meal

   _____f. Silage

   _____g. High in crude fiber

   _____h. Hay

6. List four factors that affect the feeding value of feeds.

   a.______________________________

   b. ______________________________

   c.______________________________

   d. ______________________________

7. Match the feed grains on the right to their characteristics.
(Note: Some grains may be used more than once.)

_____a.	Most common in western United States	1.	Rye
_____b.	Should not be over 50% of cattle rations	2.	Wheat
_____c.	Most important livestock grain	3.	Corn
_____d.	Lower in TDN, higher in protein and bulkier than corn	4.	Oats
_____e.	Must be ground for maximum digestibility	5.	Grain sorghums
_____f.	Least palatable of all grains	6.	Barley
_____g.	Usually the most expensive grain		
_____h.	Should be limited to not over 25% of ration		

8. Name the three most common methods of preparing grains.

a. ____

b. ____

c. ____

9. List four common sources of protein.

a. ____________________ c. ____________________

b. ____________________ d. ____________________

10. Compare plant and animal protein.

____

____

____

____

11. Describe three considerations concerning feeding minerals to livestock.

a. ____

____

b. ____

____

c. ____

12. List four pieces of information found on feed tags.

    a.____

    b. ____

    c.____

    d. ____

13. Describe two advantages and two limitations of using computers for ration balancing.

    Advantages

    a.____

    b. ____

    Limitations

    a.____

    b. ____

14. Calculate feed cost per cwt of TDN in the first example and per cwt of protein in the second example.

    Oats cost $6.00 per cwt and have 68% TDN on an as-fed basis.

    a. Cost per cwt of TDN______________________________

    Safflower costs $30.00 per cwt and has 52% protein on an as-fed basis.

    b. Cost per cwt of protein ______________________________

15. Convert the following values as indicated.

Sedge hay has 90% dry matter and has 50% TDN on a dry matter basis.

a. Percentage of TDN on an as-fed basis____________________

Crested wheatgrass has 31% dry matter and has 7.3% protein on an as-fed basis.

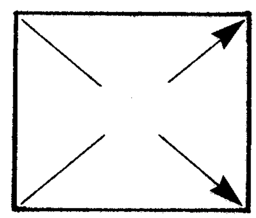
b. Percentage of protein on a dry matter basis____________________

Alsike clover hay has an 88% dry matter content. You have calculated a need for 20 lbs of dry matter in the feed.

c. Pounds of clover hay needed (as-fed basis)____________________

16. Balance the following ration for protein.

Amount of protein desired in ration = 17%
Feeds available: Timothy hay -- 10% protein
Rapeseed meal -- 39%



a. Parts of timothy hay ____________________

b. Parts of rapeseed meal ____________________

c. Total parts ____________________

d. Percentage of timothy hay ____________________

e. Percentage of rapeseed meal ____________________

FEEDING LIVESTOCK

AG 530 - I

ANSWERS TO TEST

1.

a.	14	h.	8	o.	13	v.	5
b.	18	i.	20	p.	1	w.	15
c.	10	j.	3	q.	9	x.	7
d.	19	k.	6	r.	21	y.	11
e.	2	l.	17	s.	4		
f.	22	m.	24	t.	16		
g.	23	n.	25	u.	12		

2.
   a. dry matter
   b. ash (minerals)
   c. carbohydrates - fats
   d. nitrogen-free extract
   e. starch

3. Cost per unit weight; Cost per unit weight of TDN; Cost per unit weight of protein

4. Finely grind a feed sample and weigh; Dry sample in oven; Weigh sample again, divide by the first weight and multiply by 100

5.

a.	R	d.	R	g.	R
b.	C	e.	C	h.	R
c.	C	f.	R		

6. Answer should include four of the following: Time of harvest; Harvesting and storage conditions; Soil conditions; Palatability; Fiber and lignin content; Form; Type of animal; Amount being fed

7.

a.	6	d.	4	g.	2
b.	2	e.	5	h.	1
c.	3	f.	1		

8. Grinding; Rolling; Pelleting

9. Answer should include four of the following: Oil seed meals; Whole soybeans and cottonseeds; Meat scraps and tankage; Fish meal; Milk products; Urea

10. Plant protein is generally of a lower quality, not containing as many of the essential amino acids. Plant proteins are cheaper than animal proteins. Animal proteins contain the essential amino acids in proper balance

11.
   a. Minerals cannot be manufactured by the animal and therefore must be supplied in the feed
   b. Minerals must be balanced in the ration--too much of one mineral can make another mineral unavailable to the animal
   c. Calcium, phosphorus and salt are the minerals most commonly fed

12. Answer should include four of the following: Minimum crude protein; Minimum crude fat; Maximum fiber; Ash content; Mineral content; Ingredients

13. Answer should include two advantages and two limitations:

    Advantages: Computers can balance rations with many different feeds in a very short time; Computers can include feed cost as a consideration when balancing rations with very little extra operator effort; Feed and price substitutions can be made quickly

    Limitations: Computers must still be supplied with accurate feed analyses, animal nutrient requirements and limitations on amounts of certain feeds; Computer may not be able to consider other factors which could affect the particular situation

14. a. $8.82
    b. $57.69

15. a. 45%
    b. 23.5%
    c. 22.7 lbs.

16. a. 22
    b. 7
    c. 29
    d. 76%
    e. 24%

ANIMAL HEALTH

AG 530 - J

UNIT OBJECTIVE

After completion of this unit, students should be able to recognize healthy and unhealthy livestock and develop a program to promote healthy livestock. Students should also be able to describe some laws dealing with livestock health and be able to administer oral medicines to animals. This knowledge will be demonstrated by completion of assignment sheet, laboratory exercise and test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with maintaining healthy livestock to their definitions.
2. Describe five reasons for preventing diseases as compared to simply curing diseases.
3. List five signs indicating healthy livestock.
4. List five signs of poor livestock health.
5. List the four general causes of disease.
6. Describe an effective overall livestock health program.
7. Select the maximum environmental temperatures desirable for cattle.
8. Match disinfectants to their uses and limitations.
9. Describe how immunity is supplied from different sources.
10. List the general types of vaccines.
11. Describe how vaccines should be cared for and used.
12. Name three methods of giving animals oral medicines.
13. Name the agencies responsible for enforcing livestock health regulations in Idaho.
14. Describe four general health regulations for livestock in Idaho.
15. Describe the regulation dealing with feeding garbage to swine in Idaho.
16. List five plants that are poisonous to livestock.
17. Develop a herd health plan for a livestock operation.
18. Demonstrate the ability to administer oral medicines to cattle.

ANIMAL HEALTH

AG 530 - J

SUGGESTED ACTIVITIES

I. Suggested activities for the instructor

   A. Make transparencies and necessary copies of material.

   B. Provide students with objectives and discuss.

   C. Provide students with information and discuss.

   D. Give students assignment sheets and laboratory exercise.

   E. Develop a chart of economic losses from disease in the local area using veterinarians, farmers and ranchers, and extension agents as sources.

   F. Become familiar with specific health regulations that affect the local area.

   G. Invite a veterinarian to talk about a good general health program.

   H. Invite a state health official to talk about health problems in Idaho.

   I. Collect and display samples of disinfectants.

   J. Arrange a field trip to demonstrate drenching, vaccination, taking blood samples, etc.

   K. Review and give test.

   L. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Vital Signs of Livestock

      2. TM 2--Causes of Disease

      3. TM 3--Livestock Housing

      4. TM 4--Handling Livestock

5. TM 5--Relationship Between Maximum Desirable Temperature and Humidity

E. Assignment sheet

1. AS 1--Develop a Herd Health Plan for a Livestock Operation

F. Lab exercise

1. LE 1--Administer Oral Medicines to Cattle

G. Test

H. Answers to test

III. Unit references

A. Baker, James K. and Greer, William J., *Animal Health*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1980.

B. Barrick, R., Kirby, Harmon, Hobart L., *Animal Production and Management,* McGraw-Hill Book Company, 1988.

C. Berrier, Harry H., *Animal Sanitation and Disease Prevention*. Kendall/Hunt Publishing Co., Dubuque, Iowa, 1977.

D. Campbell, John R. and Lasley, John F., *The Science of Animals That Serve Mankind*. McGraw-Hill Book Company, New York, 1975.

E. *Cow-Calf Management Guide*, Cattleman's Library. University of Idaho Cooperative Extension Service, 1980.

F. Haynes, N. Bruce, *Keeping Livestock Healthy*. Garden Way Publishing, Charlotte, Vermont, 1978.

G. *Idaho State Department of Agriculture Rules*, August 1980.

H. *Instructional Materials for Vocational Agriculture II*. Teaching Materials Center, Agricultural Education Department, Texas A & M University, College Station, Texas.

ANIMAL HEALTH

AG 530 - J

INFORMATION SHEET

I. Terms and definitions

A. Contagious disease--Infectious disease that can be spread from one animal to another

(Note: A disease can be infectious and not be contagious.)

B. Infection--Entry and development of a disease-causing organism causing harm to an animal's body

C. Diagnose--Recognize and identify a disease

D. Cud--A ball of regurgitated food which ruminants chew and then reswallow

E. Feces--Manure expelled from the intestinal tract

F. Disinfectant--Substance that kills bacterial or other microorganisms

G. Immunity--The ability of an animal to resist or overcome an infection

H. Immunization--Process of giving an animal immunity

I. Parasite--Organism that lives on or in a living animal

J. Parturition--Act of giving birth

K. Humidity--Amount of moisture in the air

L. Organic matter--Any substance from living organisms

M. Spores--Single cells from which some lower organisms reproduce

N. Bacteria--One-celled, plant-like organisms

O. Fungi--Plants that live only off of other dead or living organic matter

P. Virus--Tiny agent that causes disease; not even a complete cell

Q. Protozoa--One-celled animals

R. Mucous membrane--Lining of body openings and digestive tract that secretes a watery substance

S. Serum--Extract of blood that contains antibodies

T. Antibody--Substance produced by an animal to defend against a specific disease-causing agent

U. Vaccine--Organisms or viruses which produce an immunity in animals

V. Vaccinate--Process of giving an animal a vaccine

W. Drenching--Giving an animal a liquid by pouring or squirting the liquid into the mouth.

X. Quarantine--Isolating animals to prevent spread of disease

II. Importance of disease prevention

A. Disease costs producers money by lowering production and increasing costs

(Note: It has been estimated that livestock diseases in the United States cause losses of 3 to 6 billion dollars a year. A single major livestock disease such as brucellosis may cost Idaho producers 4 to 5 million dollars each year!)

B. Diseases are often difficult to diagnose

C. Many diseases cannot be cured

D. Disease problems restrict markets, particularly for breeding stock and dairy animals

E. Some livestock diseases can be passed on to man

III. Signs that indicate good health (Transparency 1)

A. Contentment

B. Alertness

C. Chewing of cud (ruminants)

D. Sleek coat

E. Bright eyes and pink eye membrane

F. Normal feces and urine

G. Normal temperature

H. Normal pulse rate

I. Normal respiration

IV. Signs of poor animal health

A. Loss of appetite

B. Rough hair coat

C. Abnormal feces

D. Dull eyes

E. High temperature

F. Discolored urine

G. Ruminants not chewing their cud

V. Causes of disease (Transparency 2)

A. Unbalanced diet or poisonous substances (in feed or otherwise)

B. Improper functioning of body parts

C. Physical disabilities

D. Tiny living things capable of causing disease

VI. Herd health program (Transparencies 3, 4)

A. Provide adequate nutrition

B. Maintain adequate livestock facilities; avoid overcrowding

C. Keep facilities clean and disinfected

D. Use proper immunizations

E. Develop procedure for parasite control

F. Isolate new or returning animals for 3 to 4 weeks before combining with herd

G. Rotate pastures

H. Keep animal stress to a minimum

(Note: This is especially important when moving and handling and at crucial times such as weaning and parturition.)

I. Control possible disease spread by visiting humans

(Note: This is particularly important for visitors coming from other livestock farms where a disease might exist. Some swine operations even require visitors to put on special clothing and face masks before entering the building.)

J. Work closely with veterinarian in developing <u>prevention</u> programs as well as treating diseases

K. Bring only clean animals into herd

L. Drain lots so that they will remain dry and free of stagnant water (paved lots are best)

M. Isolate all animals known to have contagious infections

N. Treat open wounds and navels of newborn calves with reliable disinfectant

O. Provide plenty of exercise for breeding herd

P. If cows calve in places other than clean pastures, be sure area is well-bedded and disinfected

Q. Provide plenty of clean, fresh water

VII. Maximum temperatures desirable for cattle (Transparency 5)

A. 95^{o}F at 0% humidity

B. 75^{o}F at 100% humidity

(Note: The maximum desirable temperature would increase from 75^{o}F to 95^{o}F in proportion to the decrease in humidity.)

VIII. Disinfectants

A. Lye

1. Mix as a 2% solution or 5% for anthrax spores

2. Effective against most bacteria and many viruses

3. Very caustic; will harm painted or varnished surfaces and aluminum

B. Lime

1. Scatter around lots or floors

2. Inexpensive

3. Dries skin and hooves of animals which may cause cracking

C. Soaps--Mainly aid in removal of dirt and manure

D. Iodine

1. Used for skin infections

2. Used on dairy utensils and equipment and for dipping teats

(Note: This type of iodine is an iodaphor or a tamed iodine.)

3. Very active in the presence of organic matter, but can be irritating to the skin

E. Chlorine

1. Effective against spores, bacteria, fungi and viruses

2. Combines readily with organic matter and must therefore be used in large amounts when used around abundant organic matter

F. Cresol

(Note: Cresol is often mixed with soap to make mixing with water easier. Lysol is one such product.)

1. Inexpensive

2. Should be used with hot water

3. Has strong odor that may be absorbed into milk; should not be used in dairies

G. Sodium orthophenylphenate

1. Effective against tuberculosis organisms

2. Can be used in dairies

3. Irritating to eyes and mucous membranes

H. Alcohol--Must be mixed with at least 30% water to be effective

I. Formaldehyde

1. Effective against viruses, bacteria, fungi and spores

2. Must be used at proper temperature (65^{o} F or greater) and humidity (60% or greater)

3. Building must be sealed for 8 hours and then allowed to air for 12 to 24 hours

IX. Sources of livestock immunity

A. Colostrum--Provides antibodies already developed by the mother

B. Serums or antitoxins made from blood of an immune animal--Provide antibodies developed by the immune animal

(Note: These can usually only be given to animals of the same species and the immunity only lasts about 10 days. However, some antitoxins, such as the one for rabies, can be given to different species.)

C. Exposure to the disease--Animal builds it own antibodies to combat the disease

(Note: Deliberately using this method is dangerous as it may well result in lost production and prevent eradication of the disease.)

D. Vaccine--Stimulates animal to develop antibodies against the disease

X. Types of vaccines

A. Bacterial

1. Killed

(Note: These are more correctly referred to as bacterins.)

Example: Blackleg vaccine

2. Live

Example: Brucellosis vaccine

B. Viral

(Note: Although killed vaccines are safer, they usually have to be given more often to maintain protection.)

1. Killed

Example: Vaccine for encephalomyelitis in horses

2. Live

Example: Vaccine for sore mouth in sheep

3. Modified live

(Note: This virus has been changed so that it is different from the original disease-causing virus, but will still cause the animal to develop the protecting antibodies.)

Example: Vaccine for IBR in cattle

XI. Care and use of vaccines

(Caution: Vaccines should only be used by people trained in their use. Consult a veterinarian for specific guidelines.)

A. Only vaccinate healthy animals

B. Vaccinate after immunity from the mother is gone

(Note: This is usually between 4 and 6 months.)

C. Read and follow all directions

D. Keep vaccines refrigerated

E. Do not use chemical disinfectants when using live vaccines--they will inactivate the vaccine

F. Keep records including serial number of vaccines

XII. Methods of giving oral medicines

A. Liquids

1. Drenching

2. Esophageal tube

(Note: This tube has a ball on the end that fits into the opening of the esophagus, but not the windpipe. This allows liquids to be poured directly into the esophagus without the animal having to swallow.)

B. Dry pills--Balling gun

XIII. Agencies responsible for enforcing livestock health regulations

(Note: Federal health officials often supply personnel and administer federal regulations for many of the major animal diseases, but they work within the state agencies.)

A. Bureau of Animal Health

(Note: This is under the Division of Animal Industries, State Department of Agriculture.)

B. Idaho Sheep Commission

XIV. General health regulations for livestock in Idaho

A. Animals being brought into the state

1. Infected animals may not be shipped into Idaho

2. Breeding and dairy cattle must have health certificate specifying freedom from infectious and contagious diseases

3. Slaughter cattle without health certificates must be taken directly to specified place of slaughter

B. Live and dead animals may not be shipped together

C. State may quarantine animals if they present a major threat to other livestock

XV. Garbage, except for private household wastes, may not be fed to swine

(Note: Garbage should generally be cooked to prevent spread of disease.)

XVI. Plants poisonous to livestock

A. Water hemlock

B. Death camas

C. Halogeton

D. Larkspur

E. Locoweed

F. Silky lupine

G. Velvet lupine

H. Silvery lupine

I. Tailcup lupine

J. Yellowstar thistle

Vital Signs Of Livestock

Species	Normal Temperature(°F)	Pulse Rate [1] Per Minute	Respiratory Rate Per Minute
Cattle	100.4 - 103.0	60 - 70	10 - 30 Beef 18 - 28 Dairy
Swine	101.0 - 104.0	60 - 80	8 - 18
Sheep	102.2 - 104.9	70 - 80	12 - 20
Horse	99.5 - 101.3	28 - 40	8 - 16
Foal	99.5 - 102.2	45 - 60 [2]	

[1] A REGULAR RHYTHM AND A STRONG PULSE IS ALSO IMPORTANT

[2] NEWBORN FOALS HAVE A HEARTBEAT OF 100 TIMES A MINUTE

Causes Of Disease

NUTRITIONAL DEFECTS—**result from unbalanced diets**

PHYSIOLOGICAL DEFECTS—**improper functioning of body parts**

MORPHOLOGICAL DEFECTS—**physical disabilities**

PATHOGENIC ORGANISMS— **tiny living things capable of causing disease**

VIRUSES- sub-microscopic organisms, not complete cells

BACTERIA- microscopic, one-celled, usually classified as plants

FUNGI- small heterotrophic plants, often found in the soil

PROTOZOA- microscopic, one-celled animals

Livestock Housing

- PROVIDE ADEQUATE SPACE FOR ALL ANIMALS
- PROVIDE ADEQUATE FRESH AIR AND CONTROL TEMPERATURE
- PROVIDE ADEQUATE DRAINAGE AND DRY, CLEAN QUARTERS
- ROTATE PASTURES
- USE DISINFECTANTS AS NEEDED

Handling Livestock

Use canvas slappers rather than clubs or whips

Eliminate protruding nails and broken boards

Remove machinery and equipment from the feedlot

Dehorn cattle

Use proper bedding in barns and trucks

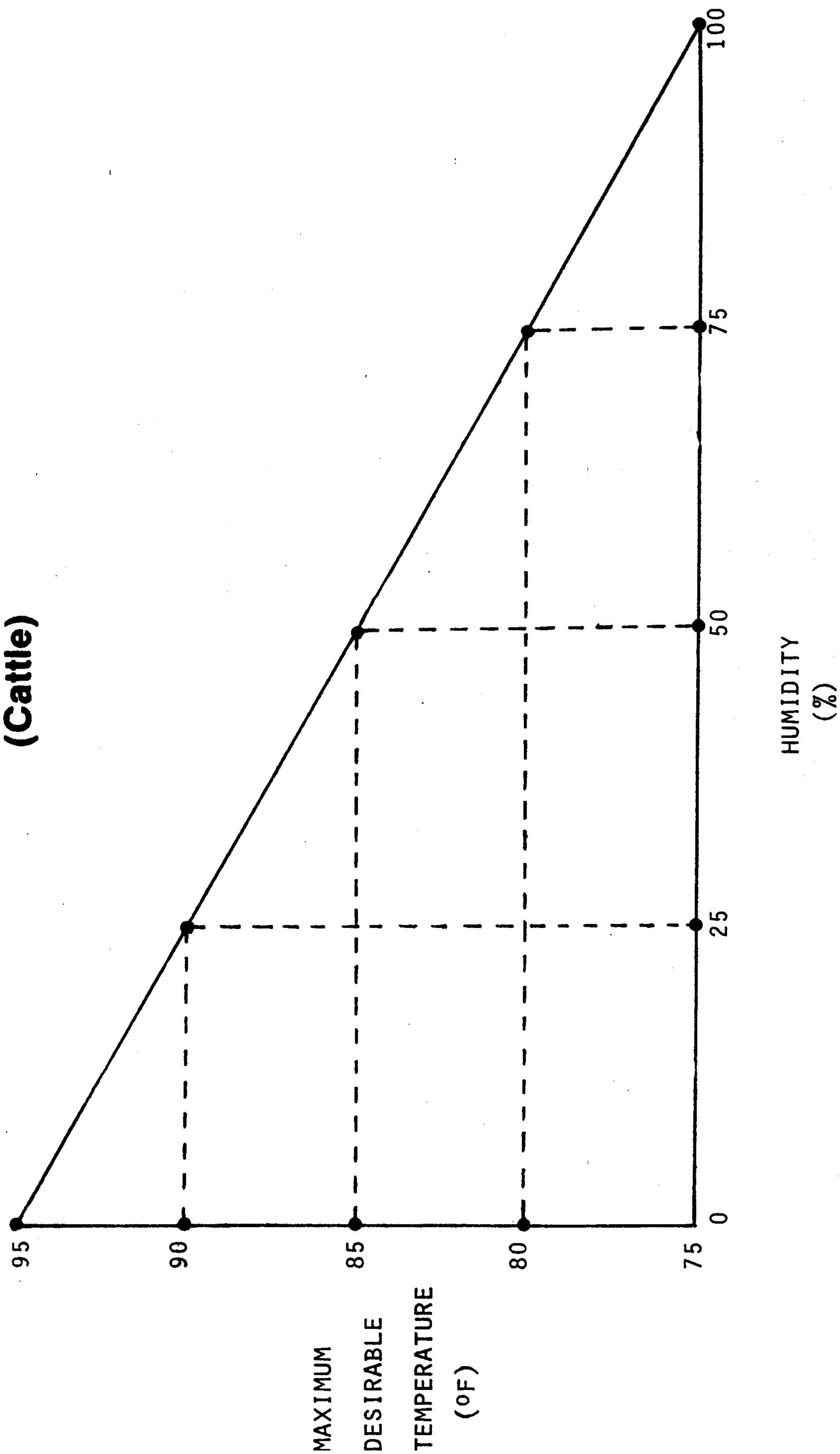
Load animals slowly and carefully

Load wisely - use partitions to separate classes of livestock

Protect livestock from weather

Relationship Between Maximum Desirable Temperature And Humidity

(Cattle)



ANIMAL HEALTH

AG 530 - J

ASSIGNMENT SHEET #1--DEVELOP A HERD HEALTH PLAN FOR A LIVESTOCK OPERATION

Name ______________________________ Score ______________________________

Using livestock in your supervised experience program, develop a plan for improving and maintaining animal health. If you do not have animals, use those on the home farm or use another local livestock operation you can get information on. Use health information presented in class and also use outside sources such as ranchers, veterinarians and livestock magazine articles.

ANIMAL HEALTH

AG 530 - J

LABORATORY EXERCISE #1--ADMINISTER ORAL MEDICINES TO CATTLE

Name ______________________________ Score ______________________________

I. Tools and equipment

A. Restraining chute for animal

B. Long-necked bottle or drenching gun

C. Balling gun

(Note: The procedures for giving liquids and giving a dry pill are included in this lab exercise.)

II. Procedure

A. Mix medicine with liquid or obtain a dry pill

B. Restrain animal in a way that will not interfere with movement of head and neck

C. Raise animal's head slightly; <u>do not raise the nose higher than the eyes</u>

D. Place gun or bottle into the mouth from the side and place on the top of the tongue towards the rear

E. Pour or squirt liquid into mouth allowing time for animal to swallow

F. For pills, place the end of the balling gun in the forepart of the esophagus and deposit pill; be careful not to deposit pill in windpipe

(Caution: This procedure can also be used with sheep, but extreme care needs to be taken when drenching to prevent choking.)

ANIMAL HEALTH

AG 530 - J

UNIT TEST

Name ______________________________ Score ______________________________

1. Match the terms on the right to their definition.

_____a.	Process of giving an animal immunity	
_____b.	Substance that kills bacterial or other microorganisms	
____c.	One-celled, plant-like organisms	
_____d.	Entry and development of a disease-causing organism causing harm to an animal's body	
_____e.	Any substance from living organisms	
_____f.	Organisms or viruses which produce an immunity in animals	
_____g.	Process of giving an animal a vaccine	
_____h.	Recognize and identify a disease	
_____i.	Giving an animal a liquid by pouring or squirting the liquid into the mouth	
_____j.	Act of giving birth	
_____k.	Plants that live only off of other dead or living organic matter	
_____l.	Tiny agent that causes disease; not even a complete cell membrane	
_____m.	One-celled animals	
_____n.	Manure expelled from the intestinal tract	
_____o.	Single cells from which some lower organisms reproduce	
_____p.	A ball of regurgitated food which ruminants chew and then reswallow	
_____q.	Organism that lives on or in a living animal	

1.	Antibody
2.	Immunity
3.	Protozoa
4.	Cud
5.	Virus
6.	Parasite
7.	Fungi
8.	Serum
9.	Feces
10.	Diagnose
11.	Bacteria
12.	Vaccine
13.	Humidity
14.	Drenching
15.	Mucous membrane
16.	Immunization
17.	Organic matter
18.	Contagious disease
19.	Quarantine
20.	Vaccinate

_____r.	Isolating animals to prevent spread of disease	21. Disinfectant
_____s.	Lining of body openings and digestive tract that secretes a watery substance	22. Spores
_____t.	Infectious disease that can be spread from one animal to another	23. Infection
_____u.	Extract of blood that contains antibodies	24. Parturition
_____v.	Substance produced by an animal to defend against a specific disease-causing agent	
_____w.	Amount of moisture in the air	
_____x.	The ability of an animal to resist or overcome an infection	

2. Describe five reasons for preventing diseases as compared to simply curing diseases.

   a. ____

   ____

   b. ____

   ____

   c. ____

   ____

   d. ____

   ____

   e. ____

   ____

3. List five signs indicating healthy livestock.

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

4. List five signs of poor livestock health.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

5. List the four general causes of disease.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

6. Describe an effective overall livestock health program. Include at least six points in the program.

   a. ______________________________
   ____

   b. ______________________________
   ____

   c. ______________________________
   ____

   d. ______________________________
   ____

   e. ______________________________
   ____

   f. ______________________________
   ____

7. Select the maximum temperatures desirable for cattle.

_____a. 65^{O}F at 80% humidity

_____b. 95^{O}F at 50% humidity

_____c. 75^{O}F at 100% humidity

_____d. 90^{O}F at 85% humidity

_____e. 95^{O}F at 0% humidity

8. Match the disinfectants on the right to their uses and limitations.
(Note: Disinfectants may be used more than once.)

_____a. Very caustic; will harm painted or varnished surfaces and aluminum

_____b. Must be used at proper temperature (65^{o} F or greater) and humidity (60% or greater)

_____c. Must be mixed with at least 30% water to be effective

_____d. Scatter around lots or floors; inexpensive

_____e. Combines readily with organic matter and must therefore be used in large amounts when used around abundant organic matter

_____f. Used for skin infections; very active in the presence of organic matter, but can be irritating to the skin

_____g. Should be used with hot water; has strong odor that may be absorbed into milk; should not be used in dairies

_____h. Used for dairy utensils and for dipping teats in the form of an iodaphor

_____i. Mainly aids in removal of dirt and manure

_____j. Mix as 2% solution or 5% for anthrax spores

_____k. Dries skin and hooves of animals which may cause cracking

_____l. Effective against tuberculosis organisms; can be used in dairies; irritating to eyes and mucous membranes

_____m. Effective against viruses, bacteria, fungi and spores; building must be sealed for 8 hours and than allowed to air for 12 to 24 hours

1. Lye
2. Cresol
3. Sodium orthophenylphenate
4. Lime
5. Chlorine
6. Formaldehyde
7. Iodine
8. Alcohol
9. Soap

9. Describe how immunity is supplied from each of the sources listed below.
   a. Colostrum

      ____

   b. Serums or antitoxins

      ____

   c. Exposure to the disease

      ____

   d. Vaccines

      ____

10. List the general types of vaccines.
    a. ____________________
    b. ____________________

11. Describe how vaccines should be cared for and used.
    a. ____________________
    b. ____________________
    c. ____________________
    d. ____________________
    e. ____________________
    f. ____________________

12. Name three methods of giving animals oral medicines.
    a. ____________________
    b. ____________________
    c. ____________________

13. Name the agencies responsible for enforcing livestock health regulations in Idaho.
    a. ____________________
    b. ____________________

14. Describe four general health regulations for livestock in Idaho.

    a. ______________________________

       ____

    b. ______________________________

       ____

    c. ______________________________

       ____

    d. ______________________________

       ____

15. Describe the regulation dealing with feeding garbage to swine.

    ____

    ____

    ____

16. List five plants that are poisonous to livestock.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

    e. ______________________________

ANIMAL HEALTH

AG 530 - J

ANSWERS TO TEST

1.
a.	16	g.	20	m.	3	s.	15
b.	21	h.	10	n.	9	t.	18
c.	11	i.	14	o.	22	u.	8
d.	23	j.	24	p.	4	v.	1
e.	17	k.	7	q.	6	w.	13
f.	12	l.	5	r.	19	x.	2

2. Diseases cost producers money by lowering production and increasing costs; Diseases are often difficult to diagnose; Many diseases cannot be cured; Disease problems restrict markets, particularly for breeding stock and dairy animals; Some livestock diseases can be passed on to man

3. Answer should include at least five of the following: Contentment; Alertness; Chewing of cud (ruminants); Sleek coat; Bright eyes and pink eye membrane; Normal feces and urine; Normal temperature; Normal pulse rate; Normal respiration

4. Answer should include at least five of the following: Loss of appetite; Rough hair coat; Abnormal feces; Dull eyes; High temperature; Discolored urine; Ruminants not chewing their cud

5. Unbalanced diet or poisonous substances; Improper functioning of body parts; Physical disabilities; Tiny living things capable of causing disease

6. Answer should include at least six of the following: Provide adequate nutrition; Maintain adequate livestock facilities, avoid overcrowding; Keep facilities clean and disinfected; Use proper immunizations; Develop procedure for parasite control; Isolate new or returning animals for 3 to 4 weeks before combining with herd; Rotate pastures; Keep animal stress to a minimum; Control possible disease spread by visiting humans; Work closely with veterinarian in developing prevention programs as well as treating diseases; Bring only clean animals into herds; Drain lots; Isolate all animals known to have contagious infections; Treat open wounds and navels of newborn calves with reliable disinfectant; Provide plenty of exercise for breeding herd; If cows calve in places other than clean pastures, be sure area is well-bedded and disinfected; Provide plenty of clean, fresh water

7. c, e

8.
a.	1	e.	5	i.	9	m.	6
b.	6	f.	7	j.	1		
c.	8	g.	2	k.	4		
d.	4	h.	7	l.	3		

9.
   a. Provides antibodies already developed by the mother
   b. Provides antibodies developed by the immune animal
   c. Animal builds its own antibodies to combat the disease
   d. Stimulate animal to develop antibodies against the disease

10. a. Bacterial--Live; Killed
    b. Viral--Live; Killed; Modified live

11. Only vaccinate healthy animals; Vaccinate after immunity from the mother is gone; Read and follow all directions; Keep vaccines refrigerated; Do not use chemical disinfectants when using live vaccines; Keep records including serial number of vaccine

12. Drenching; Esophageal tube; Balling gun

13. Bureau of Animal Health; Idaho Sheep Commission

14. Answer should include at least four of the following: Infected animals may not be shipped into Idaho; Breeding and dairy cattle must have health certificate specifying freedom from infectious and contagious diseases; Slaughter cattle without health certificates must be taken directly to specified place of slaughter; Live and dead animals may not be shipped together; State may quarantine animals if they present a major threat to other livestock

15. Garbage, except for private household wastes, may not be fed to swine

16. Answer should include five of the following: Water hemlock; Death camas; Halogeton; Larkspur; Locoweed; Silky lupine; Velvet lupine; Silvery lupine; Tailcup lupine; Yellowstar thistle

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

UNIT OBJECTIVE

After completion of this unit, students should be able to describe ways to control and treat various diseases and parasites. Students should also be able to diagnose some of the more basic livestock health problems. This knowledge will be demonstrated by the completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with livestock diseases and parasites to their definitions.
2. Name three ways diseases are diagnosed.
3. List five ways diseases and parasites are spread.
4. Match livestock diseases caused by poisoning to their characteristics, the animals they affect and the symptoms they cause.
5. Describe general measures for controlling internal and external parasites.
6. Distinguish between external and internal parasites.
7. Identify selected internal and external parasites when given a description of their life cycles.
8. Identify external parasites when given a drawing.
9. Complete a chart containing diseases, species affected, symptoms and treatment and control.
10. Complete a chart containing parasites, symptoms and treatment and control.
11. Diagnose various disease and parasite problems when given a description.

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

SUGGESTED ACTIVITIES

I. Suggested activities for the instructor

A. Make transparencies and necessary copies of materials.

B. Provide students with objectives and discuss.

C. Provide students with information and discuss.

D. Give students assignment sheets.

E. Have students prepare a panel discussion about various disease and parasite problems.

F. Have students choose one or two disease or parasite problems and write or give a report on them.

G. Arrange for students to view a necropsy.

H. Arrange a display of pictures of animals with various disease symptoms.

I. Have students develop skits representing various disease symptoms.

J. Develop a chart of the life cycles of parasites common to the area.

K. Write up an assignment sheet containing symptoms of diseases common to the local area.

L. Review and give test.

M. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Sugggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Horse Bot Fly

2. TM 2--Cattle Grub or Heel Fly

3. TM 3--Swine Intestinal Roundworm

4. TM 4--Liver Fluke

5. TM 5--Stomach Worm

6. TM 6--External Parasites

E. Assignment sheets

1. AS 1--Complete a Chart Containing Diseases, Species Affected, Symptoms and treatment and Control

2. AS 2--Complete a Chart Containing Parasites, Symptoms and Treatment and Control

3. AS 3--Diagnose Various Disease and Parasite Problems When Given a Description of the Problem

F. Answers to assignment sheets

G. Test

H. Answers to test

III. Unit references

A. Baker, James K. and Greer, William J., *Animal Health*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1980.

B. Barrick, R. Kirby, Harmon, Hobart L., *Animal Production and Management*. McGraw-Hill Book Company, 1988.

C. Berrier, Harry H., *Animal Sanitation and Disease Prevention*. Kendall/Hunt Publishing Co., Dubuque, Iowa, 1977.

D. Campbell, John R. and Lasley, John F., *The Science of Animals That Serve Mankind*. McGraw-Hill Book Company, New York, 1975.

E. *Cow-Calf Management Guide, Cattleman's Library*. University of Idaho Cooperative Extension Service, 1980.

F. Haynes, N. Bruce., *Keeping Livestock Healthy*. Garden Way Publishing, Charlotte, Vermont, 1978.

G. *Instructional Materials for Vocational Agriculture II*. Teaching Materials Center, Agricultural Education Department, Texas A & M University, College Station, Texas.

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

INFORMATION SHEET

I. Terms and definitions

A. Parasite--Organism living off another organism

B. Diagnosis--What someone has determined a disease to be

C. Life cycle--A complete pattern of normal changes an organism goes through

D. Necropsy--Examination of a dead animal to determine cause of death

(Note: This most often involves dissecting.)

E. Aborted fetus--Unborn young of a species that has been expelled or removed from the mother before full term

F. Fungus--Plant that lives only off of other dead or living organic matter

G. Convulsions--Violent, uncontrollable contractions of the muscles

H. Gangrene--Tissue decay caused by loss of blood to the tissue

I. Hemorrhage--Excessive bleeding

J. Drought--Lack of water

K. Bolus--Large pill

L. Mucous membrane--Lining of body openings and digestive tract that secretes a watery substance

M. Larva--Immature form of insects

N. Symptom--Outward expression of a disease

O. Placenta--Thin structure in the uterus from which a fetus gets its nourishment; it is expelled soon after birth

P. Conception--Uniting of the egg and sperm

Q. Infertility--Inability to reproduce

R. Inflammation--Condition of body tissue causing it to be hot, red and swollen

S. Dehydration--Loss of body fluids

T. Glucose--Type of simple sugar

U. Diarrhea--Condition of a runny, wet feces

V. Reactor animals--Animals that have a "positive" reaction to a test used to indicate the presence of a certain disease

W. Tumor--Abnormal growth of tissue

X. Cornea--Covering of the eyeball

Y. Constipation--Inability to expel feces

Z. Intravenously--By way of the veins

II. Ways diseases are diagnosed

A. Observation of symptoms

B. Laboratory tests of blood, animal wastes and animal tissue

C. Necropsy

III. Ways diseases and parasites are spread

A. Direct contact with infected animals or animal products

B. Contact with humans

(Note: This usually happens when humans have been working with infected animals and carry the infection on boots or clothing. Some diseases can be spread from humans that actually have the infection to livestock.)

C. Contact with livestock facilities and equipment that have contacted infected animals

D. Contact with dead livestock or an aborted fetus

E. Carried through the air or water

F. Insects

G. Infected wild animals

IV. Livestock poisoning

A. Ergot Poisoning

1. Fungus disease that attacks grain

2. Affects cattle, swine, sheep and poultry

3. Symptoms--Lameness in hind legs; nervousness; trembling and painfully contracting muscles; convulsions; gangrene in ears, tail and feet

4. Control--Avoid ergot infested grain; keep affected animals warm

B. Alfatoxin Poisoning

1. Product of fungus growing on stored grain

2. Affects cattle, swine and poultry

3. Symptoms--Reduced growth; decreased appetite; hemorrhaging

4. Control--Keep grains dry

C. Prussic Acid Poisoning (cyanide)

1. Formed on frost or drought-damaged Johnson grass or Sudan grass

2. Affects cattle

3. Symptoms--Staggered walking; difficult respiration; animals go down quickly

4. Treatment--Use nitrate boluses

D. Pine Needle Abortion

1. Affects cattle that eat Ponderosa Pine needles

2. Symptoms--Abortion or premature and weak calves

3. Control--Keep pregnant cattle away from Ponderosa Pine needles

E. Urea Poisoning

1. Caused by overfeeding urea in ration or by putting too much on pastures as fertilizer; also caused by resumption of feeding urea after a short interruption

   (Note: Cattle can digest up to 400 grams of urea a day, but must first become slowly adjusted to it. They can lose their tolerance in as little as 48 hours.)

2. Affects cattle, sheep

3. Symptoms--Staggering; trembling muscles; rapid pulse

4. Control--Introduce urea slowly into the ration; mix it in well with grain; use caution when introducing cattle to pastures fertilized with urea

F. Organophosphate Poisoning

1. Used as insecticides and are very toxic; can be absorbed through skin or taken in from eating sprayed plants; sometimes animals drink dip or spray

2. Affects cattle, sheep, swine, horses

3. Symptoms--Difficult breathing; excessive drooling; staggering; impaired vision

4. Control--Avoid pastures recently sprayed with organophosphates; use care when spraying or dipping cattle

V. Measures for controlling internal and external parasites

A. Internal

1. Practice pasture rotation

2. Check animals regularly

3. Treat animals showing signs of parasites

4. Practice proper lot sanitation

5. Drain wet pasture sites

6. Graze young animals on clean pastures

B. External

1. Keep manure cleaned from barnyards to prevent fly breeding

2. Spray livestock regularly

3. Spray livestock housing

4. Control grubs before they damage the hide

5. Spray new animals arriving on the farm

6. Check livestock frequently

VI. Internal and external parasites

A. Internal

1. Coccidia

2. Intestinal worm

3. Lungworm

4. Ascarid

5. Liver fluke

6. Stomach worm

7. Tapeworm

B. External

1. Blowfly

2. Horn fly

3. Screwworm fly

(Note: This fly has been nearly eradicated from the United States.)

4. Grub (heel fly)

(Note: Although the grub does migrate through the host, it is still considered an external parasite.)

5. Horsefly

6. Tick

7. Lice

8. Ringworm

9. Mite

10. Ked

VII. Life cycle of selected parasites (Transparencies 1, 2, 3, 4, 5)

A. Horse bot fly (Transparency 1)

1. Adult fly lays eggs on horse's hair

2. Larva enters mouth and attaches to stomach wall

3. Larva matures and is carried out with the feces

4. Adult fly emerges and lives only a few days

B. Cattle grub or heel fly (Transparency 2)

1. Adult fly lays eggs on heel

2. Larva enters body and migrates through connective tissue to the back of the animal

3. Larva drops to ground

4. Adult fly emerges

C. Swine intestinal roundworm (Transparency 3)

1. Egg eaten by swine

2. Egg hatches to worm

3. Adult worm in small intestine

4. Eggs are passed in feces

D. Liver fluke (Transparency 4)

(Note: This affects sheep and cattle.)

1. Adult lays eggs in bile ducts

2. Eggs pass in feces and must land in water

3. Larva finds a host snail and matures

4. Larva leaves snail and attaches to plant

5. Larva is eaten by animal

6. Young flukes then burrow into the liver

E. Stomach worms (Transparency 5)

(Note: These mainly affect cattle, sheep and horses.)

1. Adult lays eggs which pass in the feces

2. Larva hatches and is eaten

3. Adult attaches to stomach wall

VIII. External parasite identification (Transparency 6)

A. Mite

B. Lice

C. Tick

D. Horn fly

E. Barn fly

F. Heel fly

G. Screwworm fly

H. Ked

IX. Livestock diseases

(Note: The symptoms mentioned in the chart on pages 11-19 often vary with each individual situation. Contact a veterinarian when in doubt about a diagnosis.)

(Caution: The following treatments and controls are for general information only. They are deliberately vague when dealing with medicines and vaccines. Consult veterinarian before giving animals any kind of treatment.)

INFORMATION SHEET

DISEASE	SPECIES AFFECTED	SYMPTOMS	TREATMENT AND CONTROL
Brucellosis	Cattle, sheep, swine and man	Abortion; retained placenta; repeat breeders	Slaughter infected animals; purchase only vaccinated heifers; vaccinate heifer calves except in clean areas; remove aborted calves in plastic tubs or garbage cans
Leptospirosis	Cattle, sheep, swine, man	Abortion; loss of appetite; feverish; heavy breathing; bloody urine; calves may be born, but are weak and death may occur	Perform blood test; vaccinate all animals; isolate new animals
Vibriosis	Cattle	Low conception; temporary infertility; abortion	Vaccinate cows before breeding; Spread by bull --buy only non-infected animals
Vibriosis	Sheep	Abortion	Avoid fecal contamination of feed and water--feed in bunks; vaccinate ewes prior to breeding
Trichomon-iasis	Cattle	Abortion; low concep-tion; repeat breeding; inflammation of uterus	Sexual rest for cows for 3 months after abortion; market infected bulls
Blackleg and Malignant edema	Cattle; less frequently, sheep	Sudden sickness or death; high fever; lameness; swelling of muscles; with blackleg, gas bubbles are formed under skin which crackle when touched	Burn or bury carcass; vaccinate sheep 2-4 weeks before shearing, castrating, and docking; vaccinate all calves--if given before 4 months, revaccinate at 5-6 months

INFORMATION SHEET

DISEASE	SPECIES AFFECTED	SYMPTOMS	TREATMENT AND CONTROL
Anaplasmosis	Cattle; sheep to lesser extent	Animals become weak and lag behind the herd; skin becomes pale around eyes, on the muzzle, lips, and teats, and then turns yellow; difficulty in breathing; dehydration; constipation	Vaccinate all animals before insect and tick season; sterilize any instrument that contacts blood between each animal; control flies, ticks, and mosquitoes; test and separate infected and uninfected animals and treat infected animals with antibiotics
Foot rot	Cattle and sheep	Lameness; reddening and swelling of skin above hoof between toes	Move animal to dry quarters; clean pens and spread lime or lime with 10% copper sulfate on ground; trim inflamed foot and wash with warm soapy water; sulfa drugs and antibiotics are effective in treating
IBR (Red nose)	Cattle	Cough; loss of appetite; loss of weight; nasal discharge; rapid breathing; high fever; delayed breeding; abortion	Vaccinate
Ketosis	Cattle and Sheep	Cows: Loss of weight and appetite; decline in milk production Sheep: Weakness; frequent urination; trembles when exercised; death usually occurs in 90% of the cases	Glucose injection; feed well-balanced ration; add molasses to ration

INFORMATION SHEET

DISEASE	SPECIES AFFECTED	SYMPTOMS	TREATMENT AND CONTROL
Transmissible gastroenteritis (TGE)	Swine	Severe, watery diarrhea; vomiting; weakness; disease spreads rapidly	Wean infected pigs and move to warm, dry area--feed water and a prestarter; vaccination of sow is sometimes effective; practice good sanitation; move farrowing grounds; or change continuous farrowing to once every 3 months
Atrophic rhinitis	Swine	Starts with baby pigs; show signs of sneezing, snorting and nasal discharge; snout twisted or distorted	Select replacements from clean herd; slaughter infected animals; drugs in water; practice good sanitation; vaccinate piglets as well as sows
Cancer eye	Cattle	A small tumor on eyelid or eyeball; irritation around eye	Early diagnosis followed by surgery or freezing; slaughter
Pink eye (IBK)	Cattle and sheep	Watering and squinting of eyelid; severe reddening of membrane; discoloration of cornea	Isolate affected animals; use antibiotics for control; cover eye
Milk fever	Cattle, sheep, and swine	Occurs one to two days before or soon after giving birth; loss of appetite; constipation; nervousness; head usually turned back	Limit dry cow intake of calcium; severely limit nursing; treat with an injection of calcium boroglucose intravenously
Erysipelas	Swine	Purple patches under belly; stiff, swollen knees and hocks	Isolate all sick animals; clean and disinfect pens; vaccinate once or twice a year; use antibiotics for control

INFORMATION SHEET

DISEASE	SPECIES AFFECTED	SYMPTOMS	TREATMENT AND CONTROL
Swine influenza	Swine	Loss of appetite; become distressed, difficult breathing; discharge from eyes; cough is deep and loud; high fever for a few days	Provide warm, clean, well-ventilated quarters and ample supply of fresh water
Shipping fever	Cattle, sheep and swine	High fever; discharge from eyes; hacking cough; difficult breathing; sometimes swelling in neck region	Provide good feeding and management; vaccinate three weeks before stressing cattle
Pneumonia	Cattle, sheep and swine	High fever; coughing; quick, shallow breathing loss of appetite; crackling noise with breathing; discharge from nostrils	Isolate sick animals; practice good, sound management; use sulfa drugs and antibiotics
Warts	Cattle	Growths on skin varying from small to large, appearing around teats and head	Isolate cattle; clean and disinfect pens; vaccinate cattle to remove warts
Bloat	Cattle and sheep	Enlarged paunch noticeable on the left side	Feed dry hay before turning in to green, lush pasture; maintain pastures at not over 50% legumes; keep animals on feet and moving; place 3/4" rubber hose down throat and into rumen; administer defoaming agent; puncture rumen as a last resort
Laminitis (Founder)	Horses, cattle, and sheep	Extreme pain; high fever; dropping of hoof soles; turning up of toe walls	Avoid overfeeding of the animal; for horses, use anti-inflammation drugs along with a mild laxative; pack feet in ice

INFORMATION SHEET

DISEASE	SPECIES AFFECTED	SYMPTOMS	TREATMENT AND CONTROL
Grass tetany	Cattle and sheep	Excited behavior with erect ears and a wild stare; Uncoordinated movement; violent convulsions	Detect with blood test; feed magnesium supplements; use legume pastures
Bovine Virus Diarrhea (BVD)	Cattle	Fever; depression; excessive salivation; diarrhea; sores in mouth	Vaccinate cows and heifers 30 days before breeding; vaccinate additions to herd; vaccinate calves at 5-8 months
Redwater	Cattle	Sudden loss of appetite; shallow, labored breathing; rapid, weak pulse, fever; extreme weakness; dark red, clear, foamy urine, arched back	Prompt treatment with broad spectrum antibiotics or pen-icillin; limit control of animals to avoid exertion; vaccinate
Blue tongue	Cattle, sheep	Most animals show no visible signs; fever; excessive slobbering; crusty muzzle; ulcers in mouth; swollen, blue tongue	Diagnose with blood samples; vaccinate only if diagnosed in herd; close herd and control blood sucking insects
TEM (Brainers)	Cattle-weaner	Very rapid onset--often found dead or unable to rise; abnormal posture and gait; affects brain	High levels of antibiotics; two vaccinations with a 21 day interval in between
White muscle	Cattle, sheep	Difficulty walking; labored breathing; mostly affects new-borns; older animals --poor feed utilization; rough hair coat; retained placentas	Blood test for a deficiency; supplement selenium by inject-tion or in feed; improve forages

INFORMATION SHEET

DISEASE	SPECIES AFFECTED	SYMPTOMS	TREATMENT AND CONTROL
Emphysema	Cattle	Difficult breathing characterized by animals extending neck; breathing with mouth open and grunting when breathing out	Gradually introduce cattle to new pastures that contain abundant feed; feed buffers when cattle are first put on abundant feed
Scours (young animals)	Cattle, sheep, swine and horses	Diarrhea; weak or thin appearance	Reduce stress; provide balanced nutrition; keep livestock facilities clean and dry; feed water mixed with salt, baking soda and corn syrup; give antibiotics
Urinary Calculi	Cattle, sheep, swine and horses (primarily in castrated male ruminant)	Restlessness with vigorous tail switching; frequent glancing at abdominal area; attempts to urinate along with dribbling	Maintain a proper calcium-phosphorus ratio
Tetanus	Cattle, sheep (baby lambs), swine and horses	Muscle spasms; erect ears; stiff, elevated tail,	Keeping livestock areas free from injury causing objects; antibiotics, vaccinate
Enterotoxemia (Overeating disease)	Cattle, sheep	Abdominal pain--kicking at the stomach; grinding teeth and drawn- back head; convulsions	Vaccinate
Swine dysentery	Swine	Bloody diarrhea; partial loss of appetite; arched back	Medicate drinking water
MMA	Swine	Variable; reduction in milk production; irritability and restlessness	Injecting oxytocin; antibiotics

INFORMATION SHEET

DISEASE	SPECIES AFFECTED	SYMPTOMS	TREATMENT AND CONTROL
Porcine Stress Syndrome (PSS)	Swine	Extreme nervousness; skin splotches; death	Avoid breeding animals that exhibit extreme nervousness and skin splotches when excited; avoid stressful situations
Chlamydial Abortion	Sheep	Abortion	Isolate ewes that have aborted; contact veterinarian about possible antibiotics; vaccinate

X. Livestock parasites

A. EXTERNAL	SPECIES AFFECTED	SYMPTOMS	PREVENTIONS AND AND CONTROLS
Blowfly	Cattle, sheep and swine	Infected wounds; soiled hair or fleece; animals become weak and fevered	Use proper procedure for dead animals; use traps, poisoned baits, and repellents
Horn fly	Cattle	Cattle refuse to graze; seek protection by hiding in buildings, brush or tall grass	Remove manure from around barn; spray animals frequently from early May until frost
Screwworm fly	Cattle, sheep, and swine	Loss of appetite and poor condition	Branding, dehorning and castrating during winter months; keep property free of trash and report all cases to proper authority. Kill larva stage
Heel fly	Cattle	Grub (Larva) in back of cattle from December to May; swelling in backs of animals	Control flies between June and October; use systemic pesticide just after larvae enter body; use dust or spray when larvae are in back and start to emerge

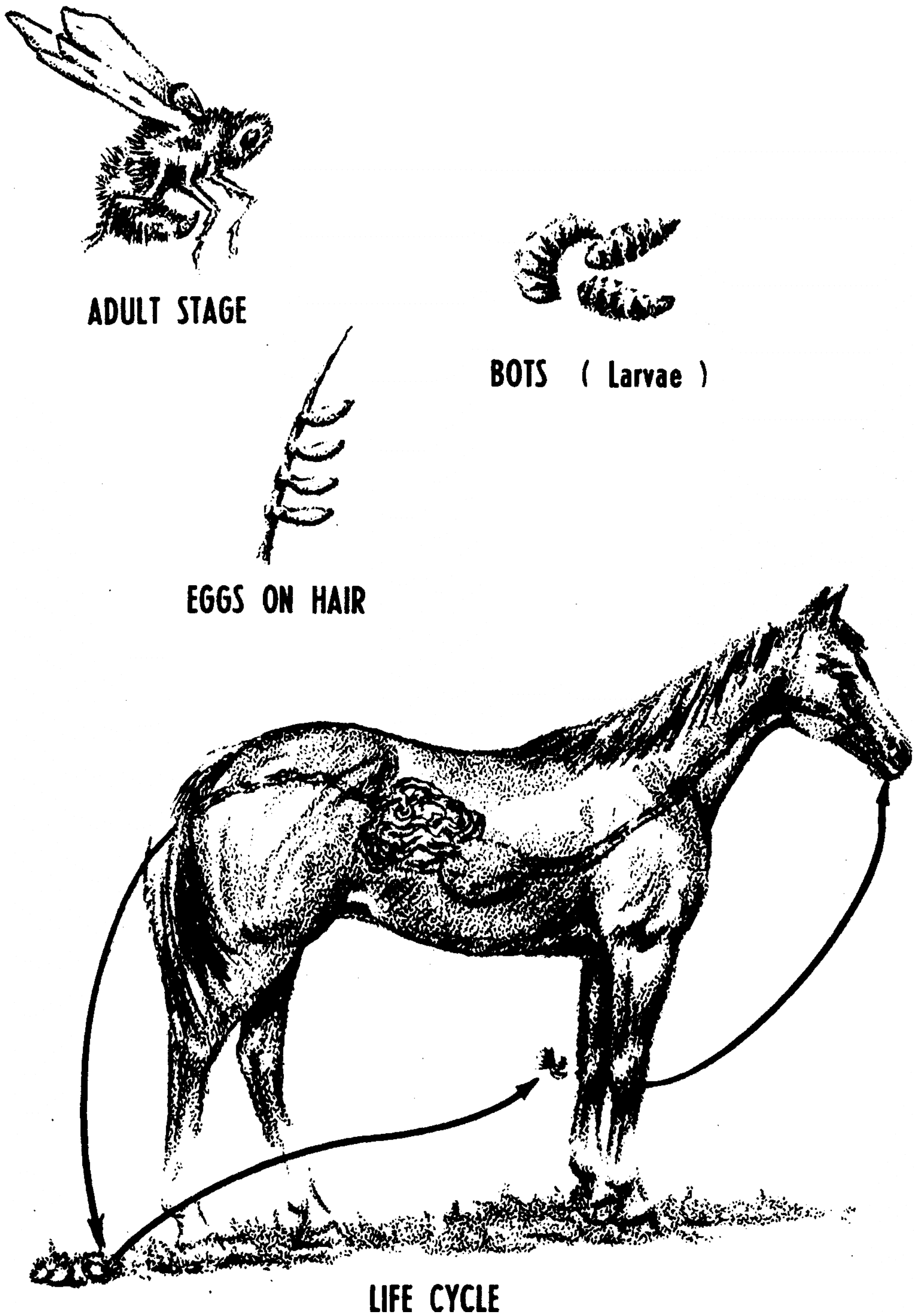
INFORMATION SHEET

A. EXTERNAL	SPECIES AFFECTED	SYMPTOMS	PREVENTIONS AND AND CONTROLS
Horsefly	Cattle and horses	Irritation, restlessness and loss of condition; causes anaplasmosis in cattle	Sprays are not very effective but frequent spraying from May until frost does help some; keep animals away from heavy brush
Tick	Cattle, sheep, and swine	May cause anaplasmosis weakness; weight loss; ears droop	Spray or dust frequently with tickcide
Lice	Cattle and sheep	Irritation, restlessness, and loss of condition; some lice cause animals to become anemic	Spray frequently from October until Spring
Ringworm	Cattle, sheep swine, and man	Round, scaly areas around ears and neck	Isolate affected animals, disinfect equipment, and practice strict sanitation; apply medication; fungicide
Mites and keds	Cattle, sheep, and swine	Skin irritated; itching and scratching	Spraying and dipping
B. INTERNAL	**SPECIES AFFECTED**	**SYMPTOMS**	**PREVENTIONS AND CONTROLS**
Coccidia	Cattle, sheep, and swine	Diarrhea, bloody feces, and weakness	Avoid contaminated feed and water, isolate affected animals, and keep feeders and waterers sanitary; consult veterinarian; use sulfa drugs
Intestinal worm	Cattle, sheep and swine	Loss of weight poor rate of gain anemia, and/or diarrhea	Rotate pastures, isolate calves and lambs from adult animals, and keep feeders and waterers sanitary

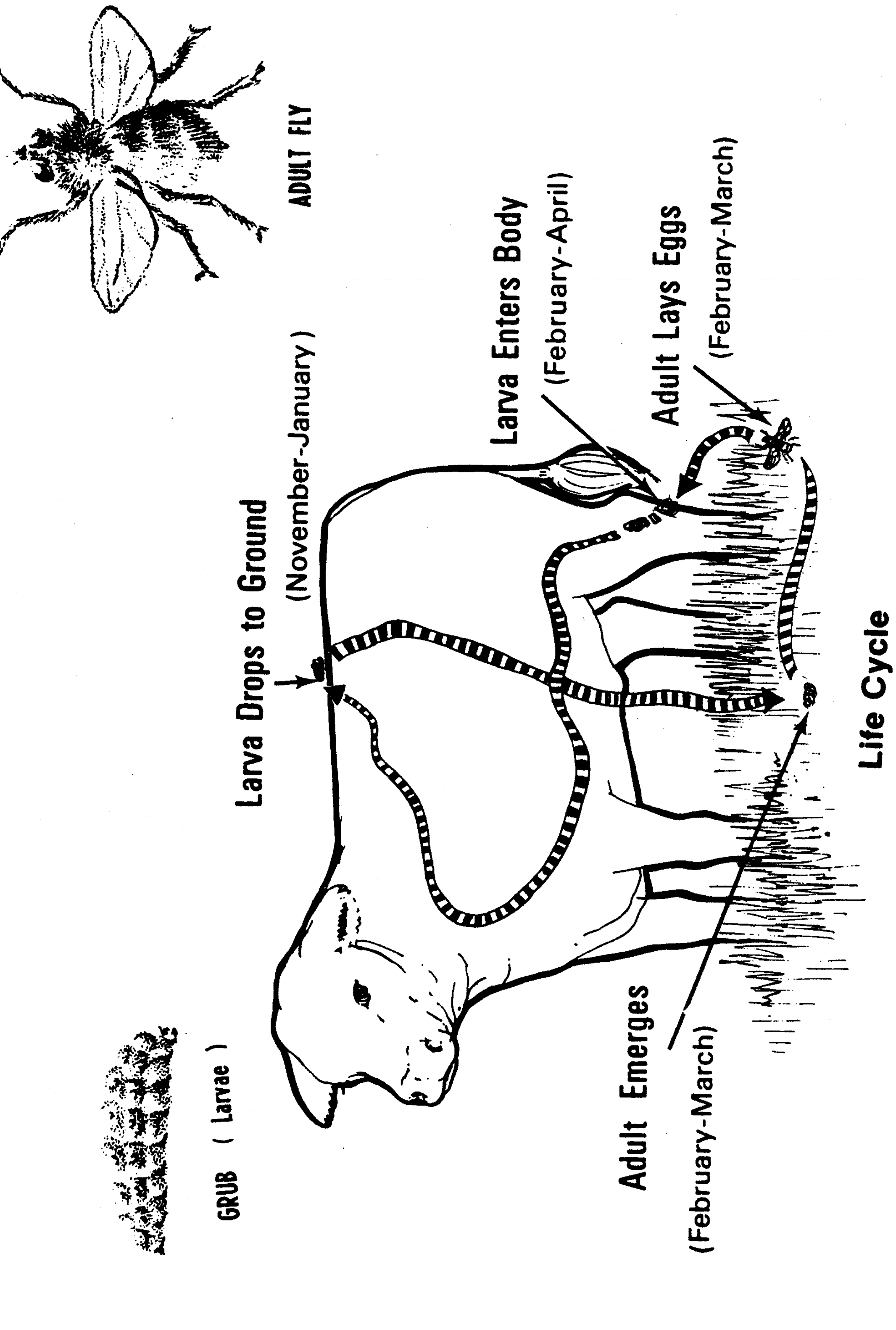
INFORMATION SHEET

B. INTERNAL	SPECIES AFFECTED	SYMPTOMS	PREVENTIONS AND CONTROLS
Lungworm	Cattle, sheep and swine	Coughing, labored breathing, and loss of appetite; young animals become stunted and unthrifty	Practice good sanitation; do not spread infested manure on pasture
Ascarid	Swine	Coughing and hard breathing; young pigs become unthrifty and stunted; liver damage	Clean farrowing quarters; wash sows before farrowing; place sows and pigs on clean pasture after farrowing; use a proper wormer.
Liver fluke	Cattle and sheep	Anemia, digestive disturbances, loss weight	Avoid wet pastures; use a flukicide
Stomach worm	Sheep	No specific symptoms	Pasture rotation
Tapeworm	Cattle, sheep and swine	No specific symptoms	Pasture rotation

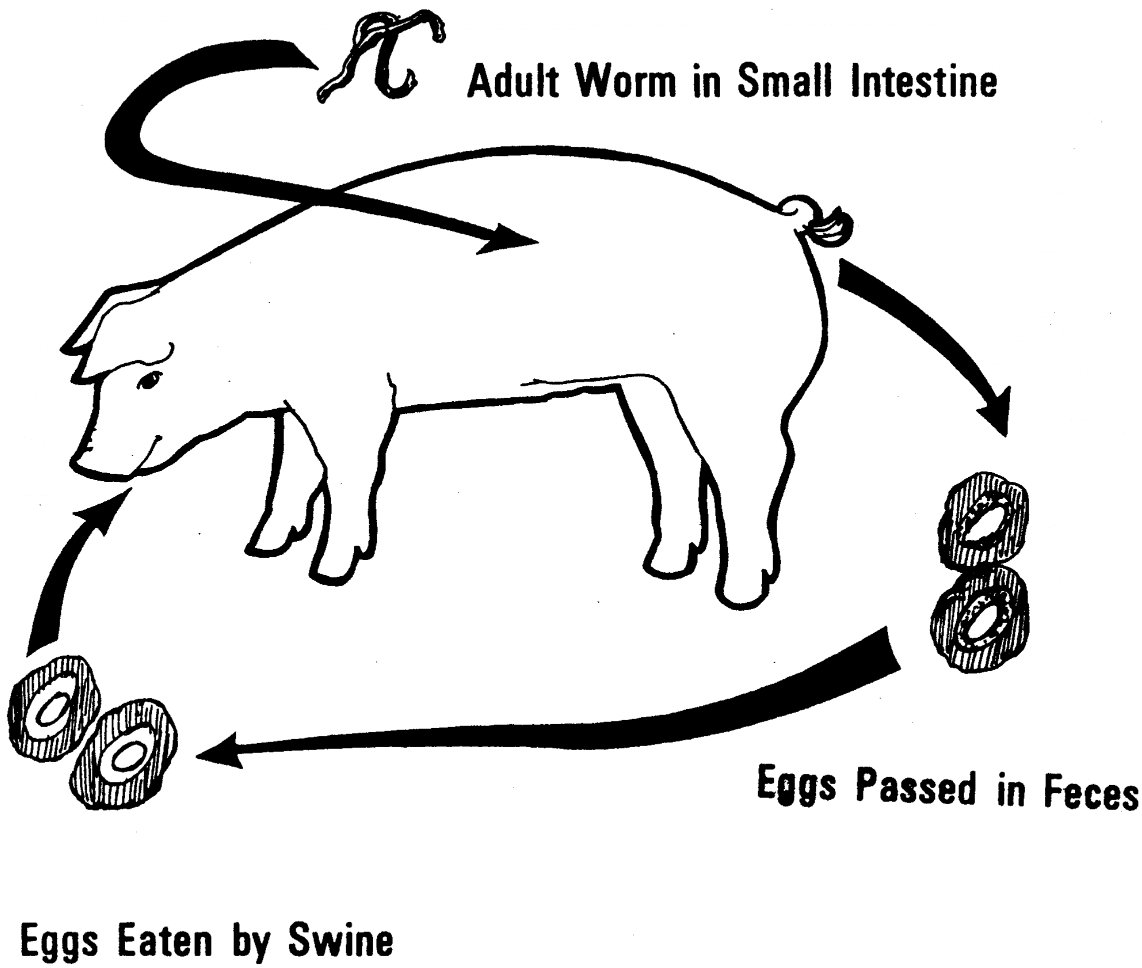
Horse Bot Fly



Cattle Grub Or Heel Fly

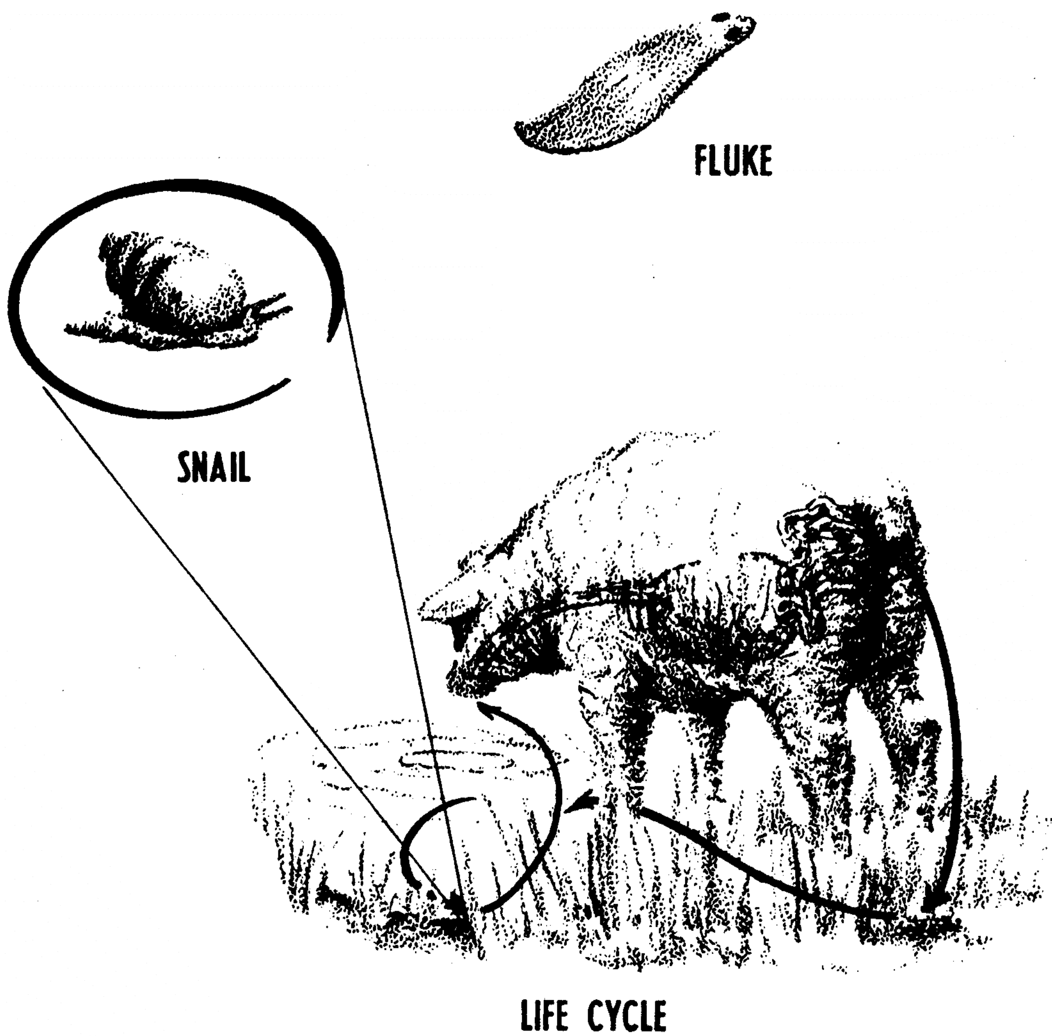


Swine Intestinal Roundworm

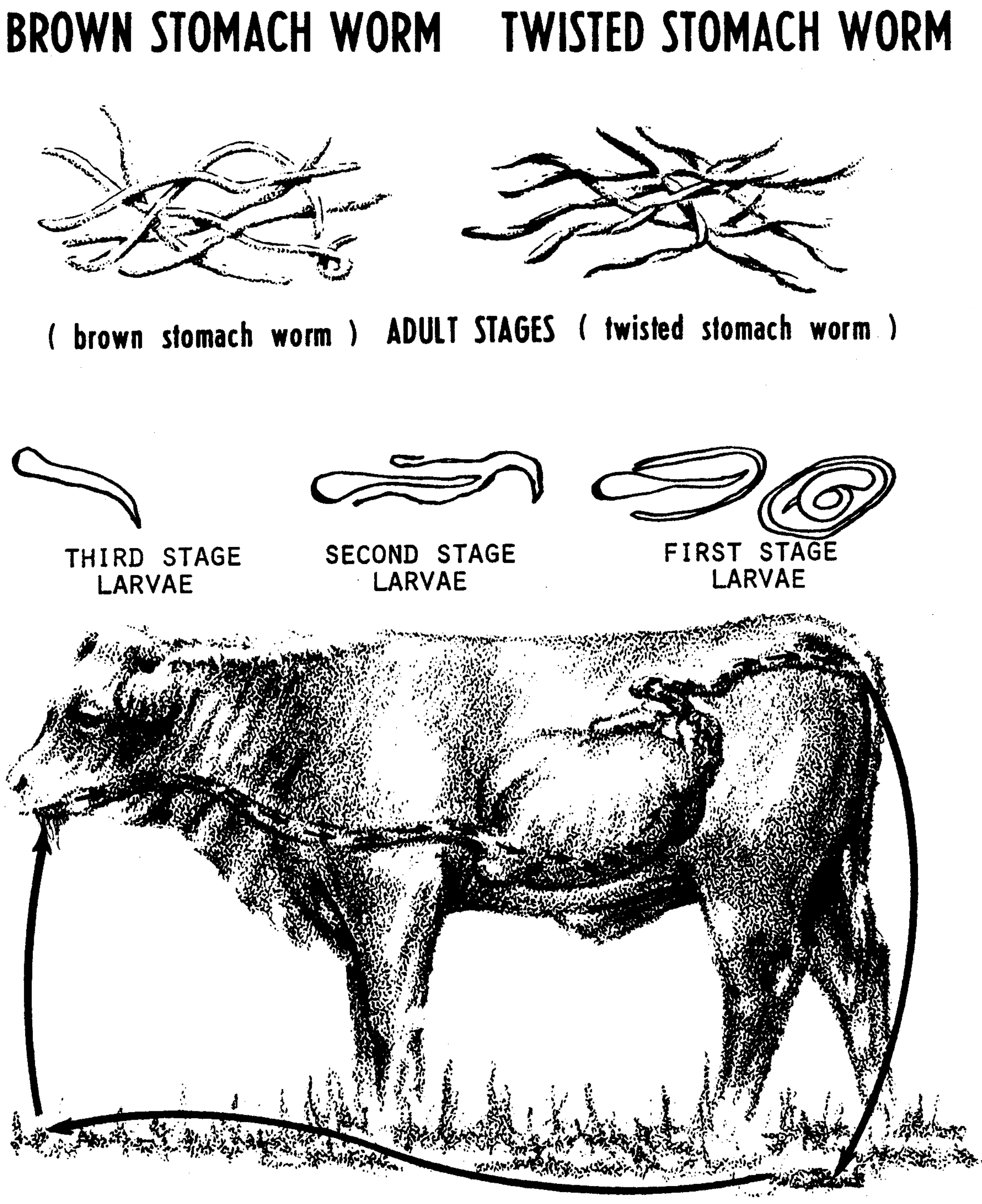


Life Cycle

Liver Fluke

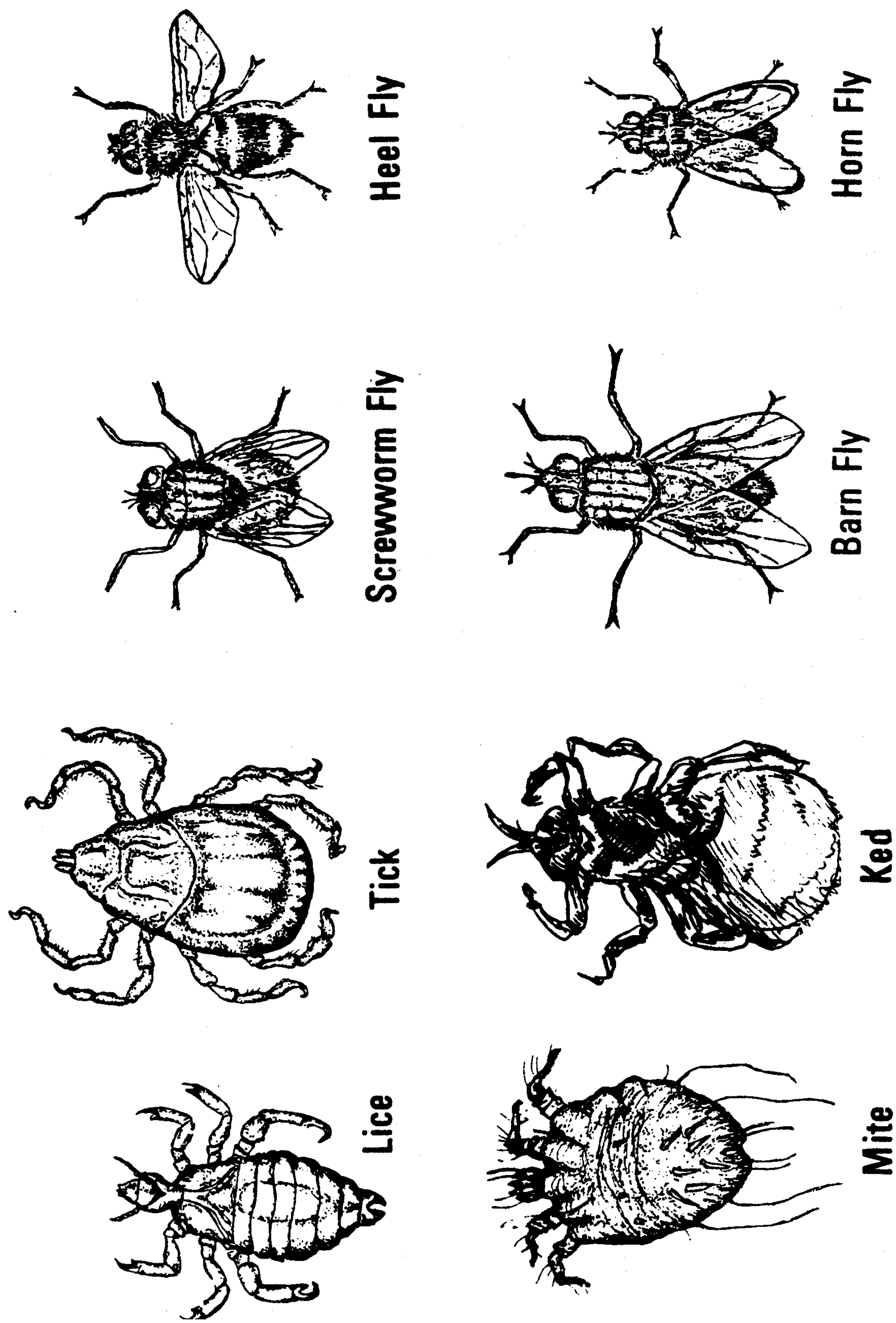


Stomach Worm



LIFE CYCLE

External Parasites



LIVESTOCK DISEASES AND PARASITES

AG 530 - K

ASSIGNMENT SHEET #1--COMPLETE A CHART CONTAINING PARASITES, SYMPTOMS AND TREATMENT AND CONTROL

Name ______________________ Score ______________________

Choose diseases most common in the local area and use them to fill in the chart below. Use information in the unit plus more specific information from a local veterinarian, extension agent, agriculture instructor and/or rancher.

Parasite and Species Affected	Symptoms	Prevention and Control

Parasite and Species Affected	Symptoms	Prevention and Control

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

ASSIGNMENT SHEET #2--COMPLETE A CHART CONTAINING PARASITES, SYMPTOMS AND TREATMENT AND CONTROL

Name ______________________ Score ______________________

Choose parasites most common in the local area and use them to fill in the chart below. Use information in the unit plus more specific information from a local veterinarian, extension agent, agriculture instructor and/or rancher.

Parasite and Species Affected	Symptoms	Prevention and Control

Parasite and Species Affected	Symptoms	Prevention and Control

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

ASSIGNMENT SHEET #3--DIAGNOSE VARIOUS DISEASE AND PARASITE PROBLEMS WHEN GIVEN A DESCRIPTION OF THE PROBLEM

Name ______________________ Score ______________________

Make a diagnosis of the problems described below.

1. Two of your beef animals have become very lame. You notice they have a high fever. After a while you also notice there is swelling over the hips and shoulder. The skin of the animal feels rather cold and crackles when you touch it.

   Diagnosis ______________________

2. You moved your cattle to a new range that has a few swampy areas. A few days later you notice an animal standing with an arched back and a pulled in abdomen. The animal is having a hard time breathing and appears very weak when it tries to move. It has a dark red, foamy urine.

   Diagnosis ______________________

3. You have just moved your cattle onto lush pastures. Soon you notice a couple of animals standing with an extended neck and making grunting sounds as they breath out.

   Diagnosis ______________________

4. One of your cows has just given birth and is not interested in eating. She is somewhat nervous and has her head turned back into her side.

   Diagnosis ______________________

5. Several of your newborn calves are having trouble breathing and act very stiff, especially in their hind quarters.

   Diagnosis ______________________

6. In the spring and summer you notice your cattle putting their tails in the air and running for the shade. A few months later you notice bumps start to form on their backs.

   Diagnosis ______________________

7. Your sheep have developed diarrhea. Some even have dark bloody feces. You have ruled out any disease.

   Diagnosis ______________________

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Answered to the satisfaction of the instructor.

Assignment Sheet #2

Answered to the satisfaction of the instructor.

Assignment Sheet #3

1. Blackleg
2. Red water
3. Emphysema
4. Milk fever
5. White muscle
6. Heel fly
7. Coccidia

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

UNIT TEST

Name ______________________________________ Score ___________________________________

1. Match the terms on the right to their correct definitions.

_____a.	Abnormal growth of tissue	1. Fungus
_____b.	Immature form of insects	2. Parasite
_____c.	Loss of body fluids	3. Cornea
_____d.	Condition of body tissue causing it to be hot, red and swollen	4. Tumor
_____e.	Examination of a dead animal to determine cause of death	5. Hemorrhage
_____f.	A complete pattern of normal changes an organism goes through	6. Convulsions
_____g.	Outward expression of a disease	7. Intravenously
_____h.	Lack of water	8. Constipation
_____i.	Type of simple sugar	9. Diagnosis
_____j.	Thin structure in the uterus from which a fetus gets its nourishment; it is expelled soon after birth	10. Mucous membrane
_____k.	By way of the veins	11. Infertility
_____l.	Inability to expel feces	12. Drought
_____m.	Plant that lives only off of other dead or living organic matter	13. Reactor animals
_____n.	Lining of body openings and digestive tract that secretes a watery substance	14. Aborted fetus
_____o.	Uniting of the egg and sperm	15. Diarrhea
_____p.	Violent, uncontrollable contractions of the muscles	16. Bolus
_____q.	Large pill	17. Placenta
_____r.	Condition of a runny, wet feces	18. Gangrene

_____s.	Unborn young of a species that has been expelled or removed from the mother before full term	19.	Dehydration
_____t.	Inability to reproduce	20.	Larva
_____u.	Tissue decay caused by loss of blood to the tissue	21.	Necropsy
_____v.	Covering of the eyeball	22.	Conception
_____w.	What someone has determined a disease to be	23.	Life cycle
_____x.	Organism living off another organism	24.	Symptom
_____y.	Excessive bleeding	25.	Inflammation
_____z.	Animals that have a "positive" reaction to a test used to indicate the presence of a certain disease	26.	Glucose

2. Name three ways diseases are diagnosed.

a.______________________________

b. ______________________________

c.______________________________

3. List five ways diseases and parasites are spread.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

e. ______________________________

____

4. Match the livestock diseases on the right to their characteristics and symptoms.

_____a.	Found on Ponderosa Pine ranges	1. Urea Poisoning
_____b.	Fungus disease causing lameness, nervousness and convulsions	2. Pine Needle Abortion
_____c.	Staggering; rapid pulse; trembling muscles; affects cattle and sheep	3. Prussic Acid Poisoning
_____d.	Fungus disease causing decreased appetite and hemorrhaging	4. Organophosphate Poisoning
_____e.	Staggering; difficult respiration; can be treated with nitrate boluses Poisoning	5. Alfatoxin
_____f.	Can be eaten or absorbed; causes difficult breathing; excessive drooling; impaired vision; caused when spraying or dipping cattle	6. Ergot Poisoning

5. Describe general measures for controlling internal and external parasites. Describe three under each category.

<u>External</u>

a.____

b. ____

c.____

<u>Internal</u>

a.____

b. ____

c.____

6. Distinguish between the internal and external parasites listed by placing an "In" by the internal parasites and an "Ex" by the external parasites.

_____a.	Lice	_____g.	Horsefly	_____m.	Intestinal worm
_____b.	Mite	_____h.	Blowfly	_____n.	Grub (Heel fly)
_____c.	Ascarid	_____i.	Ked	_____o.	Ringworm
_____d.	Tick	_____j.	Coccidia	_____p.	Stomach worm
_____e.	Tapeworm	_____k.	Lungworm	_____q.	Screwworm fly
_____f.	Liver fluke	_____l.	Horn fly		

7. Identify the correct internal and external parasites to the life cycles described below. Write the answer in the blank provided.

a. ______________________________

Life cycle: Adult fly lays eggs on heel; Larva enters body and migrates through connective tissue to the back of the animal; Larva drops to ground; Adult fly emerges

b. ______________________________

Life cycle: Egg eaten by swine; Egg hatches to worm; Adult worm in small intestine; Eggs are passed in feces

c. ______________________________

Life cycle: Adult lays eggs which pass in the feces; Larva hatches and is eaten; Adult attaches to stomach wall

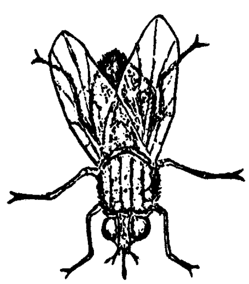
d. ______________________________

Life cycle: Adult fly lays eggs on horse's hair; Larva enters mouth and attaches to stomach wall; Larva matures and is carried out with the feces; Adult fly emerges and lives only a few days

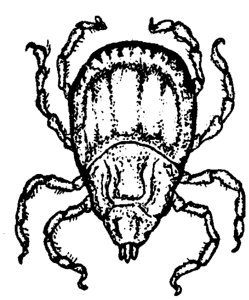
e. ______________________________

Life cycle: Adult lays eggs in bile ducts; Eggs pass in feces and must land in water; Larva finds a host snail and matures; Larva leaves snail and attaches to plant; Larva is eaten by animal; Young burrow into the liver

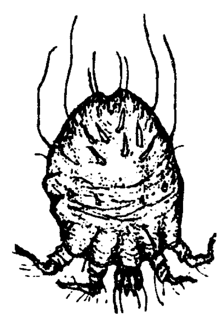
8. Identify the external parasites pictured below. Write the correct name in the blank provided.



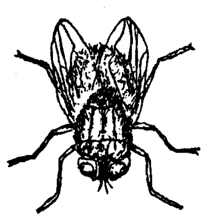
a. ____________________



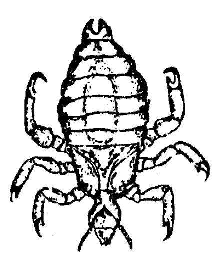
b. ____________________



c. ____________________

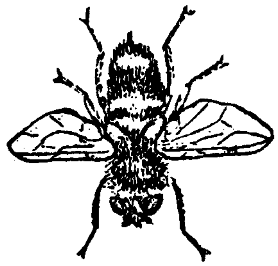


d. ____________________



e. ____________________

f. ____________________



g.________________________________ h.________________________________

LIVESTOCK DISEASES AND PARASITES

AG 530 - K

ANSWERS TO TEST

1.

a. 4	h. 12	o. 22	v. 3
b. 20	i. 26	p. 6	w. 9
c. 19	j. 17	q. 16	x. 2
d. 25	k. 7	r. 15	y. 5
e. 21	l. 8	s. 14	z. 13
f. 23	m. 1	t. 11	
g. 24	n. 10	u. 18	

2. Observation of symptoms; Laboratory tests of blood, animal wastes and animal tissue; Necropsy

3. Answer should include five of the following: Direct contact with infected animals or animal products; Contact with humans; Contact with livestock facilities and equipment that have contacted infected animals; Contact with dead livestock or an aborted fetus; Carried through the air or water; Insects; Infected wild animals

4.

a. 2	d. 5
b. 6	e. 3
c. 1	f. 4

5. Answer should include three of the following measures under each category:

External: Keep manure cleaned from barnyards to prevent fly breeding; Spray livestock regularly; Spray livestock housing; Control grubs before they damage the hide; Spray new animals arriving on the farm; Check livestock frequently

Internal: Practice pasture rotations; Check animals regularly; Treat animals showing signs of parasites; Practice proper lot sanitation; Drain wet pasture sites; Graze young animals on clean pastures

6.

a. Ex	f. In	k. In	p. In
b. Ex	g. Ex	l. Ex	q. Ex
c. In	h. Ex	m. In	
d. Ex	i. Ex	n. Ex	
e. In	j. In	o. Ex	

7.
- a. Cattle grub or heel fly
- b. Swine intestinal roundworm
- c. Stomach worms
- d. Horse bot fly
- e. Live fluke

8.

a. Barn fly	d. Screwworm fly	g. Heel fly
b. Tick	e. Lice	h. Ked
c. Mite	f. Horn fly	

ANIMAL PRODUCTS

AG 530 - L

UNIT OBJECTIVE

After completion of this unit, students should be able to describe the importance of proper nutrition for milk production and for the composition of milk. Students should also be able to discuss sources of animal protein and list animal sources for various vitamins. This knowledge will be demonstrated by completion of a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Explain the importance of proper nutrition in the laying hen as related to egg shell quality and yolk composition.
2. Describe the importance of proper nutrition for milk production.
3. Describe the importance of proper nutrition on the composition of milk.
4. Explain the effects of feed odors on animal product quality.
5. List the components and their percentages of lean muscle.
6. List seven factors that describe the value of animal fat in the human diet.
7. Distinguish between saturated and unsaturated fats.
8. List three animal products that are good sources of both calcium and phosphorus.
9. Discuss sources of animal protein, quality determination and why they are better than plant proteins.
10. List two animal products low in carbohydrates and two high in carbohydrates, and which contain lactose.
11. Indicate the only natural source for vitamin B_{12}.
12. List four animal product sources of vitamin A.
13. List three animal product sources of vitamin B.
14. List the animal product that is a good natural source for vitamin D.
15. Complete a chart to compare the nutritive content of beef sirloin steak and chicken breast in protein content, saturated fat, unsaturated fat, cholesterol and calories.
16. Discuss animal products in the American diet.

ANIMAL PRODUCTS

AG 530 - L

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Make transparencies and necessary copies of materials.

B. Provide students with objectives and discuss.

C. Provide students with information and discuss.

D. Invite a nutritionist in to talk about the value of animal products in the American diet.

E. Review and give test.

F. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Lean Muscle

2. TM 2--Value of Animal Fats in the Human Diet

3. TM 3--Comparing Nutritive Content of Beef Sirloin Steak and Chicken Breast

4. TM 4--Animal Products in the American Diet

E. Test

F. Answers to test

III. Unit references

A. Campbell, John R. and Lasley, John F., *The Science of Animals That Serve Mankind*. McGraw-Hill Book Company, New York, 1975.

B. Romans, John R.; Jones, Kevin W.; Costello, William J.; Carlson, C. Wendell; and Ziegler, P. Thomas., *The Meat We Eat*, 12th Edition, Interstate Printers and Publishers, Inc., Danville, Illinois, 1975.

ANIMAL PRODUCTS

AG 530 - L

INFORMATION SHEET

I. Effects of nutrition in egg production

   A. Sufficient quantities of proteins and lipids needed for yolk formation

   B. Sufficient calcium and phosphorus needed for egg shell quality

II. Nutrition and milk production

   A. Nutrient requirements must be met for high production

      1. Energy nutrients (60-70%)

      2. Crude protein (12-22%)

      3. Supplements (salt, calcium and phosphorus)

   B. Feed quantity should match each cow's level of production and stage of lactation

III. Nutrition and milk composition

   A. Cows on high concentrate and low forage rations often secrete milk with low fat content

   B. In the ruminant, acetate is the principle precursor of milk fatty acids and the high concentrate/low forage ration results in reduced production of acetate in the rumen

IV. Feed odors and animal product quality--Odors from feed consumed by the cow will be carried into her milk

   Example: If a cow eats wild onions in the pasture, her milk will be onion flavored

V. Components and percentages of lean muscle (Transparency 1)

   A. Protein 20%

   B. Water 72%

   C. Fat 7%

   D. Ash 1%

VI. Value of animal fats in the human diet (Transparency 2)

A. Highly digestible

B. Supply energy

C. Supply needed fatty acids

D. Carry the fat soluble vitamins

E. Protection and insulation for the human body

F. Adds palatability to the lean in meat (generates flavor and aroma)

G. Aids in calcium digestion

VII. Saturated fats and unsaturated fats

(Note: The chemical difference lies in the existence of double bonds between the carbon atoms in the fatty acids.)

A. Saturated fats

1. Carbon valance satisfied with hydrogen

2. Higher melting points

3. Hard

B. Unsaturated fats

1. Lacks a hydrogen to satisfy the carbon valance

2. Soft and oily

3. Lower melting points

4. Considered "better" in human diet (cholesterol)

VIII. Animal product sources of calcium and phosphorus

A. Calcium--Milk is the best

B. Phosphorus

1. Dairy products

2. Beef

3. Chicken

4. Lamb

5. Liver

6. Pork
7. Turkey

C. Calcium and phosphorus

1. Milk
2. Milk products
3. Fish

IX. Animal proteins

A. Excellent sources

1. Meat
2. Milk
3. Eggs

B. Quality determined by ability to support growth and maintenance

C. Superior to plant proteins--better balanced in essential amino acids

X. Carbohydrates in animal products

A. Poor sources

1. Meat
2. Eggs

B. Excellent sources

1. Honey--Contains more carbohydrates than any other animal product
2. Milk--Only substance in nature that contains the sugar lactose (37% in cow's milk)

XI. Vitamins supplied by animal products

A. Vitamin A

1. Cheese
2. Eggs
3. Milk
4. Some organ meats

B. B vitamins--meat

1. B_1--eggs, milk

2. B_2--eggs, milk

3. Animal products are the only natural source for vitamin B_{12}

C. Vitamin D--eggs (other products are fortified)

Example: Milk

XII. Nutritive content of meat (per 100 grams) (Transparency 3)

Meat	Protein	Saturated Fat	Unsaturated Fat	Cholesterol	Calories
Ground beef (10% fat)	27.2 g	7.1 g	17.3 g	94 mg	272
Beef sirloin steak	26.8 g	8.4 g	20.2 g	87 mg	297
Chicken breast	29.8 g	2.2 g	7.8 g	84 mg	197
Broiler drumstick	25.3 g	2.9 g	10.6 g	83 mg	195
Roasted duck	19.0 g	9.7 g	28.4 g	84 mg	337
Leg of lamb	26 g	6.6 g	15 g	92 mg	244
Lamb loin chop	27 g	9.1 g	20 g	97 mg	215
Pork ham	28.3 g	3.8 g	11.0 g	94 mg	220
Bacon (3 slices)	30.5 g	17.4 g	49.2 g	85 mg	576
Pork sausage	19.7 g	10.9 g	31.1 g	83 mg	369
Turkey	28.1 g	2.8 g	9.7 g	82 mg	208
Veal cutlet	27.1 g	4.8 g	11.1 g	101 mg	216

XIII. Animal products in the American diet (Transparency 4)

A. Provide 75% dietary protein, calcium, phosphorus and riboflavin

B. Provide 50% fat and niacin

C. Provide 40% iron, vitamin A and riboflavin

D. Provide 7% dietary carbohydrates

E. Provide 33% food energy

LEAN MUSCLE

20 % Protein

72 % Water

7 % Fat

1 % Ash

VALUE OF ANIMAL FATS IN THE HUMAN DIET

Highly digestible

Energy supply

Fatty acids supply

Carry fat soluble vitamins

Body protection and insulation

Palatability

Calcium digestion

COMPARING NUTRITIVE CONTENT OF BEEF SIRLOIN STEAK AND CHICKEN BREAST

	Beef Sirloin Steak	Chicken Breast
Protein	26.8 g	29.8 g
Saturated fat	8.4 g	2.2 g
Unsaturated fat	20.2 g	7.8 g
Cholesterol	87 mg	84 mg
Calories	297	197

ANIMAL PRODUCTS IN THE AMERICAN DIET

PROVIDE:

75 %........................ Protein

Calcium

Phosphorus

Riboflavin

50 %........................ Fat

Niacin

40 %........................ Iron

Vitamin A

Riboflavin

7 %........................ Carbohydrates

33%........................ Food energy

ANIMAL PRODUCTS

AG 530 - L

UNIT TEST

Name ________________________________ Score ________________________________

1. Explain the importance of proper nutrition in the laying hen as related to egg shell quality and yolk composition.

   a. ____

   ____

   b. ____

   ____

2. Describe the importance of proper nutrition for milk production.

   ____

   ____

   ____

   ____

3. Describe the importance of proper nutrition on the composition of milk.

   ____

   ____

   ____

   ____

4. Explain the effects of feed odors on animal product quality.

   ____

   ____

5. List the components and their percentages of lean muscle.

a.______________________________

b. ______________________________

c.______________________________

d. ______________________________

6. List seven factors that describe the value of animal fat in the human diet.

a.______________________________

b. ______________________________

c.______________________________

d. ______________________________

e.______________________________

f.______________________________

g. ______________________________

7. Distiguish between saturated and unsaturated fats by placing an "S" by the saturated fats and a "U" by the unsaturated fats.

_____a. Soft and oily

_____b. Higher melting points

_____c. Considered "better" in human diet

_____d. Lacks a hydrogen to satisfy the carbon valance

_____e. Carbon valance satisfied with hydrogen

_____f. Hard

_____g. Lower melting points

8. List three animal products that are good sources of both calcium and phosphorus.

a.______________________________

b. ______________________________

c.______________________________

9. List three sources of animal protein, and discuss quality determination and why they are better than plant proteins.

   a.______________________________

   b. ______________________________

   c.______________________________

10. List two animal products low in carbohydrates and two high in carbohydrates. Identify which is the only substance in nature that contains the sugar lactose.

    Low in carbohydrates: ____________________

    High in carbohydrates: ____________________

    Source of lactose: ____________________

11. List the only natural source for vitamin B12.

12. List four animal product sources of vitamin A.

    a.______________________________

    b. ______________________________

    c.______________________________

    d. ______________________________

13. List three animal product sources of vitamin B.

    a.______________________________

    b. ______________________________

    c.______________________________

14. List the animal product that is a good natural source for vitamin D.

15. Complete the following chart to compare the nutritive content of 100 grams of beef sirloin steak and 100 grams chicken breast in protein content, saturated fat, unsaturated fat, cholesterol and calories. Write the correct values in the blanks.

	Beef Sirloin Steak	Chicken Breast
Protein	26.8 g	________
Saturated fat	________	________
Unsaturated fat	________	7.8 g
Cholesterol	87 mg	________
Calories	________	________

16. Discuss animal products in the American diet.

____

____

____

____

____

ANIMAL PRODUCTS

AG 530 - L

ANSWERS TO TEST

1. Sufficient quantities of proteins and lipids needed for yolk formation; Sufficient calcium and phosphorus needed for egg shell quality

2. Answer should include the following information:

   a. Nutrient requirements must be met for high production: Energy nutrients (60-70%); Crude protein (12-22%); Supplements (salt, calcium and phosphorus)
   b. Feed quantity should match each cow's level of production and stage of lactation

3. Cows on high concentrate and low forage rations often secrete milk with low fat content; In the ruminant, acetate is the principle precursor of milk fatty acids and the high concentrate/low forage ration results in reduced production of acetate in the rumen

4. Odors from feed consumed by the cow will be carried into her milk

5. a. Protein--20%
   b. Water--72%
   c. Fat--7%
   d. Ash--1%

6. Highly digestible; Supply energy; Supply needed fatty acids; Carry the fat soluble vitamins; Protection and insulation for the human body; Adds palatability to the lean in meat; Aids in calcium digestion

7. a. U　　e. S
   b. S　　f. S
   c. U　　g. U
   d. U

8. Milk; Milk products; Fish

9. Sources: Meat; Milk; Eggs; Quality determined by ability to support growth and maintenance; Superior to plant proteins--Better balanced in essential amino acids

10. Low in carbohydrates: Meat; Eggs
    High in carbohydrates: Honey; Milk
    Sources of lactose: Milk

11. Animal products

12. Cheese; Eggs; Milk; Some organ meats

13. Meat; Eggs; Milk

14. Eggs

15.

	Beef Sirloin Steak	Chicken Breast
Protein	26.8 g	29.8 g
Saturated fat	8.4 g	2.2 g
Unsaturated fat	20.2 g	7.8 g
Cholesterol	87 mg	84 g
Calories	297	197

16. Answer should include the following information:

Provide 75% dietary protein, calcium, phosphorus and riboflavin; Provide 50% fat and niacin; Provide 40% iron, vitamin A and riboflavin; Provide 7% dietary carbohydrates; Provide 33% food energy

AG. 530 Zoology / Animal Science

M. Scientific Method Term Project

Based on: Idaho Science Content Guide and Framework. Grades 9 - 12.
Standard I. Habits of the Mind. Goal B. Values.

Goal. Investigate the risks and benefits of non-traditional livestock products.

Performance Objectives. All students will:

- Practice science that develops the value of scientific inquiry to the agricultural livestock industry.
- Exhibit critical skills in the development of information-gathering on new breeds and in the analysis of their usefulness.
- Demonstrate the ability to evaluate information on a breed's possibilities for the industry without bias.
- Exhibit curiosity about new breeds for the agricultural industry and demonstrate these attributes to peers.
- Exhibit perseverance by completing a new breed analysis specification sheet and informational brochure on raising the animal as assigned within the length of the term.

Progress Indicators. All students will:

- Research a new breed of livestock proposed or currently in use.
- Determine the various product possibilities from the new breed.
- Develop a specification sheet on the animal's functions and values for breeding and product sources.
- Develop a brochure on raising the animal, including:

    ⇒ Breeding information and reproduction
    ⇒ Nutritional and environmental needs
    ⇒ Health maintenance plan
    ⇒ Possible diseases and recommended treatments
    ⇒ Product information, including dry goods, if any
    ⇒ Comparisons to similar livestock products (advantages to this breed's products)

- Document the scientific methods of the study:

    ♦ **State the Problem.** Write a statement describing the problem you want to solve in researching a new breed. The problem may be written as a question.
    ♦ **Gather Information.** Identify the resources available to gather information about the new breed.
    ♦ **Form an Hypothesis.** Generate an educated guess or ideas of the results of the study based on the problem statement (propose an answer to your question or statement).

- **Collect the Data through Experimentation.**

    - ◊ Conduct research on a new breed, including breeding and reproduction information, nutritional and environmental requirements, health maintenance, and product viability through various sources (i.e., library, government agencies, Internet, et al).
    - ◊ Document the data collected in the form of a breed specifications sheet and record the sources of each set of information.

- **Analyze Data and Form a Conclusion.** Ascertain if the results agree with the hypothesis regarding the breed and its possibilities.
- **Report Results.** Develop the informational brochure as a document which could be disseminated to an interested public.
- **Propose a Theory.** Explain the results of the research. Relate the findings back to the problem statement and hypothesis, i.e. should this breed be used as a new product line and why.

SCIENTIFIC METHOD MATRIX

AG. 530 ZOOLOGY / ANIMAL SCIENCE

ACTIVITIES MEETING GOALS PER STANDARD

IDAHO K-12 SCIENCE CONTENT GUIDE AND FRAMEWORK

Standard I. Habits of the Mind	Goal A. Science Processes
Introduction to Animal Management	
Conduct a Community Survey on the Types of Livestock Raised in the Area	X
General Laboratory Procedure, Equipment and Report Writing	X
Using a Compound Microscope	X
The Organisms	
Outline the Classification of the Major Livestock Animals in the United States	X
Examining Cells from the Five Kingdoms	X
Classifying Organisms	X
Cell Structure	
What are the Cells?	X
Studying Cells Parts	X
Animal and Plant Cell Differences	X
Functions of the Cell	
Studying the Movement of Substances Across Membranes	X
Animal Organs and Systems	
Estimate Possible Gene Combinations Using the Checkerboard Procedure	X
Sex-Linked Traits	X
Predicting Inheritance	X
Influence of Chance on Inheritance	X
Genetics and Heredity	
Evaluate Semen Based on Color, Foreign Material, Wave Pattern, Motility and Abnormal Sperm	X
Identify Events from an Estrous Cycle Chart	X

Standard I. Habits of the Mind	Goal A. Science Processes
Breeding and Reproduction	
Compile Information on Livestock Nutrient Deficiencies in the Local Area	X
Convert Values from a Dry Matter Basis to an As-Fed Basis and Vice Versa	X
Animal Nutrition	
Balance a Ration for Protein Using the Pearson's Square Method	X
Balance a Ration Using the Trial-and-Error Method	X
Standard I. Habits of the Mind	**Goal B. Values**
Genetics and Heredity	
Pregnancy Test a Cow Using Rectal Examination	X
Inseminate Reproductive Tract Acquired from Slaughterhouse	X
Inseminate a Cow	X
Animal Health	
Develop a Herd Health Plan for a Livestock Operation	X
Administer Oral Medicines to Cattle	X
Animal Products	
Complete a Chart Containing Parasites, Symptoms, and Treatment and Control	X
Diagnose Various Disease and Parasite Problems when Given a Description of the Problem	X
Standard II. Science Themes	**Goal A. Change and Constancy**
Animal Organs and Systems	
Breeding Fruit Flies to Study Genetics	X
Standard II. Science Themes	**Goal B. Systems and Interactions**
Animal Tissues	
Nervous System	X
Respiratory System	X
Heart Structure	X
Animal Organs and Systems	
Mitosis and Meiosis	X

Standard II. Science Themes	Goal B. Systems and Interactions
Genetics and Heredity	
Placental and Fetal Development	X
Anatomy of the Female Reproductive Tract	X
Breeding and Reproduction	
Exploring the Pig Digestive System	X
Standard III. Nature of Science	**Goal B. History and Cultural Perspective**
Introduction to Animal Management	
Develop an Opinion on the Future of Livestock Production	X

AGRICULTURAL SCIENCE AND TECHNOLOGY CURRICULUM
SCIENTIFIC METHOD MATRIX

AG. 530 ZOOLOGY / ANIMAL SCIENCE

IDAHO K-12 SCIENCE CONTENT GUIDE AND FRAMEWORK

Key - X	Standard I. Habits of the Mind		Standard II. Science Themes			Standard III. Nature of Science	
Section / Activity	**Goal A. Science Processes**	**Goal B. Values**	**Goal A. Change and Constancy**	**Goal B. Systems and Interactions**	**Goal C. Models, Scale, and Structure**	**Goal A. Science and Technology in Society**	**Goal B. History and Cultural Perspective**
Introduction to Animal Management							
Develop an Opinion on the Future of Livestock Production							X
Conduct a Community Survey on the Types of Livestock Raised in the Area	X						
General Laboratory Procedures, Equipment and Report Writing	X						
Using a Compound Microscope	X						
The Organisms							
Outline the Classification of the Major Livestock Animals in the United States	X						

Key - X	Standard I. Habits of the Mind		Standard II. Science Themes			Standard III. Nature of Science	
Section / Activity	Goal A. Science Processes	Goal B. Values	Goal A. Change and Constancy	Goal B. Systems and Interactions	Goal C. Models, Scale, and Structure	Goal A. Science and Technology in Society	Goal B. History and Cultural Perspective
The Organisms							
Examining Cells from the Five Kingdoms	X						
Classifying Organisms	X						
Cell Structure							
What are Cells?	X						
Studying Cell Parts	X						
Animal and Plant Cell Differences	X						
Functions of the Cell							
Studying the Movement of Substances Across Membranes	X						
Animal Tissues							
Nervous System				X			
Respiratory System				X			
Heart Structure				X			
Animal Organs and Systems							
Estimate Possible Gene Combinations Using the Checkerboard Procedure	X						
Mitosis and Meiosis				X			

Key - X	Standard I. Habits of the Mind		Standard II. Science Themes			Standard III. Nature of Science	
Section / Activity	**Goal A. Science Processes**	**Goal B. Values**	**Goal A. Change and Constancy**	**Goal B. Systems and Interactions**	**Goal C. Models, Scale, and Structure**	**Goal A. Science and Technology in Society**	**Goal B. History and Cultural Perspective**
Animal Organs and Systems							
Sex-Linked Traits	X						
Predicting Inheritance	X						
Influence of Chance on Inheritance	X						
Breeding Fruit Flies to Study Genetics			X				
Genetics and Heredity							
Evaluate Semen Based on Color, Foreign Material, Wave Pattern, Motility and Abnormal Sperm	X						
Identify Events from an Estrous Cycle Chart	X						
Pregnancy Test a Cow Using Rectal Examination		X					
Inseminate Reproductive Tract Acquired from Slaughterhouse		X					
Inseminate a Cow		X					

Key - 4	**Standard I. Habits of the Mind**		**Standard II. Science Themes**			**Standard III. Nature of Science**	
Section / Activity	**Goal A. Science Processes**	**Goal B. Values**	**Goal A. Change and Constancy**	**Goal B. Systems and Interactions**	**Goal C. Models, Scale, and Structure**	**Goal A. Science and Technology in Society**	**Goal B. History and Cultural Perspective**
Genetics and Heredity							
Placental and Fetal Development				X			
Anatomy of the Female Reproductive Tract				X			
Breeding and Reproduction							
Compile Information on Livestock Nutrient Deficiencies in the Local Area	X						
Exploring the Pig Digestive System				X			
Convert Values from a Dry Matter Basis to an As-Fed Basis and Vice Versa	X						
Animal Nutrition							
Balance a Ration for Protein Using the Pearson's Square Method	X						
Balance a Ration Using the Trial-and-Error Method	X						

Key - X	Standard I. Habits of the Mind		Standard II. Science Themes			Standard III. Nature of Science	
Section / Activity	**Goal A. Science Processes**	**Goal B. Values**	**Goal A. Change and Constancy**	**Goal B. Systems and Interactions**	**Goal C. Models, Scale, and Structure**	**Goal A. Science and Technology in Society**	**Goal B. History and Cultural Perspective**
Animal Health							
Develop a Herd Health Plan for a Livestock Operation		X					
Administer Oral Medicines to Cattle		X					
Animal Products							
Complete a Chart Containing Parasites, Symptoms, and Treatment and Control		X					
Diagnose Various Disease and Parasite Problems when Given a Description of the Problem		X					