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ANIMAL NUTRITION. PROGRAMMED INSTRUCTION UNITS, ANIMAL NUTRITION, FEED CHARACTERISTICS, VITAMINS, MINERALS. FINAL REPORT NUMBER 12.

BY- LONG, GILBERT A.
WASHINGTON STATE UNIV., PULLMAN

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PRINCIPLES AND FACTS NECESSARY FOR EFFECTIVE ANIMAL NUTRITION PRACTICES WERE IDENTIFIED BY EXAMINATION OF RECENT SCIENTIFIC REPORTS. UTILIZING THIS INFORMATION, THE AUTHOR INVOLVED 16 VOCATIONAL AGRICULTURE TEACHERS IN THE DEVELOPMENT AND EXPERIMENTAL USE OF A UNIT OF PROGRAMED LEARNING MATERIALS. INSTRUCTIONAL RESULTS WERE NOT AVAILABLE AT THE TIME OF REPORTING. THERE WAS SUBSTANTIAL EVIDENCE, HOWEVER, THAT TEACHER INVOLVEMENT ACTIVATED THE ANALYTICAL ASSESSMENT OF OBJECTIVES AND INTEREST IN INNOVATIVE INSTRUCTION. THIS VOLUME REPRESENTS PART 12 OF THE 13-PART FINAL REPORT ON THE VOCATIONAL-TECHNICAL EDUCATION RESEARCH AND DEVELOPMENT PROJECT OF WASHINGTON STATE UNIVERSITY. RELATED VOLUMES ARE ED 010 652 THROUGH ED 010 664. (TC)

FINAL REPORT
Project No. ERD-~~267-05~~ 5-0046
Contract No. OE-5-85-109

Report No. 12

ANIMAL NUTRITION

Programmed Instruction Units
Animal Nutrition
Feed Characteristics
Vitamins
Minerals

December 1966

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

ANIMAL NUTRITION

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The research reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Department of Education, Washington State University, Pullman, Washington
Washington State Board for Vocational Education, Olympia, Washington
Vocational Education Research Coordinating Unit, Olympia, Washington

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INTRODUCTION

Background and Rationale

In the United States, population growth creates an increasing need for meat. While the market for meat grows larger, meat production becomes more technical and competitive. Effective meat production and the incomes of producers depend largely on effective use of up-to-date facts about the nature and use of nutrients.

Research continually provides new facts about better ways of feeding meat animals. Wide-spread use of that information can help the nation maintain adequate meat supplies and help producers earn adequate incomes. Agricultural teachers have an obligation to help youth and adults acquire and use that information.

Purposes and Objectives

For the above reasons this phase of Project ERD-257-65 work has a two-fold objective. The first is to develop four experimental units of programmed materials that will help youth and adults acquire and use knowledge about elements of animal nutrition, feed characteristics, the functions of minerals, and the functions of vitamins. The related objective is to stimulate experimental use of the materials by involving teachers in their development and in experimental use.

These programmed materials are conceived as components of more complete instructional systems that will include reading materials, films, graphics, models, and feeding experiments.

These units are designed to familiarize students with the following animal nutrition principles, facts, and procedures:

Animal Nutrition Unit

Chemical composition of plants and animals.

Nutritional requirements for maintenance, growth, fattening, production, and reproduction.

Chemical composition of carbohydrates.

Feeds that supply carbohydrates.

Importance of proteins.

Amino acids.

Protein concentrates.

Importance of fats as an energy feed.

Function of minerals.

Function of vitamins.

Basic concept of a feed ration.

Basic concept of a balanced ration.

Importance of nutrition to fertility.

Feeding "rules of thumb."

Economics of feed substitutions.

The Pearson Square Method of finding proportions for feed mixes that furnish desired per cents of protein.

Feed Characteristics Unit

Classification of feeds:

total digestible nutrients

net energy

concentrates

protein supplements (animal and plant)

roughages

legumes and non-legumes forage quality

Energy value.

Maintenance-feed and production-feed requirements.

Forage testing.

Minerals Unit

Importance of minerals.

Required minerals.

Body functions of minerals.

Mineral nutrition essentials.

Mineral deficiency symptoms.

Major or minor mineral classifications.

Mineral information tables.

Salt deficiency symptoms.

Major and minor element deficiencies.

Mineral content of common feeds.

Vitamins Unit

Importance of vitamins.

Nature of vitamins.

Essential vitamins.

Means of providing vitamins.

Anti-vitamins.

Vitamin deficiency symptoms.

Commonly deficient vitamins.

Vitamins and reproduction.

Related Research

The methodology of teaching through programmed instruction is based upon the principles of stimulus-response psychology. Skinner (9) has researched and written extensively in this area. Smith and Moore (10) have compiled numerous papers which describe much of the leading research in programmed learning.

One valuable feature of programmed instruction is its definition of objectives in behavioral terms. Mager (7) has deliniated the advantages of this technique. Schramm (8), Glazer (6), and others have found that programmed learning materials serve to individualize instruction. They point out that programmed instruction (a) can enlarge opportunity pacing, (b) increase the frequency of meaningful student responses, and (c) facilitate student feedback.

Although programmed instruction may stand alone, it also can be an integral part of instructional systems. DeCecco (5)

has compiled research which helps define the unique contribution programmed instruction can make to instructional systems.

Whiteman's (1) study of major subject matter development needs emphasizes the need for up-to-date instructional materials in dairy animal nutrition. Animal nutrition is one of the major instructional needs noted in Nielsen's (2) analysis of emerging needs. Nielson (3) reiterates that need in a statement of agricultural education research and development opportunities and needs.

A study by Menzel and Katz (13) indicates the extent to which in medicine professional leaders influence adoption of innovations.

Studies by Lewin and Sherif indicate the importance of involving participants in discussion of innovations to be adopted (12).

Christiansen's (11) report to the National Seminar on Agricultural Education regarding adoption of educational innovations by Ohio teachers, found that "the more innovative the experienced teacher was, the greater the degree of opinion leadership which she was likely to hold."

The relationship of animal and plant nutrition knowledge to agriculturally related or off-farm occupations has been highlighted by a report of the Ohio State Center for Research (7).

The sixteen agricultural teachers involved in development of these materials and presently assisting with their experimental use represent educational leaders. It is assumed that their participation will speed adoption.

METHOD

Content of these programmed units was derived from analysis of facts presented in publications listed as items 14 to 20 in the Reference section of this report.

Pre-test and post-test evaluation instruments were designed.

The units were pilot tested in eight schools. Students' responses were analyzed and the materials were revised to clarify some wording. They are presently being further tested in experimental situations in sixteen schools. Teachers using the materials were oriented to the use of programmed materials and helped

design experimental plans at a 1966 summer workshop conducted as part of the annual Washington Vocational Agriculture Teachers' Conference.

Each experimental teacher sends evaluations of results to the Project Coordinator along with pre-test and post-test results. This data will be analyzed and used to further revise the programmed units.

RESULTS

The experimental units of programmed instructional materials are reproduced in Appendix A.

DISCUSSION

Development and use of program learning devices are still in experimental stages. The author is aware that immediate response to verbal symbols constitutes only one dimension of learning. He views the programmed materials reported here as experimental and as only one component of more adequate instructional systems.

However, as previously noted, involvement of Vocational Agriculture teachers in this project has stimulated substantial amounts of analytical work and interest in experimentation. Both the author and the teachers involved in the project were required to reassess cognitive and behavioral objectives. They also made a fresh appraisal of just what knowledges are most essential for effective animal nutrition practices.

Of equal importance, this effort has aroused interest in development of programmed materials in other areas and in development of more comprehensive systems of instruction.

CONCLUSIONS

Evidence of the instructional values of these programmed materials is not yet available. However, evidence derived from observation of the thought and energy expended by cooperating teachers indicates that involvement in this type of developmental and experimental enterprise evokes substantial amounts of teacher

interest in analytical assessment of objectives and procedures. That evidence implies that continuation and expansion of similar effort is likely to speed development of modernized curricula and more effective instructional materials.

Consequently, we recommend that such effort be expanded and that such work be conceived and pursued as a possible starting point for development of comprehensive instructional systems.

SUMMARY

Principles and facts requisite for effective animal nutrition practices were identified by examination of recent scientific reports. Utilizing that information, the author involved sixteen Vocational Agriculture teachers in development and experimental use of this unit of programmed learning materials. The teachers are presently (1966-67) engaged in experimental use of the materials. Evidence of instructional results is not yet available. There is substantial evidence that teacher involvement has activated analytical assessment of objectives and interest in innovative instruction.

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APPENDIX A

NUTRITION

Note to Teachers

This is a programmed instruction unit titled "Animal Nutrition." This program is designed to introduce high school vocational agriculture students to a study of "Livestock Nutrition." This unit should be followed by "Feed Characteristics," "Vitamins," and "Minerals" programs in that order.

This program includes the following knowledges:

1. Chemical composition of plants and animals.
2. The animal nutritional requirements for maintenance, growth, fattening, production, and reproduction.
3. Chemical composition of carbohydrates.
4. Feeds that supply carbohydrates.
5. Importance of proteins.
6. Amino Acids.
7. Protein concentrates.
8. Importance of fats as an energy feed.
9. Function of minerals.
10. Function of vitamins.
11. What a feed ration is and what a balanced ration is.
12. Importance of nutrition to fertility of livestock.
13. Some examples of practical "rules of thumb" for feeding different classes of livestock.
14. Economics of feed substitution within balanced rations.
15. The Pearson Square Method of finding the proportion or percentage of two (or more) feeds which, when mixed together, will furnish a desired per cent protein.

Name _____

NUTRITION

Pre-Test

UNDERLINE THE CORRECT ANSWER.

1. Animals require nutrients to sustain life with no loss or gain of weight. This is called

   a. growth
   b. fattening
   c. maintenance
   d. production

2. _____ are the chief sources of heat and energy for animals.

   a. Minerals
   b. Carbohydrates
   c. Proteins
   d. Fats

3. The nutrients to provide milk and wool are called the requirement for

   a. reproduction
   b. fattening
   c. growth
   d. production

4. _____ include starches, sugars, and cellulose.

   a. Carbohydrates
   b. Fats
   c. Proteins
   d. Minerals

5. Feeds that are high in _____ include corn, oats, barley, and wheat middlings.

   a. protein
   b. fats
   c. carbohydrates
   d. minerals

Name _____

6. The kind and quality of _____ are fully as important as the amounts.

   a. fats
   b. proteins
   c. minerals
   d. carbohydrates

7. _____ are the high energy compounds of feeds.

   a. Proteins
   b. Minerals
   c. Calcium
   d. Carbohydrates
   e. Fats

8. _____ are essential minerals for feeding livestock. (choose two)

   a. Gold
   b. Platinum
   c. Sodium
   d. Manganese
   e. Silver

9. Fats supply _____ times as much heat energy as do carbohydrates.

   a. 2.25
   b. 2.50
   c. 2.75
   d. 2.00

10. _____ requirements vary according to what is created for "sale" by the animal (milk, wool, meat, eggs, etc.).

   a. Maintenance
   b. Production
   c. Reproduction
   d. Growth

Name _____

11. A(n) _____ is the amount of feed nutrients in the proper proportion for a 24-hour period.

a. ration
b. balanced ration
c. adequate supply
d. increment

12. _____ are common protein supplement feeds. (Choose two.)

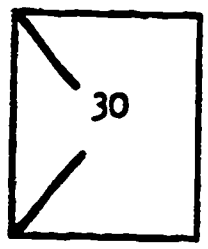
a. Barley
b. Oats
c. Cottonseed meal
d. Bone meal
e. Soybean oil meal
f. Corn

13. To reduce gain of bred sows or gilts, feed more _____ and less _____.

a. roughage
b. vitamins
c. protein
d. grain
e. minerals

14.

Corn 10



Soybean meal 40

_____ parts of corn

(Fill in the blanks)

_____ parts of soybean oil meal

a. 10 parts corn
b. 70 parts corn
c. 10 parts soybean oil meal
d. 20 parts soybean oil meal

(underline two)

INFORMATION PANEL

This is a programmed instruction unit for "Animal Nutrition." You will find it relatively easy to answer the questions in each

"frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Animal Nutrition

If you have not read the information panel, do so now, then proceed to frame 1.

Cut on broken lines.

Name _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____

Nutrition, Continued

Cut on broken lines.

Name _____

28. _____
29. _____
30. _____
31. _____
32. _____
_____
_____
_____
_____
33. _____
_____
_____
_____
_____
34. _____
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35. _____
36. _____
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37. _____
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38. _____
39.
40. _____
_____
41. _____
42. _____
43. _____
44. _____
45. _____

_____
_____
46. _____
47.
48. _____
49. _____
50. _____
51. _____
_____
_____
52.
53. _____
_____
54. _____
_____

Nutrition, Continued

Cut on broken lines.

Name _____

55. _____

_____

_____

56.

57.

58.

59.

60. _____

_____

water carbohydrates (organic matter) ash	1. Plants and animals are composed of (1) water, (2) organic matter, and (3) mineral matter or ash. Organic matter is composed of carbon united with hydrogen and oxygen and, in some cases, nitrogen and other chemical elements. Mineral matter is neither animal nor vegetable; it is an inorganic homogeneous substance. Plants and animals are composed of _____, _____, and _____.
3/4	2. Carbohydrates make up about three-fourths of all the dry matter in plants, and they are the chief source of energy and heat for animals. Carbohydrates are composed of carbon, hydrogen, and oxygen. Carbohydrates form about _____ of all dry matter in plants.
(1) water (2) carbohydrates (3) mineral matter or ash	3. Plants and animals are composed of (1) _____, (2) _____, and (3) _____.
carbohydrates	4. Animal nutritional requirements are most conveniently spoken of as requirements for maintenance, growth, fattening, production, and reproduction. _____ are the chief source of heat and energy for animals.
maintain	5. To sustain life with no loss or gain of weight requires sufficient feed to m_____ the animal.

growth	6. In addition to a maintenance ration, an animal requires additional feed to put on weight and increase in muscle and bone. This is called a _____ requirement.
fattening	7. Increased fat deposition is obtained by satisfying a requirement for _____.
production	8. The nutrients to provide milk and wool are called the requirements for _____.
reproduction	9. The required feed nutrients needed for an animal to produce young are called requirements for _____.
maintenance growth production fattening reproduction	10. The nutrient requirements are classified by the functions of _____, _____, _____, _____, and _____.

no	11. A nutrient is any compound or group of compounds having similar chemical composition that aids in the support of life. Is beet pulp a nutrient?
nutrient	12. A compound or group of compounds having similar chemical composition that aids in the support of life is called a _____.
carbohydrates proteins fats minerals vitamins	13. The different groups of nutrients are <u>carbohydrates</u>, <u>proteins</u>, <u>fats</u>, <u>minerals</u>, and <u>vitamins</u>. Copy these.
carbohydrates	14. Carbohydrates are the <u>starches</u>, <u>cellulose</u>, and <u>sugars</u>. _____ make up 3/4 of all dry matter of plants.
carbohydrates	15. Feeds high in <u>carbohydrates</u> are the grains and their by-products such as corn, oats, barley, wheat middlings, and wheat bran, and the fiber portions of roughages. These grains and their by-products are high in _____.

carbohydrates fats minerals vitamins proteins	16. The different groups of nutrients are _____, _____, _____, _____, and _____.
protein	17. Proteins are compounds made up of amino acids. Proteins are particularly important nutrients needed for growth. Compounds made up of amino acids and important for growth are _____. The kind and quality of protein is fully as important as the amount.
protein	18. The common protein supplements are soybean meal, cottonseed meal, linseed meal, tankage, meat and bone scraps, fishmeal, and dried skimmilk. All common feeds contain some _____ but not to the extent that those listed here do.
amino acids	19. Protein are very complex substances, made up of 24 or more different amino acids. In the digestion of food the proteins are split into these amino acids which are absorbed from the digestive system and enter the blood streams. _____ _____ are the component parts of protein.
fats	20. Fats in the forms of esters of fatty acids and glycerol are the high-energy compounds of feeds. They are also the carriers of many of the vitamins present in feeds. _____ are the high-energy compounds of feeds.

blood stream	21. Minerals are the major elements of bones and teeth and a vital part of main tissues, organs, and the body's enzyme system, as well as the soft tissues and the fluids of the body. The amino acids are absorbed by the animal body through the _____ _____.
minerals	22. Calcium, phosphorus, sodium, chlorine, potassium, sulfur, magnesium, iron, iodine, copper, cobalt, zinc, manganese, molybdenum, florine, and arsenic are _____ that are essential for, or affect in some way, livestock feeding.
proteins	23. _____ are made up of amino acids and are furnished in adequate supplemental forms in soybean meal and fishmeal.
amino acids	24. Proteins are made up of _____ _____ and are particularly important to meet the growth requirements.
protein growth maintenance reproduction	25. Young animals require the nutrient _____ to meet _____ requirements. Mature cattle need nutrients to maintain the same weight. This is a _____ requirement. Bred cattle require an additional _____ requirement.

growth maintenance production	26. A fattening ration must satisfy g_____, _____, and _____ requirements.
carbohydrates	27. C_____ includes starches, sugars, and cellulose.
fats	28. _____ supply 2.25 times as much energy as carbohydrates. Fats aid in absorption from food of Vitamin A and may help in the absorption of calcium.
organic	29. Vitamins are trace organic nutrients. Essential vitamins to livestock feeding are: A, D, E, K, Thiamin or B_1, niacin or nicotinic acid, B_{12}, and C or ascorbic acid, choline pyridoxin, biotin, and folic acid. Vitamins are trace _____ nutrients.
green forage crops	30. One of the most important facts in livestock production is that all green forage crops are rich in most of the vitamins required by farm animals. The only exception seems to be Vitamin D and Vitamin B_{12}. Vitamin D and Vitamin B_{12} are not supplied by _____.

Vitamins	31. Water and oxygen provided inadequately, or inconveniently, may affect the performance of livestock. _____ are trace organic nutrients and must be considered in the balancing of rations.
maintenance growth fattening production reproduction	32. The nutrient requirements are classified by functions as _____, _____, _____, _____, and _____.
proteins minerals carbohydrates fats vitamins	33. The different groups of nutrients are _____, _____, _____, _____, and _____.
oxygen water	34. _____ and _____ are essential for successful performance of livestock but are not expensive to provide in most cases.
maintenance	35. The body can be kept at a constant weight and temperature when carrying on only such activities as digestion, heartbeat, and breathing by providing a _____ ration. The energy-producing nutrients (carbohydrates and fats) along with small amounts of protein, minerals, and vitamins fulfill this requirement.

proteins minerals vitamins water	36. Animals need proteins, minerals, vitamins, and water for growth, so feeds that are relatively high in these nutrients should be fed. A young growing animal suffers sooner and much more seriously from nutritive deficiencies than does a mature animal. Animals need _____, _____, _____, and _____ for growth. Proteins are most commonly limiting in a growth ration.
carbohydrates fats	37. Carbohydrates and fats are required for fattening. Little or no protein is necessary, but any extra protein in the ration that is not used otherwise can be used by the body for fattening. Proteins are generally more expensive, however, than carbohydrates and fats. _____ and _____ are more economical for fattening purposes than the protein feeds. The purpose of fattening is to cause "marbling" in the lean meat (deposition of fat in the lean meat) and a covering of fat over the carcass.
false	38. The nutrients that are needed for production vary according to the type of production. Milk is high in calcium, protein, and phosphorus, and feeds for milk cows should be high in these elements. All production requirements are the same. True or false?
	39. Eggs are rich in protein, fats, minerals, vitamins, and water. Feeds high in these nutrients need to be fed to laying hens.
calcium phosphorus	40. Milk production requires feeds high in the minerals _____ and _____.

nutrition	41. The fertility of breeding stock is dependent on adequate nutrition levels. Small and weak litters of swine and poor hatchability in poultry result from inadequate rations. Flushing of swine and sheep are two examples of the importance of adequate _____ to fertility of breeding stock.
vitamins	42. Breeding herds or flocks should be provided a liberal supply of protein, minerals, and vitamins. Liberal supplies of proteins, minerals, and _____ _____ are necessary to maintain high fertility.
24	43. A ration is the amount of feed allowed an animal during a 24-hour day. If a ration contains all the nutrients in proportion and amounts necessary for proper nourishment, the ration is said to be balanced. A ration is the amount of feed allowed an animal during a _____-hour period.
balanced	44. A good ration in addition to containing nutrients in the proper amounts should (1) be as economical as possible, (2) not be harmful to the animal, (3) be palatable, and (4) be in the proper proportion. A ration that agrees with the above requirements is said to be a b_____ ration.
2 3 1	45. The following are some practical "rules of thumb" for feeding livestock. For beef cattle maintenance, feed approximately 2 lbs. of air dry roughage for every 100 lbs of liveweight. If silage is used, then substitute 3 lbs. of silage for 1 lb. of air dry roughage. Protein and mineral supplements may have to be added to the hay or silage rations. A rule of thumb ration of roughage for beef cattle would be _____ lbs. per 100 lbs. of liveweight. If silage is used, substitute _____ lbs. of silage for each _____ lbs. of air dry roughage.

1 2	46. For beef cattle fattening, feed approximately 3/4 to 1 lb. of air dry roughage and 2 lbs. of concentrate per 100 lbs. liveweight to cattle on full feed. The ratio of roughage to concentrate is _____ to ____.
	47. For dairy cattle feed 2 lbs. of air dry roughage per 100 lbs. of liveweight and concentrate as follows: Jersey and Guernsey, feed 1 lb. concentrate for every 3 lbs. milk produced. Holstein, Brown Swiss, and Ayrshires, feed 1 lb. concentrate for every 4 lbs. milk produced.
1 3	48. Jersey and Guernsey cattle require a ratio of concentrate to milk of _____ to _____.
1 4	49. Holstein, Brown Swiss, and Ayrshire cattle require a ratio of grain to milk of _____ to _____.
3	50. For sheep maintenance, feed 3 lbs. roughage per 100 lbs. liveweight and supplement with proteins and minerals if needed. Ratio of roughage to 100 lbs. liveweight is _____ lbs. per 100 lbs. liveweight.

1 1/2 2 100	51. For sheep fattening feed 1 1/2 lbs. roughage and 2 lbs. of concentrate per 100 lbs. liveweight. Ratio _____ to _____ to _____.
	52. For bred sows and gilts. If self-feeding, provide enough ground roughage to furnish 12-15% fiber. Approximately 1/3 roughage, such as ground legume hay or corn cobs; 1/3 oats; and 1/3 corn supplemented (barley may be substituted for corn) with protein, minerals, and vitamins will be satisfactory. Control the gain in weight by changing the proportion of roughage to concentrate. More concentrate results in more gain and vice versa.
concentrate barley	53. To reduce gain, reduce _____ and increase _____ proportionately.
12 15	54. If self-feeding sows and gilts, feed enough roughage to provide _____ to _____% of fiber.
roughage oats corn or roughage	55. Bred sows and gilts should be fed 1/3 _____, 1/3 _____, and 1/3 _____ with proper supplements.

56. The Pearson Square Method of balancing rations is used to simplify and systematize the procedure.

To find the proportion or percentages of two feeds which, when mixed together, will furnish the desired percent of protein (or any other nutrient), use the square as follows:

Calculate the amount of corn (10% crude protein) and soybean oil meal (50% crude protein) that will be needed to furnish 10 lbs. of a mixture containing 20% crude protein.

1. Draw a square with line connecting opposite corners.

2. In the center of the square, enter the crude protein percentage desired in the mixture.

3. At the left-hand corners of the square, write the materials mixed together and their crude-protein content.

Corn	10	
Soybean meal	50	

4. Subtract along the diagonals, the smaller from the larger, and place the difference at the opposite end of the diagonals. Thus 20 minus 10 is 10, and 50 minus 20 is 30.

Corn	10		30
		20	
Soybean meal	50		10

The 30 then becomes the parts of corn required in the ration and the 10, the parts of soybean meal.

Corn	10		30
		20	
Soybean meal	50		10
			40 total parts

5. To find the percentage of each feed in the desired mixture, divide the parts of <u>each</u> by the <u>total</u> parts.

Corn $30 \div 40 \times 100 = 75\%$

Soybean meal $10 \div 40 \times 100 = 25\%$

6. Since we want 10 lbs. of the mixture, mix (10 lbs. x 75%) 7.5 lbs. of corn with (10 lbs. x 25%) 2.5 lbs. of soybean meal.

57. Calculate, using the Pearson Square, the amount of barley (8% crude protein) and soybean oil meal (50% crude protein) that will be needed to furnish 100 lbs. of a mixture containing 18% crude protein.

Barley	8		32	32 ÷ 42 = 76 parts or 76% barley
Soybean oil meal	50	18	10	10 ÷ 42 = 24 parts or 24% soybean oil meal
			42 total parts	

The 100 lb. mixture should be made up of 76 lbs. of barley and 24 lbs. of soybean oil meal.

58. Calculate, using the Pearson Square, the amount of barley (9% protein) and cottonseed cake (42% crude protein) that will be needed to furnish 100 lbs. of a mixture containing 12% crude protein.

Barley	9		30	30 ÷ 33 = 90.9 parts or 90.9% barley
Cottonseed cake	42	12	3	3 ÷ 33 = 9.1 parts or 9.1% cottonseed cake
			33 total parts	

The 100 lb. mixture should be made up of 90.9 lbs. of barley and 9.1 lbs. of cottonseed cake.

59. Suppose you plan to use 20% wheat at 10.5% protein, 40% barley at 9% protein, and 40% mill run at 13% protein. You will supplement this grain ration with a 38% protein supplement. You require a 14% mix. Solve using the Pearson Square for 100 lbs. of feed.

Wheat = .105 x 20 = 2.10
Barley = .09 x 40 = 3.60
Mill run = .13 x 40 = 5.20

2.1 + 3.6 + 5.2 = 10.9% protein in the mixture of wheat, barley, and mill run at the percentages given.

Mix	10.9		24.0	24 ÷ 27.1 = 88.6 parts or 88.6% "mix"
Supplement	38.0	14	3.1	3.1 ÷ 27.1 = 11.4 parts or 11.4% protein supplement
			27.1 total parts	

The 100 lbs. mixture should be made up of 88.6 lbs. of mixed grain and 11.4 lbs. of cottonseed cake.

60. The key to profitable livestock feeding is to feed a balanced ration. Define such a ration.

Sufficient nutrients in a 24-hour period in proportion to requirements of the animal.

Name _____

NUTRITION

Post-Test

UNDERLINE THE CORRECT ANSWER.

1. Animals require nutrients to sustain life with no loss or gain of weight. This is called

   a. growth
   b. fattening
   c. maintenance
   d. production

2. _____ are the chief sources of heat and energy for animals.

   a. Minerals
   b. Carbohydrates
   c. Proteins
   d. Fats

3. The nutrients to provide milk and wool are called the requirement for

   a. reproduction
   b. fattening
   c. growth
   d. production

4. _____ include starches, sugars, and cellulose.

   a. Carbohydrates
   b. Fats
   c. Proteins
   d. Minerals

5. Feeds that are high in _____ include corn, oats, barley, and wheat middlings.

   a. protein
   b. fats
   c. carbohydrates
   d. minerals

Name _____

6. The kind and quality of _____ are fully as important as the amounts.

   a. fats
   b. proteins
   c. minerals
   d. carbohydrates

7. _____ are the high energy compounds of feeds.

   a. Proteins
   b. Minerals
   c. Calcium
   d. Carbohydrates

8. _____ are essential minerals for feeding livestock. (choose two)

   a. Gold
   b. Platinum
   c. Sodium
   d. Manganese
   e. Silver

9. Fats supply _____ times as much heat energy as do carbohydrates.

   a. 2.25
   b. 2.50
   c. 2.75
   d. 2.00

10. _____ requirements vary according to what is created for "sale" by the animal (milk, wool, meat, eggs, etc.).

   a. Maintenance
   b. Production
   c. Reproduction
   d. Growth

Name _____

11. A(n) _____ is the amount of feed nutrients in the proper proportion for a 24-hour period.

a. ration
b. balanced ration
c. adequate supply
d. increment

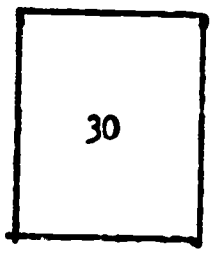
12. _____ are common protein supplement feeds. (Choose two.)

a. Barley
b. Oats
c. Cottonseed meal
d. Bone meal
e. Soybean oil meal
f. Corn

13. To reduce gain of bred sows or gilts, feed more _____ and less _____.

a. roughage
b. vitamins
c. protein
d. grain
e. minerals

14.



_____ parts of corn

(Fill in the blanks)

_____ parts of soybean oil meal

a. 10 parts corn
b. 70 parts corn
c. 10 parts soybean oil meal
d. 20 parts soybean oil meal

(underline two)

FEED CHARACTERISTICS

Note to Teachers

This programmed instruction unit titled "Feed Characteristics" is designed to follow the "Animal Nutrition" unit as the second unit in a series of four nutrition programs.

This instrument includes the following knowledges:

1. Classification of feeds into:
   a. total digestible nutrients
   b. net energy
   c. concentrates
   d. protein supplements (animal and plant)
   e. roughages
   f. legumes and non-legumes forage quality
2. Energy value as a measure of feeding value.
3. Maintenance and production-feed requirements.
4. The importance of forage testing as an economic tool for efficient feeding of livestock.
5. The method of matching forage-test information with grain requirements for dairy cattle.

Name _____

FEED CHARACTERISTICS

Pre-Test

UNDERLINE THE CORRECT ANSWER(S).

1. Livestock feeds are generally classified according to the amount of _____ they provide.

   a. nutrients not fat
   b. total digestible nutrients
   c. net energy available
   d. availability
   e. color

2. Feeds that contain relatively large amounts of _____ are called roughages.

   a. protein
   b. lignin
   c. fiber
   d. minerals
   e. ash

3. Feeds that contain relatively small amounts of _____ are called concentrates.

   a. protein
   b. carbohydrates
   c. minerals
   d. fiber

4. _____ are feeds that have a comparatively high digestibility.

   a. Concentrates
   b. Roughages
   c. Protein
   d. Total digestible nutrients

Name _____

5. _____ are feeds that have a comparatively low digestibility.

   a. Concentrates
   b. Carbohydrates
   c. Roughages
   d. Protein

6. Protein supplements contain _____ or more per cent protein.

   a. 10
   b. 15
   c. 20
   d. 30
   e. 40

7. Tankage is classified as a

   a. concentrate
   b. protein supplement
   c. low fiber food
   d. feed additive

8. Protein supplements originate from _____ or _____.

   a. animals
   b. fibrous
   c. plants
   d. cereal

9. Fish meal is a

   a. plant derivative protein supplement
   b. animal derivative protein supplement
   c. little used protein supplement
   d. unpalatable feed

10. The _____ derivative proteins are the best quality proteins of the common protein supplements.

   a. plant
   b. mineral
   c. vegetable
   d. animal
   e. enzyme

Name _____

11. The small grains are

    a. roughages
    b. concentrates
    c. low energy feeds
    d. protein supplements

12. Feeds _____ depending upon such things as variety, soil fertility, where grown, methods of harvesting, stage of maturity, and length of time in storage.

    a. vary
    b. do not vary
    c. vary but do so in no particular order

13. The _____ determines to some extent the quality of the feed.

    a. manufacturing process
    b. distribution methods
    c. price
    d. quantity

14. _____ losses occur through chewing, digesting, assimilation of feed, and losses through undigested material in the feeds.

    a. Protein
    b. Energy
    c. Mineral
    d. Time
    e. Amino acid

15. It is _____ to have the farmer obtain a chemical analysis of his home-grown feeds.

    a. of little importance
    b. important
    c. of no economic value
    d. a and c

Name _____

16. Net energy values of feed are commonly expressed as _____.

a. calories
b. pounds
c. therms
d. ounces

17. The _____ represents the amount of energy available for productive purposes, such as growth.

a. total digestible energy
b. energy value
c. real income value
d. net energy value

18. For purposes of balancing rations we must know _____ and _____.

a. the nutrient content of the feed
b. the nutrient requirements of the animal
c. the type of feeding system used
d. the preferences of the owner
e. the cost of the feeds

19. _____ is only partially digestible (75-85%).

a. Digestible protein
b. A mineral
c. A carbohydrate
d. Crude protein

20. Net energy requirements are broken down into requirements for _____ and _____.

a. growth
b. maintenance
c. production
d. therms

21. Net energy values of feed for _____ are generally higher than net energy values of feed for maintenance.

a. reproduction
b. production
c. neither a nor b

Name _____

22. Livestock require about _____ times as much energy as protein.
    a. 3
    b. 4
    c. 5
    d. 12

23. NEp stands for
    a. net energy potential
    b. net energy for production
    c. net energy power
    d. net energy

24. The value of a Feed _____ as digestibility decreases and crude fiber increases.
    a. increases
    b. decreases
    c. stays the same

25. Ruminant stomached animals are fed _____ protein feeds because the higher quality animal derivitive proteins are unnecessary and, generally, more expensive.
    a. total digestible
    b. plant
    c. energy
    d. unusual

26. The single most important step in forage testing is _____.
    a. accurate size samples
    b. a proportional sample
    c. a large sample
    d. none of the above

27. Home grown grain is _____ adequate when feeding 13 per cent protein hay.
    a. probably
    b. probably not
    c. never

28. Roughages are divided into _____ and non_____. (Fill in the blanks). _____ are higher in protein than _____.
    a. fiber
    b. legume
    c. non-legume
    d. concentrates

INFORMATION PANEL

This is a programmed instruction unit for "Feed Characteristics." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Feed Characteristics

If you have not read the information panel, do so now, then proceed to frame 1.

Name _____

1.
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
_____
10. _____
11. _____
12. _____
13. _____
14. _____
15.
16. _____
17.
18. _____
19. _____
20. _____
21. _____
22. _____
23.
24. _____
_____
25.
26.
27. _____
_____
_____
_____
28.
29. _____
30.
31.
32.
33. f _____
g _____
34. _____
35.
36. _____
37.
38.
39. d _____
i _____

Feed Characteristics, Continued

Name _____

f _____

p _____

40. _____

41. f _____

p _____

42. _____

43. _____

44.

45. _____

46.

47.

48.

49.

50. _____

_____

51.

52. _____

53.

54. _____

55. _____

56. _____

57. __1. __2.

__3. __4.

__5. __6.

__7.

58. _____

59. _____

60. See frames 48, 49.

	1. Livestock feeds are generally classified according to the amount of total digestible nutrients they provide, or according to the amount of specific nutrients they furnish in the ration.
Roughages	2. Feeds that contain relatively large amounts of fiber or non-digestible material are called roughages. _____ contain large amounts of fiber.
fiber	3. Concentrates are feeds that have a comparatively high digestibility, and are high energy goods. They are relatively low in _____. They include all grains and many by-products of grains and animals, such as wheat middlings, tankage, and soybean oil meal.
grains	4. Concentrates include all _____ such as wheat, corn, oats, and barley.
concentrate	5. Tankage is a protein supplement as is soybean oil meal because it has 20 per cent or more protein. Oats is a _____.

concentrates	6. Protein concentrates may be classified as a subdivision of concentrates. They contain 20 or more per cent protein. _____ have a comparatively high digestibility.
20	7. Protein concentrates contain _____ or more per cent protein.
Animal	8. Protein concentrates are derived from either animal or vegetable substances. Proteins derived from animal or animal by-products are high quality protein feeds valuable for poultry and swine. They are more expensive than plant proteins. _____ proteins are high quality proteins.
vegetable or plant animal	9. Vegetable or plant proteins are found in the by-products of plants. Soybean oil meal, linseed oil meal, cottonseed meal, and peanut oil meal are _____ protein concentrates. Tankage, meat scraps and fish meal are _____ protein concentrates.
animal	10. The ruminant-stomached livestock are fed vegetable proteins because _____ proteins are more expensive and are not essential feed stuffs for ruminant animals. They synthesize their own protein "quality proteins" whereas swine and poultry cannot.

protein	11. Cottonseed oil meal, soybean oil meal, and linseed oil meal have in excess of 20 per cent protein and are classified as _____ supplements.
grains or high energy feeds	12. The grains are the best source of energy for the common feed stuffs and they have the best fattening value. Corn and oats are examples of _____.
non-legume	13. Roughages are divided into legume and non-legume. Legumes are plants that have the ability to use nitrogen which they take from the air. Legumes are higher in protein than are _____ roughages.
Grains	14. Grains and roughages vary considerably in nutrient values depending upon variety, stage of maturity, soil fertility where grown, methods of harvesting, and length of time in storage. _____ and roughages vary considerably in nutrient value.
	15. The manufacturing process determines to some extent the values of feeds. Therefore, average composition of various feeds is often used when planning livestock rations. This is true regarding grains, but forage testing is done chemically and will be discussed later in this program.

important	16. It is (important, unimportant) for the farmer feeding home-grown feeds to have a chemical analysis made of his feed because of the variability of these feeds.
	17. The energy value of a feed is a very good criteria of its feeding value. Energy losses occur through undigested material in the feeds, energy losses in the urea, energy lost (in small amounts) in the combustible gases, and energy lost in the various processes of chewing, digesting, and assimilating food.
less than	18. The animal can be likened to an automobile. There is (less than, nearly perfect) efficiency in utilization of the "fuel."
energy	19. An additional energy loss is through the heat increment produced in the body following and because of the consumption of the food. These losses are higher in feeds that are high in fiber. Fiber content has an effect on _____ losses.
net energy	20. The net energy value of a feed is the amount of energy left after deducting the losses previously mentioned. The _____ _____ value represents the real value of the feed for productive purposes such as growth, production of body fat, milk or wool or performance of work.

therm	21. The net energy values of feeds are commonly expressed as therms in this country. A therm (unit for measuring heat) is the amount of heat required to raise the temperature of 1,000 lbs. of water about 4° Fahrenheit. The unit for measuring heat is the _____.
1,000	22. In human nutrition the calorie is used as the unit for measuring heat. One therm is 1,000 Calories or 1,000,000 small calories. A therm is the amount of heat required to raise the temperature of _____ lbs. of water about 4° Fahrenheit.
	23. Net energy values and total digestible nutrients (T.D.N.) values are available information for balancing rations. Net energy values are generally the most useful. T.D.N. values are most accurate for some particular purposes.
T.D.N. Net energy	24. Two of the categories of information, other than protein, available for ration balancing are _____ and _____ values.
	25. For purposes of balancing rations, we must know (1) the nutrient requirement of the animal, and (2) the nutrient content of the feed. Crude protein and energy are the measurements that we use primarily for the nutrient content of the feed (T.D.N.)

	26. Net energy is measured as NEm or net energy for maintenance, and NEp or net energy for production. For example: Alfalfa — Crude Protein 15 — TDN 50 — NE m 34 — NE p 24 The net energy value of alfalfa for maintenance is higher than the energy value for production. This is characteristically true as the maintenance ration must be satisfied before the production requirement is met.
net energy maintenance n[illegible]rgy pr[illegible]ion production maintenance energy T.D.N.	27. NEm stands for _____. NEp stands for _____. Net energy is calculated in terms of _____ requirements and _____ requirements. _____ is a more sensitive indicator of feeding values than is _____.
	28. Maintenance feed requirements furnish the nutrients to provide neither gain nor loss of weight, plus normal nutritional health. The production requirement is the requirement for wool and milk or fat above the maintenance requirement.
seven	29. Livestock require about seven times as much energy as protein in their diets. There is a considerably greater difference between the net energy value of a high grade concentrate and that of a dry roughage than there is between the percentages of total digestible nutrients furnished by the same feed. Livestock require _____ times as much energy as protein.
	30. Dent corn of Grade No. 1 supplies 81.9 therms of net energy per 100 lbs. while timothy hay, all analysis, furnishes but 37.3 therms, or only 46 per cent as much. However, timothy hay has about 60 per cent as much digestible nutrients as does corn. It has 49.1 per cent total digestible nutrients, in comparison with 81.9 per cent of No. 1 dent corn.

	31. Dent Corn — Grade No. 1 — Net Energy Therms: 81.9 — TDN %: 81.9 Timothy Hay — All Analyses — Net Energy Therms: 37.3 — TDN %: 49.1 37.3 is 36% of 81.9 49.1 is 60% of 81.9
	32. The net energy figures are more meaningful than the TDN (total digestible nutrients) figures in most cases when balancing feed rations.
Forages grains	33. The nutrient requirements of dairy cattle are satisfied largely by forages and grains. F_____ make up 60-80 per cent of the total nutrients and g_____ the other 20-40 per cent of the nutrients for dairy cattle.
low	34. The protein in the grain mixture should complement the protein supplied by the forage. The grain, of course, is the primary energy feed. A high protein hay would require a _____ protein grain.
	35. A poor quality hay may require a high protein grain costing as much as $15 more per ton. Washington forage tests have resulted in a range of 2.8-14.9% protein for grass hay and 10.6-24% for legume hay.

errors	36. These quality differences demonstrate differences in harvesting, climate, soils, and variety of seed. Using average values of forages when balancing the protein level in grain mixtures leads to large (advantages, errors).
	37. Visual estimates of forage quality, as are used for Federal grading of hay, are often in error. Errors as much as 5 per cent in crude protein and 9 per cent TDN (total digestible nutrients) are made by trained individuals.
	38. The case for forage testing is based upon the relation between the chemical composition of a forage and its feeding value for animals. As a plant matures, its digestibility decreases and its protein content declines. Chemically these changes are reflected by an increase in crude fiber (and lignin) and by a decrease in crude protein. This is the basis of forage testing. Hays that are weathered also show an increase in fiber and a decrease in protein since soluble nutrients are washed out by rain and leaves are lost during harvest.
declines increases fiber protein	39. As a plant matures its digestibility d_____. As a plant matures, crude fiber content i_____. Weathered hay shows an increase in f_____ and a decrease in p_____. Weathered hay loses Vitamin A in large amounts, but does not lose a like amount of energy unless the hay molds.
less	40. As digestibility of a feed declines and its crude fiber content increases, the value of this particular feed becomes _____.

fiber protein	41. Forage testing tests for the amount of crude f_____, and, therefore, crude p_____.
15	42. Hay varies with the way in which it is grown, cured, and stored. Soils, climate, and variety of plant also affect quality of hay. There are often differences in quality within the same field due to weather changes during harvest. A representative sample is, therefore, important (15% approximately). To sample a 5-ton of hay one should take at least (5, 12, 15) core samples from different bales.
1	43. The purpose of forage testing is to _____. (Choose one.) (1) Establish an accurate feed value for roughage. (2) Establish an accurate feed value for the concentrate fed. (3) Determine how much an animal requires to produce at a certain level.
	44. The single most important step in forage testing is sampling. Fifteen cores (drill samples) should be taken from one lot of forage. Samples from one bale vary as much as 1.8 per cent protein. Bales in a truckload vary as much as 6.5 per cent protein.
15	45. _____ core samples should be taken from each lot of forage. Samples should be taken each time a change in feed is noticed; for example, change from first cutting to second cutting.

46. We said that we try to balance protein content of our forage by the grain we purchase or mix. In general, we expect our hay to follow the following averages:

Remember a forage test is the only accurate method--the table below is here for use as an example only.

47.

	Average Crude Protein (moisture free)
Alfalfa	16%
Brome Grass	7%
Ladino Clover	18%
Red Clover	9%
Oat Forage	7%
Orchard Grass	8%
Timothy	5%
Corn Silage	5%
Pea Vines	13%

48 and 49.

The following tables will tell you what per cent of protein grain to feed with your forage.

% Crude Protein in Forage	% Crude Protein Needed in Grain Mix
2.0 - 3.3	20
3.4 - 4.5	19
4.6 - 5.6	18
5.7 - 6.8	17
6.9 - 7.9	16
8.0 - 9.1	15
9.2 - 10.2	14
10.3 - 11.4	13
11.5 - 12.5	12
12.6 - 13.7	11
13.8 +	10

50. What per cent protein grain would you feed if your forage tested 8.3% on a dry matter basis? (See above table.)

And if the forage tested 13.2%?

15%
11%

	51. Many cases where high quality forage is fed require only 10-12% crude protein in the grain mix (as per table). When this occurs economical grain mix may be fed which does not include a protein supplement. Such mixtures as steamed rolled barley, barley-oats, or barley-mill run combinations which contain 1% steamed bone-meal* and 1% iodized or trace mineralized salt are good feeds. *or dicalcium phosphate
does not	52. A high quality forage (does, does not) require a grain mix containing a protein supplement
	53. How can we establish how much grain and hay to feed each cow? We need to know what her individual nutrient requirements are. This is determined by her production. Tables are available to conveniently arrive at the correct amounts. (E.M. 2040, Rev., October, 1965, Washington State Cooperation Extension Bulletin.)
forage	54. The basis for an economical feeding system for dairy cows is _____ testing.
are not	55. High quality alfalfa hay requires a mixture of home-grown grains plus 1% steamed bonemeal and 1% salt, iodized or trace mineralized. Protein supplements (are, are not) necessary with this kind of forage.

$675.00	56. Through forage testing it was found that a dairy farmer needed 10% protein grain rather than the 13% protein grain he had been feeding. This resulted in a saving of $5 per ton of grain. Over a 10-month period, feeding 60 cows at an average of 15 lbs. per animal, the farmer saved $_____.
2,3,5,-A 1,4,6,7,-P	57. Label the plant derived protein supplements with a P, the animal derived protein supplements with an A. _____1. Soybean oil meal _____2. Tankage _____3. Meat scraps _____4. Cottonseed oil meal _____5. Fish meal _____6. Linseed oil meal _____7. Peanut oil meal
animal	58. (Plant proteins or Animal proteins) are higher quality proteins and are more expensive.
concentrate	59. Barley, wheat, and middlings are (protein supplements, concentrates).
See frames 48-49	60. Suppose a forage test indicated a 16% crude protein hay. What per cent protein grain is necessary?

Name _____

FEED CHARACTERISTICS

Post-Test

UNDERLINE THE CORRECT ANSWER(S).

1. Livestock feeds are generally classified according to the amount of _____ they provide.

   a. nutrients not fat
   b. total digestible nutrients
   c. net energy available
   d. availability
   e. color

2. Feeds that contain relatively large amounts of _____ are called roughages.

   a. protein
   b. lignin
   c. fiber
   d. minerals
   e. ash

3. Feeds that contain relatively small amounts of _____ are called concentrates.

   a. protein
   b. carbohydrates
   c. minerals
   d. fiber

4. _____ are feeds that have a comparatively high digestibility.

   a. Concentrates
   b. Roughages
   c. Protein
   d, Total digestible nutrients

Name _____

5. _____ are feeds that have a comparatively low digestibility.

   a. Concentrates
   b. Carbohydrates
   c. Roughages
   d. Protein

6. Protein supplements contain _____ or more per cent protein.

   a. 10
   b. 15
   c. 20
   d. 30
   e. 40

7. Tankage is classified as a

   a. concentrate
   b. protein supplement
   c. low fiber food
   d. feed additive

8. Protein supplements originate from _____ or _____.

   a. animal
   b. fibrous
   c. plant
   d. cereal

9. Fish meal is a

   a. plant derivative protein supplement
   b. animal derivative protein supplement
   c. little used protein supplement
   d. unpalatable feed

Name _____

10. The _____ derivative proteins are the best quality proteins of the common protein supplements.

    a. plant
    b. mineral
    c. vegetable
    d. animal
    e. enzyme

11. The small grains are

    a. roughages
    b. concentrates
    c. low energy feeds
    d. protein supplements

12. Feeds _____ depending upon such things as variety, soil fertility, where grown, methods of harvesting, stage of maturity, and length of time in storage.

    a. vary
    b. do not vary
    c. vary but do so in no particular order

13. The _____ determines to some extent the quality of the feed.

    a. manufacturing process
    b. distribution methods
    c. price
    d. quantity

14. _____ losses occur through chewing, digesting, assimilation of feed, and losses through undigested material in the feed.

    a. Protein
    b. Energy
    c. Mineral
    d. Time
    e. Amino acid

Name _____

15. It is _____ to have the farmer obtain a chemical analysis of his home-grown feeds.

a. of little importance
b. important
c. of no economic value
d. a and c

16. Net energy values of feed are commonly expressed as _____.

a. calories
b. pounds
c. therms
d. ounces

17. The _____ represents the amount of energy available for productive purposes, such as growth.

a. total digestible energy
b. energy value
c. real income value
d. net energy value

18. For purposes of balancing rations we must know _____ and _____.

a. the nutrient content of the feed
b. the nutrient requirements of the animal
c. the type of feeding system used
d. the preference of the owner
e. the cost of the feeds.

19. _____ is only partially digestible (75-85%).

a. Digestible protein
b. A mineral
c. A carbohydrate
d. Crude protein

20. Net energy requirements are broken down into requirements for _____ and _____.

a. growth
b. maintenance
c. production
d. therms

Name _____

21. Net energy values of feed for _____ are generally higher than net energy values of feed for maintenance.

    a. reproduction
    b. production
    c. neither a nor b

22. Livestock require about _____ times as much energy as protein.

    a. 3
    b. 4
    c. 5
    d. 7
    e. 12

23. NEp stands for

    a. net energy potential
    b. net energy for production
    c. net energy power
    d. net energy

24. The value of a feed _____ as digestibility decreases and crude fiber increases.

    a. increases
    b. decreases
    c. stays the same

25. Ruminant-stomached animals are fed _____ protein feeds because the higher quality animal derivative proteins are unnecessary and, generally, more expensive.

    a. total digestible
    b. plant
    c. energy
    d. unusual

26. The single most important step in forage testing is _____.

    a. accurate size samples
    b. a proportional sample
    c. a large sample
    d. none of the above

Name _____

27. Home-grown grain is _____ adequate when feeding 13 per cent protein hay.

a. probably
b. probably not
c. never

28. Roughages are divided into _____ and non-_____.

(Fill in the blanks.) _____ are higher in protein than _____.

a. fiber
b. legume
c. non-legume
d. concentrates

VITAMINS

Note to Teachers

This is the "Vitamins" programmed instruction booklet. It is the third program in the animal nutrition series of programs.

This program includes the knowledges listed below:

1. The importance of vitamins to animal nutrition.
2. What vitamins are.
3. Which vitamins are essential to animal nutrition.
4. How are the individual vitamins provided to livestock.
5. What anti-vitamins are.
6. Symptoms of vitamin deficiency.
7. Which vitamins are commonly deficient within particular classes of livestock.
8. The importance of vitamins to reproduction.

Name _____

VITAMINS

Pre-Test

UNDERLINE THE CORRECT ANSWER(S).

1. The chemical make-up and functions of vitamins are _____.

   a. similar to each other
   b. similar but distinct
   c. different from each other

2. Vitamin _____ is required by all animals and must be present in the feeds.

   a. A
   b. B
   c. C
   d. D
   e. B_{12}

3. Research in vitamins is _____.

   a. extensive
   b. limited
   c. questionable
   d. economical

4. So called "cottonseed meal poisoning" is really a deficiency of vitamin _____.

   a. A
   b. B_{12}
   c. C
   d. D
   e. F

5. Severe losses of vitamin _____ occur through oxidation during hay making or long storage periods.

   a. A
   b. B_{12}
   c. C
   d. E
   e. B_2

Name _____

6. Adequate vitamin D is necessary for the proper assimilation and use of the minerals _____ and _____.

a. phosphorous
b. manganese
c. calcium
d. magnesium
e. iron
f. zinc

7. Poultry need more vitamin _____ in their rations than do other farm stock, especially for egg production.

a. A
b. B
c. C
d. D
e. E

8. Deficiency of vitamin _____ causes rickets.

a. A
b. B
c. B_2
d. D
e. B_{12}

9. Swine need _____ because they do not synthesize it in their digestive tracts as sheep, beef, and dairy cattle do.

a. Vitamin A
b. Vitamin B-complex
c. Vitamin C
d. Vitamin D

10. All green forages are _____ sources of vitamins.

a. poor
b. moderate
c. rich
d. inadequate

Name _____

11. A deficiency of vitamin _____ accompanied by loosening of the teeth is evidence of scurvy.

a. A
b. B_2
c. C
d. D
e. B_{12}

12. An _____ prevents the actions of vitamins or kills the vitamins.

a. exovitamin
b. antivitamin
c. killer vitamin
d. antidote

13. Vitamin _____ is necessary for reproduction in poultry, rats, and perhaps some other animals.

a. A
b. E
c. C
d. D

14. Lack of vitamin _____ seems to cause "white muscle disease."

a. A
b. E
c. C
d. D

15. Slow healing wounds are symptomatic of a deficiency of vitamin _____.

a. A
b. B_{12}
c. C
d. D

INFORMATION PANEL

This is a programmed instruction unit for "Vitamins." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Vitamins

If you have not read the information panel, do so now, then proceed to frame 1.

Name _____

1. _____
2.
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9.
10.
11. _____

_____

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12. _____

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13. _____
14. _____
15. _____
16. _____
17. _____

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18. _____

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19. _____
20. _____

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21. _____

_____

_____
22. _____
23. r _____
24. _____
25. _____
26. _____
27. _____
28. _____
29. _____

_____

_____
30. _____
31. _____

_____

_____
32. _____

_____

_____
33. r _____
34. _____
35. _____
36. _____
37. _____

vitamins	1. Much of our modern efficiency in feeding livestock, particularly swine and poultry, can be attributed to the rapid succession of discoveries concerning <u>vitamins</u>. Research concerning _____ has increased the efficiency of animal production and has made possible the prevention of serious diseases.
	2. Previous to 1911 vitamins were unknown. The vitamins that are known are not related chemically to each other, as are proteins, fats, or the carbohydrates. The function of the vitamins are also entirely different from each other.
vitamins	3. The _____ are grouped together because each vitamin is organic in nature and because in many cases it is a nutritive essential required only in an exceedingly small amount.
Vitamins	4. Some vitamins are needed by only a few species of animals. Others are required by all species, but there is no need for a supply in the feed. That is because an adequate supply is synthesized, either in the body tissues or by bacteria in the digestive tract. _____ are grouped together because they are organic in nature.
Vitamin A carotene	5. <u>Vitamin A</u> is required by all animals and can be made only from <u>carotene</u> in plants. Animals must, therefore, receive in their food an adequate supply of _____ or _____.

carotene	6. The knowledge concerning the different amounts of each vitamin in various feeds is limited compared with our knowledge of the ordinary nutrients. Vitamin A is found in the form of _____ in many plants. Animals cannot synthesize this vitamin.
A	7. All green forage crops are rich in most of the vitamins required by farm animals. Animals are not able to produce Vitamin _____. It must be in their feed.
forage	8. Green _____ crops are a rich source of vitamins. These crops provide vitamins (and minerals) in proportion to the leafiness of the plant.
	9. The exception to the preceeding statement is lack of Vitamin D and Vitamin B_{12}. These two vitamins, D and B_{12}, are not plentiful in green forage crops.
	10. Swine and poultry on good pasture do not seem to need Vitamin B_{12} even though pasture is not a good provider of Vitamin B_{12}. Vitamin D is supplied by sunlight.

D D, B_{12}	11. Hay and other dry forage cured in the sun supply vitamin _____. Pasture is not a good source of vitamins _____ and _____.
forages vitamins and minerals	12. Green forages supply undiscovered vitamins as indicated by the fact that sows on dry lot fed a seemingly balanced diet are unable to reproduce--until supplied with green _____. Legumes have more leaves than grasses and are richer in _____ and _____.
D	13. A study of vitamins is not complete without some mention of the antivitamins. Antivitamins are substances that prevent the action of the vitamin or even destroy it. The sun supplies vitamin _____ to animals directly and indirectly through hay.
antivitamin	14. Paralysis for foxes raised for fur is caused by an _____ in certain raw fish that destroys the vitamin thiamin. Bracken fern poisoning of cattle also seems to be caused by an antivitamin.
A	15. Vitamin _____ must be included in an animal's feed as carotene. This vitamin is essential for maintenance of mature animals and in greater amounts for growth, reproduction, and lactation.

carotene	16. The so-called "cottonseed-meal poisoning," produced when cattle are fed for lengthy periods on such a ration as cottonseed meal and cottonseed hulls, is due primarily to the lack of Vitamin A. Vitamin A is found in plants as _____.
Vitamin A	17. Severe losses of vitamin A occur through oxidation during hay making or long storage periods. Hay stored a year or longer has little or no vitamin A feed value. "Cottonseed-meal poisoning" is caused primarily by a shortage of _____. Rain on drying hay results in severe losses of vitamin A. Energy losses occur if molding occurs.
Antivitamins A	18. The cereal grains with the exception of corn are very low in vitamin A. _____ are substances that prevent the action of vitamins or even destroy them. Severe losses of vitamin _____ occur during the hay making process due to the drying action of the sun (oxidation).
A	19. Adequate vitamin D is necessary for the proper assimilation and use of Calcium and Phosphorous and the development of good bones and teeth. Vitamin D is needed especially during growth. Much less Vitamin D is necessary for maintenance of mature animals. The cereal grains, with corn the one exception, are low in vitamin _____.
calcium phosphorous	20. Poultry need more vitamin D in their rations than do other farm stock, especially for egg production. Vitamin D is necessary for the proper assimilation of the minerals _____ and _____.

Poultry L	21. _____ need more vitamin D than do other livestock. The assimilation of calcium and phosphorous is tied to adequate amounts of vitamin _____.
growth	22. Deficiency of vitamin D causes rickets. Less severe deficiencies retard growth and produce a weak skeleton. Vitamin D is needed especially during _____.
rickets	23. A deficiency of vitamin D in mature fowls causes thin-shelled eggs, decreased egg production, and lowered hatchability. Deficiency of vitamin D causes r_____.
A	24. When dairy cows, beef cattle, or sheep receive ordinary rations that include satisfactory roughage, no attention need generally be given to the B-complex vitamins because of the synthesis of these vitamins in the rumen. The cereal grains are low in vitamin _____ except for corn.
vitamin D	25. Swine need the B-complex vitamins in their feed because there is little synthesis of them in their digestive tracts. Their requirements are met by pasture during the growing season and good well-cured legume hay when not on pasture. Thin-shelled eggs may be caused by a deficiency of _____.

synthesize or produce	26. Sheep, beef, and dairy cattle _____ the B-complex vitamins in the rumen.
swine	27. Forms of yeast such as brewers dried yeast are sometimes used as a B-complex vitamin supplement. _____ do not synthesize B-complex vitamins in their digestive tracts and, for this reason, must receive adequate B-complex vitamins in their feed.
Riboflavin	28. Riboflavin or Vitamin B_2 is required in large amounts for poultry. Milk and dairy by-products such as dried skim milk, dried buttermilk, and dried whey are especially rich in riboflavin. They are valuable poultry feeds. _____ is vitamin B_2.
Yeasts riboflavin milk products	29. _____ are sometimes used as B-complex vitamin supplements. Vitamin B_2, or _____, is supplied in good amounts by _____ _____.
rich	30. Niacin or nicotinic acid is a B-complex vitamin that is necessary for all animals. Ruminants synthesize their own supply. Humans, dogs, swine, and poultry require a supply in their food. Milk and dairy products are a _____ source of riboflavin.

Ruminants humans, dogs, swine or poultry	31. Dried yeast, rice polish, rice bran, wheat bran, peanut oil meal, and green forage and pasture crops are rich in the vitamin niacin. Good quality hay supplies a fair amount, while corn, grain, oats, rye, and dairy by-products have a rather low content. _____ synthesize their own supply of niacin; _____ do not.
rich Ruminants humans, dogs, swine or poultry	32. Vitamin E is necessary for Reproduction in poultry, rats, and perhaps some other animals. "Stiff lamb disease," can be prevented or cured by vitamin E. A deficiency of vitamin E seems to be the cause of "white muscle disease" also. Green forage is _____ in niacin. _____ synthesize their own supply of niacin; _____ do not.
reproduction	33. A lack of vitamin in poultry feeds causes the disease encephalomalacia, or "crazy chick disease." A prolonged lack causes lowered hatchability of eggs and sterility of males. Vitamin E is necessary for r_____ in poultry.
E	34. Deficiency of vitamin _____ seems to cause "white muscle disease." "Stiff lamb disease" can be cured by this vitamin. "Crazy chick disease" is caused by a deficiency of this vitamin.
Vitamin C	35. Only human beings, monkeys, and guinea pigs lack the ability to synthesize ascorbic acid (vitamin C). Sailors in our early history suffered from a deficiency of _____ _____.

vitamin C	36. A deficiency of vitamin C (ascorbic acid) in man, monkeys, or guinea pigs causes scurvy. The symptoms are loosening of the teeth, inflammation of the gums, hemorrhages, brittleness of the bones, slow healing of wounds, and loss of vigor. Slow healing of wounds is a symptom of a deficiency of _____ _____.
scurvy	37. A deficiency of vitamin C evidenced by loosening of the teeth is a sign of _____.

Name _____

VITAMINS

Post-Test

UNDERLINE THE CORRECT ANSWER(S).

1. The chemical make-up and functions of vitamins are _____.

   a. similar to each other
   b. similar but distinct
   c. different from each other

2. Vitamin _____ is required by all animals and must be present in the feeds.

   a. A
   b. B
   c. C
   d. D
   e. B_{12}

3. Research in vitamins is _____.

   a. extensive
   b. limited
   c. questionable
   d. economical

4. So-called "cottonseed meal poisoning" is really a deficiency of vitamin _____.

   a. A
   b. B_{12}
   c. C
   d. D
   e. F

5. Severe losses of vitamin _____ occur through oxidation during hay making or long storage periods.

   a. A
   b. B_{12}
   c. D
   d. E
   e. B_2

Name _____

6. Adequate vitamin D is necessary for the proper assimilation and use of the minerals _____ and _____.

   a. phosphorous
   b. manganese
   c. calcium
   d. magnesium
   e. iron
   f. zinc

7. Poultry need more vitamin _____ in their rations than do other farm stock, especially for egg production.

   a. A
   b. B
   c. C
   d. D
   e. E

8. Deficiency of vitamin _____ causes rickets.

   a. A
   b. B
   c. B_2
   d. D
   e. B_{12}

9. Swine need _____ because they do not synthesize it in their digestive tracts as sheep, beef, and dairy cattle do.

   a. vitamin A
   b. vitamin B-complex
   c. vitamin C
   d. vitamin D

10. All green forages are _____ sources of vitamins.

   a. poor
   b. moderate
   c. rich
   d. inadequate

Name _____

11. A deficiency of vitamin _____ accompanied by loosening of the teeth is evidence of scurvy.

    a. A
    b. B_2
    c. C
    d. D
    e. B_{12}

12. An _____ prevents the actions of vitamins or kills the vitamins.

    a. exovitamin
    b. antivitamin
    c. killer vitamin
    d. antidote

13. Vitamin _____ is necessary for reproduction in poultry, rats, and perhaps some other animals.

    a. A
    b. E
    c. C
    d. D

14. Lack of vitamin _____ seems to cause "white muscle disease."

    a. A
    b. E
    c. C
    d. D

15. Slow healing wounds are symptomatic of a deficiency of vitamin _____.

    a. A
    b. B_{12}
    c. C
    d. D

MINERALS

Note to Teachers

This is a programmed instruction unit titled "Minerals." This program is the fourth of the animal nutrition series.

This program is designed for high school students who have successfully completed the first three units in the animal nutrition series.

"Minerals" includes the knowledges listed below:

1. Importance of minerals for animal growth and reproduction.
2. Which minerals are required.
3. Which body functions minerals perform in the body.
4. Adequate mineral nutrition, what it depends upon.
5. Symptoms of mineral deficiencies.
6. Classification of minerals as major or minor elements.
7. Knowledge of information tables available to balance a ration for minerals based upon the minerals supplied by particular feeds.
8. Salt deficiency symptoms.
9. Symptoms of deficiency for the major and minor elements.
10. Specific mineral information for common feeds for different classes of livestock.

Name _____

MINERALS

Pre-Test

UNDERLINE CORRECT ANSWER(S).

1. A ration containing an abundance of protein, carbohydrates, and fat, without minerals will generally result in the death of an animal _____ than if no food at all is given.

   a. at the same time
   b. sooner
   c. later

2. _____ minerals are known to be required by animals.

   a. 7
   b. 9
   c. 11
   d. 13
   e. 15

3. Extra minerals fed as "insurance" _____ an economical supplement to feed.

   a. are
   b. are not

4. Mineral deficiencies are important only if deficiency symptoms can be observed.

   a. True
   b. False

5. Block salt _____ be depended upon as a lone supply of salt for average to high producing dairy cattle.

   a. should
   b. should not

Name _____

6. Animals with a craving for salt based upon a lengthy deficiency may eat enough to _____.

   a. require none for a period of time
   b. catch up on their requirements
   c. injure themselves

7. Alfalfa is classed as _____ in phosphorus.

   a. poor
   b. moderate
   c. rich

8. Plenty of _____ will help prevent rickets.

   a. sunlight
   b. alfalfa hay
   c. protein
   d. milk

9. The important function of _____ in sheep nutrition is to promote synthesis of Vitamin B_{12} in the rumen.

   a. manganese
   b. iron
   c. cobalt
   d. zinc

10. _____ cannot get enough black salt to satisfy their requirements.

   a. Swine
   b. Cattle
   c. Sheep

11. "Shot gun" mixtures of minerals _____ an economical feed supplement for livestock.

   a. are
   b. are not

12. Thumps are an indication of _____.

   a. too much milk
   b. anemia
   c. too much iron

Name _____

13. The Pacific Northwest is a(n) _____ deficient area.

    a. iron
    b. iodine
    c. calcium
    d. phosphorus

14. _____ is a good source of calcium.

    a. Ground limestone
    b. Bonemeal
    c. Meat scraps
    d. Tankage
    e. Sodium chloride
    f. Dicalcium phosphate

15. Plenty of _____ will help prevent rickets and cure if in its early stages.

    a. iron
    b. salt
    c. bleached hay
    d. sunshine

16. Mineral deficiencies _____ economic losses even though deficiency symptoms are not visibly apparent.

    a. can cause
    b. cannot cause

17. Anemia in animals results from a deficiency of _____.

    a. salt
    b. iron
    c. cobalt

18. _____ is necessary for the formation of thyroxine, a hormone of the thyroid gland.

    a. Iron
    b. Salt
    c. Cobalt
    d. Manganese
    e. Iodine

Name _____

19. Slipped tendons in growing chickens result from _____ deficiency.

a. mangesium
b. iron
c. manganese
d. cobalt

20. Match the following materials with the minerals they provide.

a. Oystershell	_____ calcium
b. Iron sulfate	_____ salt
c. Sodium chloride	_____ iron

21. _____ _____ or _____ _____ are good sources of calcium and phosphorus.

a. Oystershell
b. Dicalcium phosphate
c. Steamed bone meal
d. Iron sulfate
e. Vitamin A

22. The function(s) of phosphorus in the animal is (are) _____. Choose correct answer(s).

a. bone formation
b. regulating body processes
c. necessary for usage of carbohydrate by animal
d. necessary for usage of fat by animal
e. necessary for usage of protein by animal

23. _____ animals have the greatest need for minerals such as calcium and phosphorus.

a. Young
b. Mature
c. Aged

Name _____

24. Label the following with

A. Major element
B. Minor element
C. Not essential for livestock

_____1. Calcium
_____2. Gold
_____3. Selenium
_____4. Cobalt
_____5. Platinum
_____6. Uranium
_____7. Phosphorus
_____8. Magnesium
_____9. Copper
_____10. Potassium
_____11. Manganese
_____12. Iodine
_____13. Chlorine
_____14. Sulfur
_____15. C
_____16. Sodium
_____17. Iron
_____18. Lead
_____19. Tin
_____20. Aluminum

25. Studies at WSU indicate adequate amounts of most minerals with the exception of _____, in the state of Washington.

a. zinc
b. copper
c. selenium
d. sulfur
e. calcium

INFORMATION PANEL

This is a programmed instruction unit for "Minerals." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Minerals

If you have not read the information panel, do so now, then proceed to frame 1.

Name _____

1. _____
2. _____
3. _____
4. _____
_____
_____
5.
6. _____
7. _____
8. c _____
p _____
p _____
s _____
s _____
c _____
m _____
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25. _____
26. _____
27. _____
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_____
28. _____
A. _____
_____

Minerals,
Continued

Name _____

28. B. _____
_____
C. _____
_____
29. c _____
p _____
30. _____
31. _____
32. _____
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47. _____
48. L _____
_____
_____
49. _____
50. _____
51.

linerals	1. A ration containing an abundance of protein, carbohydrates, and fat without minerals will generally result in the death of an animal sooner than if no food at all is given. _____ are necessary for many body processes including growth and reproduction.
15	2. Fifteen separate and distinct mineral elements are known to be required by animals. Some of the important functions they perform in the body are: (1) they contribute to the body structure, particularly the bones and teeth, (2) they aid in muscular activities, in the reproduction processes, and in lactation and egg production, and (3) they promote digestion of food, repair the body tissues in maintenance, formation of new tissue in growth, and liberation of energy for muscular work and activity and the production of heat. _____ minerals are known to be required by animals.
minerals	3. Adequate mineral nutrition is dependent on: (1) a sufficient intake of each required element, (2) presence of the elements in forms biologically available to animals, (3) a suitable balance between each of the elements, and (4) adequate supply and balance of other nutrient factors. Sufficient energy and vitamins in balance with other nutrients are necessary to insure adequate absorption of available _____.
3 2 and 3 1 and 4	4. We must know the type of ration and the form in which the mineral is fed based upon item _____ in frame 3 above. Fertilizer elements added to a deficient soil might result in a deficiency of a mineral element previously adequate in the feed ration and probably adequately supplied now. This condition could be explained by _____ and _____, listed in frame 3. Irrigation may wash away soluble minerals such as calcium. Calcium might become deficient because of _____ and/or _____ listed in frame 3.
	5. When supplementing rations, only those minerals that are deficient need be added. As necessary as minerals are, an oversupply can reduce performance or in some cases even be toxic. As an example, cobalt is most essential yet when as little as 12 ppm (.1 gram/day) is fed, digestion of roughage is reduced. Consequently, cattle feeders cannot operate on the theory that if a small amount of mineral is good three times this level would be better. Indiscriminate use of minerals may be expensive in cost and in reducing performance.

False	6. Mineral deficiencies may be so slight as to be hardly noticeable or acute enough to cause death. Correct feeding practices must include feeding of the minerals that the animal needs. Nothing is gained in adding a mineral to a ration in which enough of that mineral is already included. Extra minerals fed as "insurance" are an economical supplement to feed. True or False.
False	7. Mineral deficiencies that are not severe enough to result in visible symptoms may represent an economic loss because of reduced growth and inefficient feed utilization. Therefore, mineral deficiencies may result in an economic loss before they are serious enough to cause visible symptoms. Mineral deficiencies are important only if deficiency symptoms can be observed. True or False.
calcium phosphorus potassium sodium sulfur chlorine magnesium False	8. The essential elements are usually classified as either major or minor. The essential major elements are calcium, phosphorus, potassium, sodium, sulfur, chlorine, and magnesium. The essential major elements are: c_____, p_____, p_____, s_____, s_____, c_____, and m_____. Mineral supplements should be added to rations according to the theory "if a little is good, a lot is better." True or False.
iron zinc copper iodine manganese cobalt selenium molybdenum fluorine	9. The minor or trace elements usually considered as essential are iron, zinc, copper, iodine, manganese, cobalt, selenium, molybdenum, and fluorine. Write these names on your answer sheet. You should become familiar with them. In addition to these elements known to be required, an animal's body may contain 20 to 30 additional different elements in trace amounts. Some of them may one day prove to be essential.
cannot	10. Studies at WSU indicate that animals studied at 20 locations throughout Washington state were being fed rations containing an adequate amount of most minerals with the exception of copper on the West side and in the Basin. Certain by-product feeds are exceptionally low in one or more minerals, and a deficiency proportional to the amount of the by-product fed might occur. Also, when rapid gains are expected the stress is likely to increase the requirements over that normally needed for many of the minerals. General recommendations of mineral supplements for all rations (can, cannot) be made with assurance for a statewide area.

feed lot operation False May cause imbalance and thereby cause a deficiency	11. Mineral deficiency will be more likely with a (feed lot operation) or (cow and calf operation). Extra minerals fed liberally as "insurance" are an economical supplement to a ration. True or False. Why or why not?

12. In order to supply the correct amount of minerals, it is necessary first to know the mineral composition of the feeds. Knowing this, one can add the correct minerals and amounts as needed. Some of the commonly used cattle feeds of Washington have the following approximate mineral compositions:

	Calcium	Phosphorus	Salt		Copper	Iodine	Cobalt
			Sodium	Chlorine	mg/lb.		
	%	%	%	%			
Alfalfa	1.50	0.25	.13	.37	2-4	b	b
Barley	0.06	0.35	.06	.15	1-2[a]	b	b
Beet pulp	0.62	0.09	.18	.17	5	b	b
Corn silage (dry matter basis)	0.33	0.23	.01	.05	0.6	b	b

[a]Estimated
[b]Not present, in amounts too small to be detected or contents not known.

If you were feeding a ration composed as follows:

Alfalfa 20%
Beet pulp 30%
Barley 50%

It would contain approximately 0.52 per cent calcium, 0.25 per cent phosphorus, 0.3 per cent salt, and 1.4 mg copper per pound. Such a ration is inadequate in iodine, copper, and salt. It will be readily observed that adequate calcium is present. There is enough phosphorus--if it is all available. In this case phosphorus supplementation would be good insurance.

13. A general statement about possible mineral deficiencies* in the state of Washington is that salt and iodine (iodized salt) should be added to rations. There is also a possibility of copper deficiencies. Other minerals should be fed as needed in a form that is most available to cattle.

*beef cattle

sodium and chlorine or salt	14. Sodium and chlorine combined as sodium chloride is common salt. The symptoms of a salt deficiency are, an intense craving for salt, rapid weight loss, lusterless eyes, and in the case of dairy cattle, diminished milk production. A rapid weight loss can be symptomatic of a _____ deficiency in cattle.
salt	15. Calves and sheep require 1/4 to 1/2 ounce of salt per day, while high producing cows may require as much as 3 ounces. Salt may be included in the swine ration (1/2 to 1 per cent) but generally it is advisable to supply animals free choice also. Block salt should not be depended upon as the lone supply of salt for average to high producing dairy cattle. Lusterless eyes, rapid loss of weight and diminished milk production are symptoms of _____ deficiency.
kill or make sick	16. Animals that have not had salt for some time should not be given free access to it because they may eat enough to cause digestive disturbances or even death. They should be given small quantities daily until the craving has largely disappeared. Animals with a craving for salt based upon a length deficiency may eat enough to _____ if given free access to large amounts of it.
regulating body processes	17. Phosphorus also is found primarily in the bones and teeth. About 80 per cent of it is used for structural purposes. Like calcium, it is important in bone formation, but this is not its most important function since it is vitally concerned in regulating various body processes. Protein, fat, and carbohydrates cannot be used by the animal in the absence of phosphorus. This compound serves at least 14 different functions in the body. Phosphorus is primarily important for (bone formation) or (regulating body processes).
	18. Potassium has received renewed interest in the last few years. Deficiency symptoms may range from barely noticeable to acute. Slightly reduced feed intake or performance may go unnoticed. A minor stiffness, especially in the front joints that could be mistaken for disease, weather, or effects of age, may actually be due to insufficient potassium intake. One possible reason for a higher incidence of these problems is that rations have been changed to include more feedstuffs with lower potassium content. Most cereal and animal products are, at best, only marginal in potassium content and these ingredients comprise the major part of today's rations for rapidly growing and fattening cattle.

is not	19. One example of comparative availability of minerals is that of calcium. It has been shown that the calcium contained in milk is much more readily available for absorption than is the calcium in other foods. But, even if the calcium available for absorption is high, unless there is a proper ratio of calcium and phosphorus and vitamin D, the absorption cannot be fulfilled and the calcium will pass through the body and be excreted. Adequate supply of a mineral is or is not a guarantee of adequate absorption by the animal?
phosphorus	20. Symptoms of a phosphorus deficiency are stiffness and soreness of the joints, listlessness, and lack of appetite, and even a depraved appetite causing the animal to eat dirt or chew bones or wood. Thus rate of growth and production are affected. Lack of _____ can affect rate of growth and production.
moderate poor	21. Feeds are classed as phosphorus <u>poor</u>, <u>moderate</u>, or <u>rich</u>. Most legume hays are <u>moderate</u> in phosphorus while the grass hays are <u>poor</u>. If the dry matter of the feed contains less than .2 per cent, it is classed as <u>phosphorus poor</u>; between .2 per cent and .5 per cent, as <u>moderate</u> amount; and more than .5 per cent, as <u>phosphorus rich</u>. Alfalfa is _____ in phosphorus. Grass hay is _____ in phosphorus.
moderate poor	22. The cereal grains are moderate in phosphorus while beet pulp, silage, and early green pastures are poor. The cereal grains are _____ in phosphorus while beet pulp, silage, and early green pastures are _____.
rich	23. Wheat bran, cottonseed meal, skimmilk, and linseed meal are rich in phosphorus. Wheat bran, cottonseed meal, skimmilk, and linseed meal are _____ in phosphorus.

TABLE 1

PHOSPHORUS

Poor	Moderate	Rich
Dry -.2%	Dry .2 - .5%	Dry .5%+
Grass hay	Legume hay	Wheat bran
Beet pulp	Cereal grains	Cottonseed meal
Silage		Skimmilk
Early green pasture		Linseed oil meal

TABLE 2

CALCIUM

Poor	Moderate	Rich
Cereal grains	Bluegrass pasture	Alfalfa hay
Legume feeds	Linseed oil meal	Red clover hay
Grass hay*	Cottonseed oil meal	Ladino clover hay
	Soybean oil meal	Tankage
	Dried beet pulp	Meat scraps
	Corn silage	Fish meal
	Fodder	Milk products

*Grown on acid soils

steamed bonemeal	24. Rations poor in phosphorus should be supplemented with steamed bonemeal, dicalcium phosphate, or defluorinated rock phosphate. Dicalcium prosphate is generally preferred but any one of the three materials will supply phosphorus in a satisfactory form, especially if it doesn't contain fluorine. It becomes a matter of convenience to make available steamed bonemeal and salt in two containers. One container to contain salt, the other to contain 2/3 salt and 1/3 dicalcium phosphate or steamed bonemeal. _____ is the supplement generally preferred as a source of phosphorus.
calcium	25. Calcium deficiencies result in weakening of the bones, lameness, and even fractures. Less serious symptoms include slow growth, poor condition, or unsatisfactory milk production. Bones are composed largely of phosphorus and _____.
gypsum (calcium sulphate), lime	26. An excess of calcium will often decrease absorption of zinc and manganese. What plant fertilizer additive adds calcium to the soil? Calcium is the major mineral of the body. About 99 per cent of this mineral is found in the bones and teeth while the remaining 1 per cent is in the soft tissue. Since calcium is used largely for structural purposes it is needed in greater amounts for younger animals than for feed lot cattle. Calcium has other functions in the body such as blood clotting.
rich poor moderate	27. Calcium poor feeds include cereal grains, and their by-products, legume seeds and all grass hay grown on acid soils. Calcium in moderate amounts is supplied by bluegrass pasture, linseed meal, cottonseed meal, soybean meal, all grass hay grown on non-acid soils, dried beet pulp, and corn silage and fodder. Calcium rich feeds include alfalfa hay, red clover hay, ladino clover hay, tankage, meat scraps, fish meal, and milk products. Alfalfa hay and tankage are calcium _____ feeds. The cereal grains are _____ in calcium and _____ in phosphorus.
limestone, ground oystershell, steamed bonemeal, dicalcium phosphate	28. Calcium supplements include good grade limestone, dicalcium phosphate, ground oystershell, or steamed bonemeal. Vitamin D, furnished by direct sun rays enables an animal to make better use of the calcium available to it. _____ is a good calcium supplement.

Practice Review Use Tables 1 and 2

A. Grass hay grown on acid soil is _____ in calcium and _____ in phosphorus.

B. Cottonseed meal is _____ in phosphorus and _____ in calcium.

C. Ladino hay is a calcium _____ feed and a _____ source of phosphorus.

calcium phosphorus	29. Fattening hogs require no additional calcium or phosphorus if fed enough tankage, fishmeal, or milk by-products to balance the protein needs of the ration. Soybean meal used as a protein supplement requires additional finely ground limestone or bonemeal fed free choice. Fattening hogs require no additional c_____ or p_____ if fed enough tankage, fishmeal, or milk by-products to balance the protein needs of the ration.
milk	30. (Beef Cattle) More calcium and phosphorus is need by young calves than by older cattle. Nursing calves or calves getting skimmilk need no extra calcium. Should the soil of their pasture be deficient in phosphorus, dicalcium phosphate should be made available. Phosphorus is more of a problem than calcium and dicalcium phosphate has a good balance of calcium and phosphorus. _____ is an adequate source of calcium for young calves.
aremia	31. Anemia in animals results from a deficiency of iron. It is recognizable by paleness of the skin and especially membranes of the mouth. Thumps in suckling pigs is also an indication of anemia. The problem usually is limited to pigs kept on concrete or wooden floors with no access to soil and calves, lambs, or colts kept too long on milk as their only feed. Milk is deficient in iron. A deficiency of iron results in _____.
iodine	32. Iodine is necessary for the formation of thyroxine which is a hormone of the thyroid gland. When a deficiency of iodine exists, the gland enlarges in an effort to provide more thyroxine. _____ is necessary for the formation of thyroxine.
iodized salt iodine	33. Iodized salt with stabilized iodine added is a good way to provide iodine. Iodine deficiency in sheep results in the birth of weak, dead, or woolless young. Stabilized _____ is a good way to provide _____.

stabilized	34. Iodine deficient areas occur locally throughout the Northwest, the Great Lakes Region, Indiana, Ohio, Pennsylvania, Illinois, the Dakotas, Nebraska, Utah, Nevada, Colorado, Idaho, and Montana. _____ iodine is necessary to prevent weathering of iodized salt blocks.
coprer	35. Copper deficiency may exist as a primary deficiency or in combination with cobalt and possibly iron deficiencies. Copper deficiency seems to be associated with anemia. Anemia is recognizable by paleness of the skin and especially the membranes of the mouth. _____ deficiency may exist as a primary deficiency or in combination with cobalt and possible iron deficiencies.
copper	36. Animals suffering from inadequate copper intake appear to be unable to absorb iron at a normal rate, and a defect in hemoglobin synthesis exists. Symptoms of copper deficiency in young lambs are muscular incoordination with partial paralysis of the hindquarters. A defect in hemoglobin synthesis may result from a _____ deficiency preventing absorption of adequate iron.
vitamin B_{12}	37. The important function of cobalt in sheep nutrition is to promote synthesis of Vitamin B_{12} in the rumen. Cobalt deficiency causes a loss of appetite, lack of thrift, weakness, anemia, and a decrease in fertility and in milk and wool production. Cobalt functions in the rumen to promote synthesis of _____.
sulfur	38. Sulfur is essential in livestock diets. It functions in the synthesis of sulfur containing amino acids in the rumen and certain other sulfur compounds of the body. Mature grass and grass hays are sometimes low in sulfur and may not furnish adequate amounts for optimum animal performance. _____ functions in the synthesis of some amino acids in the rumen.

manganese	39. The symptoms of manganese deficiency are poor hatchability of the eggs in the laying flock and slipped tendons in growing chickens. Rations containing wheat or wheat products or a small amount of manganese sulfate will generally prevent the trouble. A deficiency of m_____ does affect hatchability of eggs and causes slipped tendons in growing chickens.
salt	40. Tankage, milk by-products, or fishmeal fed to boars in large enough amounts to balance their protein needs satisfies the mineral needs except for salt. _____ is the only mineral not adequately supplied to boars when protein requirements are satisfied with tankage, milk by-products, or fishmeal.
sunshine	41. Calves in confinement sometimes get rickets. Feeding a well-balanced ration made up of grain and sun-cured legume hay, and access to sunlight will prevent rickets and cure it in its early stages. Plenty of _____ will help prevent rickets.
Dicalcium phosphate	42. Cows nursing calves on early spring pasture may need calcium added to their ration. Dicalcium phosphate is a good form to use. Good legume hay fed at the rate of 6 or 7 pounds daily with other roughage should provide enough calcium but phosphorus may be lacking. _____ _____ is a good source of phosphorus.
ground limestone or dicalcium phosphate	43. Bulls fed mixed hay and grain during winter need no mineral supplement other than salt. If no legume hay is fed, calcium should be supplied by ground limestone, free choice, or dicalcium phosphate. Bulls on pasture and grain, or bulls on grass hay should be supplied with _____ _____.

will not	44. Neither calcium or phosphorus are necessary supplements when stocker and feeder cattle are fed a balanced ration of grain and good legume hay. Feeder and stocker cattle on a balanced ration for nutrients other than minerals including legume (will, will not) be adequately supplied with calcium and phosphorus.
pasture legume hay	45. Supplementary minerals are not necessary for young dairy cattle on pasture or legume hay except for salt. It is good practice to keep dicalcium phosphate available to them, however. High producing cows in the early stages of lactation may need additional calcium and phosphorus. Supplementary minerals are not necessary for young dairy cattle on _____ or _____ except for salt.
ground limestone steamed bonemeal or dicalcium phosphate phosphorus phosphorus	46. Producing dairy cattle not receiving legume hay should be furnished ground limestone or steamed bonemeal. These may be mixed with the grain at the rate of 1 to 2 pounds for each 100 pounds of grain mixture, or for cows on pasture a mixture consisting of equal parts bonemeal or dicalcium phosphate, limestone, and salt may be supplied in feeders to which the cattle have free access. Dairy cattle not on legume hay should receive _____ or _____. Dairy cattle fed grass hays are generally deficient in _____. This can be remedied usually by feeding supplements high in _____.
loose	47. Salt should be available at all times. Swine cannot eat enough block salt to get all that they need, so loose salt should be fed in the ration or free choice. Brood sows and pigs not running on pasture should be self-fed sun-cured legume hay to provide calcium and Vitamins A and D. This is especially true during the winter when pastures are not available. Salt should be provided for swine in the _____ form.
Legume iron copper NOTE: Iron injection or solution painted on the udder or iron sulfate (iron + copper) or ferrous sulfate fed to the litter.	48. L_____ hay is needed to provide calcium and Vitamins A and D for brood sows and pigs not on pastures. It is impossible to give a lactating sow the feeds that will enable her to furnish enough iron and copper in her milk to prevent anemia in her pigs. For this reason young pigs kept on concrete or wooden floors should have _____ and _____ provided.

manganese	49. Poor hatchability of the eggs in a laying flock and slipped tendons in growing chickens result from manganese deficiency. Wheat and wheat products or 4 or 5 ounces per ton of manganese sulfate will generally prevent the trouble. Slipped tendons in growing chickens result from _____ deficiency. Manganese deficiencies are common only in the poultry industry.
no	50. Now that you are aware of mineral deficiencies to be concerned about, answer this question again. Should extra minerals be fed as "insurance" to maximize profits?
	51. With the increasing usage of irrigation in the United States mineral supplements will become more necessary. Some of the important minerals are soluble and will become deficient because of irrigation. Commercial fertilization has the effect of adding minerals to the soil. In some cases this could bring about a poor balance of minerals. In other cases the fertilizer elements will compensate for losses through irrigation.

Name _____

MINERALS

Post-Test

UNDERLINE CORRECT ANSWER(S).

1. A ration containing an abundance of protein, carbohydrates, and fat, without minerals will generally result in the death of an animal _____ than if no food at all is given.

   a. at the same time
   b. sooner
   c. later

2. _____ minerals are known to be required by animals.

   a. 7
   b. 9
   c. 11
   d. 13
   e. 15

3. Extra minerals fed as "insurance" _____ an economical supplement to feed.

   a. are
   b. are not

4. Mineral deficiencies are important only if deficiency symptoms can be observed.

   a. True
   b. False

5. Block salt _____ be depended upon as a lone supply of salt for average to high producing dairy cattle.

   a. should
   b. should not

Name _____

6. Animals with a craving for salt based upon a lengthy deficiency may eat enough to _____.

   a. require none for a period of time
   b. catch up on their requirements
   c. injure themselves

7. Alfalfa is classed as _____ in phosphorus.

   a. poor
   b. moderate
   c. rich

8. Plenty of _____ will help prevent rickets.

   a. sunlight
   b. alfalfa hay
   c. protein
   d. milk

9. The important function of _____ in sheep nutrition is to promote synthesis of Vitamin B_{12} in the rumen.

   a. manganese
   b. iron
   c. cobalt
   d. zinc

10. _____ cannot get enough block salt to satisfy their requirements.

   a. Swine
   b. Cattle
   c. Sheep

11. "Shot gun" mixtures of minerals _____ an economical feed supplement for livestock.

   a. are
   b. are not

Name _____

12. Thumps are an indication of _____.

    a. too much milk
    b. anemia
    c. too much iron

13. The Pacific Northwest is a(n) _____ deficient area.

    a. iron
    b. iodine
    c. calcium
    d. phosphorus

14. _____ is a good source of calcium.

    a. Ground limestone
    b. Bonemeal
    c. Meat scraps
    d. Tankage
    e. Sodium chloride
    f. Dicalcium phosphate

15. Plenty of _____ will help prevent rickets and cure if in its early stages.

    a. iron
    b. salt
    c. bleached hay
    d. sunshine

16. Mineral deficiencies _____ economic losses even though deficiency symptoms are not visibly apparent.

    a. can cause
    b. cannot cause

17. Anemia in animals results from a deficiency of _____.

    a. salt
    b. iron
    c. cobalt

Name _____

18. _____ is necessary for the formation of thyroxine, a hormone of the thyroid gland.

a. Iron
b. Salt
c. Cobalt
d. Manganese
e. Iodine

19. Slipped tendons in growing chickens result from _____ deficiency.

a. mangesium
b. iron
c. manganese
d. cobalt

20. Match the following materials with the minerals they provide.

a. Oystershell	_____calcium
b. Iron sulfate	_____salt
c. Sodium chloride	_____iron

21. _____ _____ or _____ _____ are good sources of calcium and phosphorus.

a. Oystershell
b. Dicalcium phosphate
c. Steamed bonemeal
d. Iron sulfate
e. Vitamin A

22. The function(s) of phosphorus in the animal is (are) _____. Choose correct answer(s).

a. bone formation
b. regulating body processes
c. necessary for usage of carbohydrate by animal
d. necessary for usage of fat by animal
e. necessary for usage of protein by animal