A COMPARISON OF TEACHING METHODS OF ANIMAL SCIENCE TO OLDER 4-H CLUB BOYS AND GIRLS

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PREFACE

Extension teachers are constantly challenged with the problem of selecting an appropriate and effective teaching method, or combination of methods, which is best suited to do a particular teaching job with specific audiences under specific circumstances.

The purpose of this study is to critically evaluate and measure the effectiveness of the short-course system in teaching selected facets of animal science to older 4-H Club members. Effectiveness of teaching is measured by gains in knowledge of the participants.

The writer wishes to express his appreciation and sincere thanks to his adviser, Dr. Victor Hornbostel, under whose supervision this thesis was planned, conducted, and completed. His entire committee composed of Dean H. E. Sorenson, Dr. Victor O. Hornbostel, Dr. E. J. Turman, Dr. J. C. Egermeier, and Dr. Charles E. Larsen has been a source of guidance, encouragement, and invaluable constructive criticism in the preparation and completion of this thesis.

Special thanks is due to Dr. Bill Taggart and the personnel of Oklahoma Extension Animal Science Division for their assistance and guidance in the study. The writer is also grateful to County Extension staffs in Oklahoma and local leaders in conducting the educational program and collecting the necessary data.

The author wishes to extend special acknowledgement to Earline, his wife, for her help in proofreading, typing the study, and for her

assistance and understanding during this period of graduate study. Gratitude is also expressed to his children Morris, Kaye, and Mark, without whose sacrifices and understanding this study would not have been possible.

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CHAPTER I

INTRODUCTION

The 4-H Club program is an important segment of the Land Grant College system, which is concerned with the development of youth. It has been conducted in the United States for about fifty years, having been formally organized in 1914. The Cooperative Extension Service in cooperation with local schools, began sponsoring corn and canning clubs. Through individual projects for boys and girls, new ideas were demonstrated in communities when adults were not inclined to be interested in accepting the ideas. Chief interest in the early days was on crops, canned products, and calves. With the growth of the 4-H Club program through the years, emphasis has shifted to the development of boys and girls.[1]

The major objective of 4-H Club work is the development of boys and girls through self-help programs and the improvement of farm, home, and neighborhood practices in such a way that both rural and urban youth are brought into touch with the best in each environment and helped to make of themselves efficient, public spirited, and useful citizens.[2] The basic philosophy of this objective is

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[1] A. C. True, A History of Agricultural Extension Work in the United States (Washington, 1928), p. 114.

[2] T. T. Martin, The 4-H Club Leader's Handbook (New York, 1956), p. 6.

pragmatically oriented; it emphasizes individual growth through the ability to learn from experience. To attain the goals or objectives of 4-H Club work, learning experiences have been developed for youth, allowing them the opportunity to grow intellectually and psychologically through each successive experience. Dewey says, "Education is life... not a preparation for it." By this statement he emphasizes that education or learning entails an active, thinking organism by continually reconstructing and integrating his own experiences.[3]

Traditionally, people think of 4-H Club work as an organization only for rural people, but there are no legal barriers to conducting youth programs in urban areas. Also, urban people pay taxes for the support of this service and feel that they are within their rights as citizens in requesting its opportunities.

In the main, rural procedures with small adaptations have been used in urban areas, but the rural and urban situations are different. Consequently, present trends indicate that group activities, such as special training programs, may become relatively more important than project work in urban areas.

Progress in science has been extremely rapid during the past decade, spurred partly by the spectacular success with space exploration. The Cooperative Extension Service, well aware of these rapid changes, has been analyzing its overall program in order to update it in terms of "science" emphasis. An increased emphasis in science has

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[3]John Dewey, Experience and Education (Tiffin, Ohio, 1938), p. 4-115.

been given attention in the 4-H Club work also. Many of the 4-H Club projects concern subject matter areas of great scientific depth and scope. The animal and agronomic 4-H Club projects encompass many phases of science; such as, the chemistry of digestion, metabolism, and plant growth.

A recent study by the National 4-H Club Foundation made the following statement about the percent status of science in the 4-H Club meat animal livestock program. "Project information is based on research; therefore, members are applying the results of science. However, most members are not aware of the science involved in their projects. There is great potential in this field for science improvement."[4] The need exists for the development and analysis of a revised teaching program in animal science.

The teaching methods employed by the extension workers in 4-H Club work have directly influenced the effectiveness of their efforts. An understanding of the capabilities and limitations of the available teaching tools is essential to their intelligent selection and efficient use. The leaders must recurringly exercise judgment in choosing the working tools which they consider appropriate to accomplish the task at hand. The method or combination of methods is sought which is likely to be more effective than other methods in attaining the desired goals.

The problem faced by the leaders in choosing appropriate tools for the various teaching jobs is not an easy one at best. The leaders are

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[4] Science in 4-H Study, National 4-H Club Foundation Report, April, 1963 (Washington, 1963), p. 7.

attempting to influence the behavior of large numbers of people in life situations which are subject to continual change as the result of economic and social developments. The group to receive the teaching may vary greatly in educational training, age levels, and other characteristics that influence their response to educational stimuli. The on-going youth programs represent all stages of development from new lines of work just starting to projects in advanced stages.

The widespread utilization of volunteer lay leaders to enlarge 4-H Club coverage and increase the teaching of young people emphasizes the importance of a constant evaluation of teaching methods and of helping the local leaders to be more effective in their teaching efforts.

Success of local leaders in teaching others seems to be largely dependent upon such factors as educational background, home ownership, and sex. The training meetings for local leaders are one of the more important influencing factors. Data summarized from four leadership studies by the Federal Extension Service stated that local leaders who attended training meetings influenced 50 percent more people in making two and one-half times as many changes in practices as was true of the leaders who did not participate in such training activities.[5]

There is no easy "patent-medicine" answer to the question, "How can I select and use the various methods available with greater

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[5]Meredith C. Wilson and Gladys Gallup, Extension Teaching Methods (Washington, 1955), p. 3-73.

confidence?" Teaching is far too complex. However, through continual evaluation and objective studies, methods can be compared, revised, and improved.

Nature of the Problem

The purpose of this study is to obtain information that will evaluate a teaching method and assist in developing a more effective educational program of science in youth development. This study will determine the effectiveness of teaching animal science to older 4-H Club boys and girls through project-type clubs as compared with organizational clubs.

Pilot studies in Oklahoma have shown that the relatively new approach to extension teaching often called the "Project Club," is an effective teaching method in several areas of extension activities.[6] The project club is a homogeneous group in interests and age that carry on specific activities in a specific area of 4-H Club work. The organizational 4-H Clubs are composed of boys and girls with varied interests and wide ranges in age difference. The organizational type is the conventional method used primarily in the Southern and Central United States. Additional information defining the two groups is presented later in this chapter.

The effectiveness of the teaching methods will be measured by the amount of knowledge obtained by the participants during the special

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[6]William F. Taggart, "A Critical Analysis of the Short-Course System in Selected Facets of Extension Animal Science Teaching and Program Planning." (Unpublished, Ed.D. Dissertation, Oklahoma State University, 1964), p. 3-4.

training period. The amount of information gained will be measured through evaluation forms in conjunction with a special training course in animal nutrition.

A "t" test was used to evaluate correlated samples for a significant difference. This test was used in evaluating the learning of a particular group from the pretest to the posttest scores. The analysis of covariance was conducted for measuring the difference on pretest and posttest scores between the groups. The final measurement will be the Scheffe's method of evaluation for the significant difference between two group mean scores.

One of the purposes of this study is to prepare an evaluation instrument. The instrument will be used in measuring the effectiveness of the educational training program. The evaluation form was a multiple choice, objective-type instrument pretested for reliability and validity. Appendix A presents a copy of the instrument of evaluation with the correct responses checked.

The animal science material presented to the 4-H Club members was prepared by Iowa State University and the Animal Science Branch of the Federal Extension Service. This material consists of a packet of information for each student plus other training material. This material was taught by local volunteer adult leaders and county extension employees.

Leader training meetings were held prior to the instruction period. The purpose of the meetings was to outline techniques of instruction and familiarize the instructors with material and training aids to be used.

The information received from this study should be beneficial to Cooperative Extension administration and specialists in reaching decisions regarding teaching methods for future science training programs.

Review of Literature

The future of any society depends on how well it prepares its young people to make the decisions and carry the responsibilities of mature citizenship. This task can challenge the best educational efforts of the entire society. Chance and circumstance cannot be counted on to provide the experiences that will help young people become useful, well-informed, self-reliant, responsible adults.[7]

For more than 50 years, 4-H Club work has been a successful method of working with young people. Priority has in the past been given to the needs of farm youth, but 4-H Club work must also interpret its responsibility as applying to young people in rural non-farm homes and in suburban or urban families.[8]

It is becoming clear that if young people of all ages are to be served by the same youth program, it must recognize that their needs differ at various developmental stages. The concept of maturation emerged early in the history of psychology and had a profound effect

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[7] A Guide to Extension Program for the Future, the Scope, and Responsibilities of the Cooperative Extension Service, authored by Special Task Force of Extension Personnel (Raleigh, North Carolina and USDA, 1959), p. 28.

[8] "Objectives of 4-H Youth Work" (unpub. educational material, Oklahoma State University, 1962), p. 1-10.

on early studies of child development. Dennis and Dennis (1940) were able to demonstrate the built-in nature of the walking activity through the study of Hopi Indians.[9] Hilgard (1933) with a pair of twins, concluded from this study that little was gained by providing early practice periods for the twin who did not have this opportunity quickly caught up with the one who had early training.[10]

Research so far undertaken indicates that learning in the child is complex. The emergence of behavior does not occur in a standard way in all spheres of activities. The answer in the complex development of intellectual ability varies in relation to the maturation process.[11]

The development of an individual both physically and intellectually is often defined as growth. Growth is the process by or through which an immature organism reaches maturity. There are physical, mental, emotional, and social aspects to growth. An understanding of these factors is important for the personal development of the young immature person.[12]

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[9]D. W. Dennis and M. G. Dennis, "The Effort of Cradling Practices Upon the Asset of Walking in Hopi Children," Journal of Genetic Psychology, 1931, p. 77-86.

[10]J. R. Hilgard, "The Effect of Early and Delayed Practices on Memory and Motor Performances," Genetic Psychology Monographic, 1933, p. 14.

[11]Robert M. Travers, Essentials of Learning (Macmillian, New York, 1963), p. 226.

[12]D. M. Hall, Dynamics of Group Action (Interstate, Danville, Illinois, 1960), p. 30-90.

"The Scope Report,"[13] a guide to Cooperative Extension programs for the future, outlined specifically the objectives of helping young people to:

1. Acquire knowledge, skills, and attitudes for a satisfying home and family life.
2. Enjoy a useful work experience together with the responsibility and satisfaction of personal accomplishment.
3. Develop leadership talents and abilities to achieve their citizenship potential.
4. Appreciate the values of research and learn scientific methods of making decisions and solving problems.
5. Recognize the importance of scientific agriculture and home economics and their relationships to our total economy.
6. Explore career opportunities in agriculture, home economics, and related fields, and recognize the need for a continuing education.
7. Appreciate nature, understand conservation, and make wise use of natural resources.
8. Cultivate traits of healthful living, purposeful recreation, and intelligent use of leisure time.
9. Strengthen personal standards and philosophy of life based on lasting and satisfying values.
10. Gain attitudes, abilities, and understandings for working cooperatively with others.

Work in 4-H Club is a practical, informal, primarily out-of-the-classroom educational program. These goals suggest that the true measure of success in 4-H Club work with young people will be found in the growth and development it brings to individual personalities.

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[13] A Guide to Extension Program for the Future, the Scope, and Responsibilities of Cooperative Extension Service, p. 30.

One of the objectives outlined by the Scope Report of 4-H Club work is to appreciate the values of research and to learn scientific methods of making decisions and solving problems. The 4-H Club members are trained to understand the "why" of the physical and biological world around them as well as "how" to do things.[14]

Research on teaching of science in relation to pupil behavior has utilized pupil gain on achievement tests concerned mainly with recall and recognition behavior. Although the whole realm of affective behavior has been neglected in our post-sputnik concern for identification and development of scientists, the emotional impacts of instruction and learning are of basic importance.[15]

A test on understanding science for use with pupils in upper grades in high school was prepared by Cooley and Klapfer (1961).[16] Its three subscales were concerned with pupils' images of (1) scientists (18 items), (2) the scientific enterprise (18 items), and (3) the method and aims of science (24 items). This study was designed to measure reaction to science as a vocation rather than to measure the amount of achievement gained in a specific area of science.

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[14] Objectives of 4-H Youth Work, Oklahoma 4-H Club Office (Stillwater, Oklahoma, April, 1962).

[15] Benjamin Bloom, et al., Taxonomy of Educational Objectives (New York, 1956), p. 25-39.

[16] W. W. Cooley and L. E. Klapfer, Manual for the Test on Understanding Science (Princeton, N. J., 1961), p. 1-20.

Kahn (1962)[17] investigated the use of current events as a medium for influencing attitudes toward science. Two teachers and two groups were involved, pretests and posttests were used, and Kahn concluded that the experimental group receiving special instruction scored significantly higher than the group which received no special training. Furthermore, more than four months later, after no further special instruction, the experimental group still excelled the control group.

Boech (1956)[18] investigated the effect of reading and demonstration on pupils scientific understandings. Three groups were formed: (1) one to read and discuss, (2) one to observe demonstrations, but not to read, (3) one to both read and observe demonstrations. Eight teachers and sixteen classes of ninth grade pupils were involved. The topic used was mirrors and mirror images. Six class periods were used.

Analysis of variance showed that performance on final achievement tests was nearly the same for all three methods. On the attitude scale, Boech did find a significant difference. Those who only read about the phenomena had markedly lower interests.

Research on teaching methods is the study of consistencies in the behavior of teachers and the effect of these consistencies on the learning process. A teaching method, a pattern of teacher behavior, may be described and identified in a number of ways. The more common

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[17] P. Kahn, "An Experimental Study to Determine the Effect of a Selected Procedure for Teaching the Scientific Attitudes to Seventh and Eighth Grade Boys," Science Education, 1962, Vol. 46, p. 115.

[18] C. H. Boech, "The Relative Efficiency of Reading and Demonstration Methods of Instruction in Developing Scientific Understandings," Science Education, 1956, Vol. 40, p. 92-97.

practice has been to attempt to describe a particular pattern of teaching behavior in terms of the background of thought or practice on which such patterns are based. For this reason, it is of interest to consider the conditions that generate particular teaching methods.

Wallen and Travers (1963)[19] state that most teaching methods are not mainly derived from an empirical knowledge of learning, but originate from a classification of six factors:

1. Patterns derived from teaching tradition. Illustration: A teacher teaches as he was taught.

2. Patterns derived from social learnings in the teachers background. Illustration: A teacher reinforces the behavior of pupils so as to develop a middle-class ideology.

3. Patterns derived from philosophical traditions. Illustration: A teacher teaches in accordance with Dewey tradition.

4. Patterns generated by the teachers own needs. Illustration: A teacher adopts a lecture method because he needs to be self-assertive.

5. Patterns generated by conditions existing in the school and community. Illustration: A teacher conducts his classroom in such a way as to produce formal and highly disciplined behavior because this represents patterns required by the principal.

6. Patterns derived from scientific research on learning. Illustration: A systematic design of a pattern of behavior for teachers which would maximize the achievement of the pupil.

Very little has been done to develop teaching methods on the basis of scientific knowledge of learning. Most widely advocated

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[19]Norman Wallen and Robert W. Travers, "Analysis and Investigation of Teaching Methods," Handbook of Research Teaching, ed. N. L. Gage (Chicago, 1963), p. 101-120.

teaching methods are based on a philosophical tradition or on the personal need of teachers.

When research on educational methods are viewed in relation to the above classification, the majority of studies involve authoritarianism; that is, the degree to which some person or persons exercise control over the behavior of the students. For example, Lewin, Lippitt, and White (1939)[20] developed a study using three boys' club atmospheres wherein one group's activities were determined by an adult authority leader, a second group employed democratic group-decision processes, and the third group designated a laissez-faire condition wherein no structure existed. The children were ten to eleven years old. Each of the four leaders played the autocratic and democratic "roles" and each child was exposed to all three procedures.

The significant differences found among the three groups were more incidences of aggressive behavior under autocratic procedure than was found in the other two groups. The laissez-faire group was the highest of all, and the democratic approach was intermediate. Secondly, the authoritarian leadership was of little importance in a democratic setting and a hindrance to the laissez-faire group.

Over the years a number of general teaching methods have evolved which imply particular patterns of teacher behavior as well as modifications in objectives and content. Among the best known of

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[20]K. Lewin, R. Lippitt, and R. K. White, "Patterns of Aggressive Behavior in Experimentally Created 'Social Climates'," Journal of Social Psychology, 1939, Vol. 10, p. 270-299.

these methods are: (1) the recitation method (study and recites), (2) the lecture method, (3) the discussion method, as well as the (4) laboratory or project method, (5) the problem solving method, and also (6) the activity method.

The research which has been done has not produced consistent results. The slight differences found usually favor whatever is designated as the "experimental" method. An observation of the differing results may be due to intervening variables involved in the studies.

Critical thinking is a renewed approach that is drawing considerable attention. The critical thinker is often described as possessing three major attributes. They are: (1) use of scientific methods, including emphasis on evidence and nature of hypotheses, (2) the tendency to be inquisitive, critical, and analytical with respect to issues and personal behavior, and (3) use of correct principles of logic. Henderson (1958)[21] carried on an extensive study of this approach in three Illinois high schools. Thirty-six teachers and approximately 1,500 students in English, geometry, science, and social studies participated. In summary, the students taught by the experimental method showed greater gain on measures of critical thinking than the control group.

The study of motivation for learning has been approached from various viewpoints. Early studies gave a great deal of credit to

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[21] K. B. Henderson, The Teaching of Critical Thinking (Phi Delta Kappa, 1958), Vol. 39, p. 280-282.

instinct when trying to explain why animals of all farms followed certain patterns of behavior. Freud (1920),[22] in some of his early writings, tried to rationalize many everyday actions of people in terms of unconscious motivation. Studies involving human subjects were much fewer until recently.

Stephens (1956)[23] says the uncomfortable fact is that we are not sure how any motives operate. Much of the evidence does not tell us whether the motive helped students acquire any additional skill or whether it merely led them to make more vigorous use of the skill they already had.

Sherif and Sherif (1956),[24] social psychologists, define motives as "goal directed behavior." They divide motives into: (1) those which originate in the functioning of organic needs, (2) those which are acquired in the course of genetic development, and (3) those derived from interpersonal experience.

The concept of level of aspiration has been used by social psychology researchers in approaching the problem of motivation. Brunner (1959)[25] states, "The major premise for this concept is that an individual raises or lowers his goals within certain frames of reference which are relevant to these goals or levels of aspiration."

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[22] The World Book Encyclopedia (Chicago, 1965), Vol. 7, p. 457.

[23] J. M. Stephens, Educational Psychology (New York, 1956), p. 35.

[24] M. Sherif and Carolyn Sherif, An Outline of Social Psychology (New York, 1956), p. 365.

[25] Edmund Brunner, et al., An Overview of Adult Education (Chicago, 1959), p. 32.

Chapman and Volkman (1958)[26] studied the effects of certain anchoring points on the level of aspiration of students in psychology courses. The test involved a test of literary ability. First, the students were asked to estimate their score. The test groups were given identical scores but each group was told the score was achieved by groups of people of different status (supervisors, average or peer group, and inferior). Results showed that the mean level of aspiration varied with the frame of reference. From this study it was concluded that the subjects own labor had taken on ego-value, even though it may not have been comparatively good.

The simplest motive, according to Stephens (1956),[27] is the intention to learn. It greatly boosts performance, yet it is not absolutely essential to learning. Other motives usually applied increase immediate output. Even though there is considerable dispute about the precise part motivation plays, there is evidence that it does contribute to efficiency of learning.

In the previous portion of this chapter has presented an overview of the results of research on learning which is applicable to this specific study. The studies reported indicate that scientists are still far from the development of a set of precisely stated laws which can be used in educational practices. Extension education, which is a unique form of education, is particularly lacking empirical

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[26] D. W. Chapman and John Volkman, "A Social Determinant of the Level of Aspiration," Social Psychology, ed. Eleanor E. Moscoby, et al. (New York, 1958).

[27] J. S. M. Stephens, Educational Psychology, p. 64.

evidence for effective teaching. Because early research does not answer the questions asked about effectiveness of teaching methods in extension education, this study seems to be appropriate and timely.

Specific Statement of Problem

This study was designed with two major objectives in mind:

1. To determine if there was a significant difference in the effectiveness of teaching animal science to older 4-H Club boys and girls through project clubs as compared with organizational-type 4-H Clubs.
2. To determine if the study could be evaluated effectively and the information obtained could be used in developing a science emphasis 4-H Club program for all counties in Oklahoma.

Major Variables of Concern

By design, the independent variables are the educational materials used in the educational program along with their use in the two types of clubs. The materials were prepared and were obtained from the Cooperative Extension Service of the Iowa State University. They consisted of individual student packets, instructor guides, and visual aids.

The unit being measured covered only animal nutrition. Other phases of the educational program such as animal breeding were not measured. It was assumed that the data obtained in animal nutrition would probably be applicable to other phases of the science program.

The dependent variable was the posttest scores of the students. The posttest instrument was designed to measure the knowledge gained in animal nutrition of the various groups in the experiment.

Certain frequently used terms in this dissertation require specific definition. These terms are:

Organizational Club: The Oklahoma 4-H Club program is identified as an organizational-type 4-H Club program. The 4-H Club is usually a heterogeneous group of youth by interest and age. A portion of the 4-H Club group may be very interested in a lesson presented, while the remaining 4-H Club members may not be very interested initially. The age of the group will range from nine to twenty-one years. The county extension staff attends the local, monthly 4-H Club meetings and presents a short lesson on one phase of 4-H Club work. The knowledge received by the individual through this process is broad in scope and is from several different areas or projects. Additional project training is conducted by local adult leaders.

Project Club: These are more homogeneous groups of boys and girls organized in inter-community or county-wide clubs. The local 4-H Club is supervised by an adult in the community who is not associated with the school but has special training and knowledge in the subject matter taught. Instruction and training is given by the local leader or leaders. This teaching method is broader in scope than any one method. It is a carefully planned and conducted series of lessons concerning one subject matter area.

Animal Science Lessons: This material was designed by T. W. Wickersham of the Iowa State University Cooperative Extension Service,

Ames, Iowa. The brochure of lessons, leaders guides, and training aids can be purchased from Iowa State University. The lessons were designed to help young people to appreciate the values of research, to learn scientific methods of making decisions and solving problems, and to recognize the importance of the scientific segment of agriculture in the total economy. The lessons were presented on a pilot basis for this project. If successful, they will be revised to fit the needs of all Oklahoma counties.

Null Hypothesis

There will be no significant difference in the effectiveness of teaching animal science to older 4-H Club boys and girls through project clubs as compared with organizational-type clubs.

Assumptions of the Study

The effectiveness of the teacher would be similar if training aids, teaching outline, prepared teaching time schedule, and training of teachers were the same prior to instruction. It was assumed that if boys and girls enroll in 4-H Club projects, they were interested in the education program. It was also assumed that previous experience and location of the subjects had no effect if the matched trio pretest scores were similar. It is expected that young people will increase their knowledge of science, provided they are afforded the opportunity to attend a well-organized, well-planned, and well-presented series of educational classes.

Limitations

There was an attempt to control the following factors whenever possible. However, in some cases, control was not feasible or possible. This investigator is of the opinion that by the use of the control group the possible effects of uncontrolled variables are estimated well enough so that the value of the proposed study is not seriously limited.

A. Both groups of students knew they were involved in a study. Therefore, they may have been influenced by the "Hawthorne Effect,"[28] but any such effects should be similar for both groups.

B. This study was limited to the nutrition phase of the animal science program. If the program is effective on this phase, it probably will be effective in other phases of instruction.

C. The experimental groups were located in different counties in Oklahoma and there may have been geographical differences. It was assumed that if there were differences, the matching on pretest scores of subjects from several different geographical areas would probably control for this limitation.

D. This study involved two or more instructors presenting the information. The variation in teacher effectiveness was reduced by appropriate teacher training and the use of the same teaching material and outline.

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[28] Edwin A. Fleishman, Studies in Personnel and Industrial Psychology, Article 26 (Homewood, Illinois, 1964), p. 252.

E. The written, objective type of measurement was the main type of instrument used. By testing the instrument for reliability and validity with a test group, prior to the experiment, there is an estimate of its effectiveness in measuring the objectives.

F. An evaluation form for adult leaders was developed and used as a secondary tool of evaluation. The instrument was not designed for statistical analysis but to be used as a guide in developing other programs similar in nature.

Significance of the Study

A. The study offered objective evaluation of the project-type system of teaching an aspect of animal science compared with the organizational-type instruction in the 4-H Club program.

B. The study suggested areas in which 4-H Clubs could more effectively and appropriately make a greater contribution to deeper and more widespread understanding, belief, and competence in using the scientific approach among 4-H Club members, their parents, and other related persons.

C. The study offered suggestions for developing educationally appropriate science emphasis programs on a state-wide basis in animal science and other related areas.

CHAPTER II

PROCEDURE

The purpose of this chapter is to present the methodology used in designing, investigating, and analyzing the problem under study.

The study was designed to obtain information that will evaluate two teaching methods and assist in developing a more effective educational program of science in youth development.

Sample and Population

The sample population consists of approximately 300 students which were matched in homogeneous groups of three. The population was located in fifteen counties of Oklahoma. (See Appendix B)

Three counties were selected at random from each of the five extension districts. The counties in each district were assigned at random to the two types of teaching method and the control group. Thus, five counties were designated as project-type counties (Group I) five counties were designated organizational-type counties (Group II) and five counties were designated control group counties (Control Group).

The participating county extension staff was asked to participate in the study and a group meeting was held of all counties on July 29, 1965, for the purpose of further explanation of the program, and for developing a time schedule for the instructor training meeting.

The boys and girls in the five project-type groups were individuals from various locations within the respective county. They met at a central location in the county for the meetings. The organizational club groups were the boys and girls from a particular area or school within each county. The control group members were 4-H Club members of similar ages as the experimental groups. These students selected to act as the control group were selected at random by the county extension staff. The county extension personnel explained the program to each member, and supervised the examination. The county extension staff conducted all examinations, collected the evaluation forms, and submitted the forms to the person conducting the study.

The three groups of individuals were formed from individually matched trios on the basis of scores on the pretest, sex, and age. Initially the boys and girls were asked if they were particularly interested in animal science. The majority of students gave an affirmative response. Therefore, to reduce the effects of the variable of interest, all students stating they were not interested in animal science were eliminated. The scores of matched groups varied slightly. This variation in the mean scores of the two groups was adjusted by the use of analysis of covariance in the statistical analysis.

Leader Training Program

To control the possible differential effects of the teacher, a special leaders' training meeting was held for the instruction of both groups. There was one leaders' training meeting held in each of

the five extension districts. The investigator conducted the leader training meeting. All necessary educational materials needed in teaching the course were presented to the group. The leader training meetings were scheduled for the months of September and October in 1965. Mileage reimbursement was furnished to the extension personnel attending the leader training meetings. This permitted the participating counties in each district to meet at a convenient location for the instruction.

The importance of presenting the educational information in a similar manner, using the same training aids and evaluation techniques, was emphasized to each instructor. The organizational training lessons were presented in conjunction with the local organizational 4-H Club meetings. The project club meetings were county-wide meetings, held at a central location in the county.

Developing the Instrument of Evaluation

The instrument developed is a non-standardized, achievement test. Test items are multiple choice, true or false, and completion-type questions. Each question has only one correct answer and each correct item counts one point. The instrument (see Appendix A) was pretested on 68 boys and girls of age similar to the experimental group. The instrument testing groups were students at Morrison High School, Morrison, Oklahoma; and who were not involved further in the proposed experiment.

The purpose of the instrument testing was to evaluate the instrument as to its capabilities of meeting the objectives for which

the instrument was designed. In using the Coo-Richardson method of reliability analysis, the reliability score was .58. The preferred score was .70. The discrimination power which is the percent of high scoring half of the group to answer the items correctly was 9.98 percent. The preferred discrimination was 10 percent. Overall difficulty of the instrument was 46.8 percent while the preferred was 50 to 60 percent of the class answering the items correctly. The standard error of student scores was 6.68. It can be said that the "true scores" did not differ from their respective "obtained scores" by more than 6.8 score points in approximately two-thirds of the measurements.[29]

The validity of the test items was established by three authorities. Two persons examined each item for item construction, and one person examined each item for subject matter validity.[30] Fifty-nine percent of the test items were classified above the "knowledge level" (first level of learning) according to Bloom's Taxonomy.[31]

Following the analysis of the instrument of evaluation, each item was analyzed according to data obtained. Items not operating effectively were revised by the investigator prior to using the instrument. The same instrument was used for the pretest and posttest measurements.

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[29]Stanley J. Ahmann and Marvin D. Glock, Evaluating Pupil Growth (2d ed., Boston, 1964), p. 323.

[30]Ibid., p. 299.

[31]Benjamin Bloom, Taxonomy of Educational Objectives, Cognative Domain (New York, 1956), p. 201-207.

Proposed Statistical Analysis

This paradigm is given as a general outline or model of the procedure to be used in the statistical analysis of this study. Let T_1 = First Test, T_2 = Second Test, P = Project, O = Organizational, C = Control.

Step 1.

Group I T_{1P} Project Club Type of Instruction T_{2P}

Group II T_{1O} Organization Club Type of Instruction T_{2O}

Group III T_{1C} No Instruction T_{2C}

Let D_P = Difference between mean scores on Project Group, D_O = Difference between mean scores on Organizational Group, and D_C = Difference between mean scores on Control Group.

Step 2.

Group 1

$$\overline{T}_{2P} - \overline{T}_{1P} = D_P$$

Group 2

$$\overline{T}_{2O} - \overline{T}_{1O} = D_O$$

Group 3

$$\overline{T}_{2C} - \overline{T}_{1C} = D_C$$

Step 3. Compare Means

D_P with D_C

D_P with D_O

D_O with D_C

The data obtained were subjected to statistical analyses to determine significance. The analysis of covariance was used to test

the null hypothesis. Fifty-seven groups or trios were selected by matching on sex, age, and interest. The posttest scores were adjusted by the use of analysis of covariance technique. A significant difference was found at the .01 level in using the "F" test.

Following the application of an "F" test, a comparison of pairs of means was conducted. Using the Scheffe'[1] procedure, it is possible to determine if there is a significant difference between one pair or all pairs of means.

Data Collection Periods

During the month of October, 1965, the training programs were initiated in both experimental and control groups. The specific data for the first meeting varied from county to county according to other county activities scheduled and the type of instructional method. The first meeting was an introduction to the training program and completion of the pretest evaluation form. The scheduling of successive meetings was arranged by local adult leaders and county extension staff.

The training programs were concluded in April, 1966. The final meeting was a summarization of the training sessions, followed by the posttest evaluation. All evaluation forms were mailed to the investigator for grading and statistical analysis.

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[1] Henry Scheffe', The Analysis of Variance (New York, 1959), p. 209.

CHAPTER III

ANALYSIS OF THE DATA

In this chapter, the scores made concerning knowledge gained as measured by a pretest and posttest will be examined and the findings organized to present the following:

1. A correlated design "t" test was conducted to measure students within a group if their scores improved significantly during the training period. Significant differences appeared; therefore, further statistical analyses were made.
2. A comparison of the amount of achievement between experimental and control groups was made. The analysis of covariance was used to adjust the posttest mean scores for differences in pretest scores. This analysis was used to test the null hypothesis also.
3. A comparison of mean scores, two at a time, following the "F" test when a significant difference was found.
4. Tabular comparison of ranges, average scores, and standard deviation of pretest and posttest scores of experimental and control groups was made.

Findings on Comparison of Mean Scores

A total of 171 boys and girls made up of 57 matched trios were tested. This group was obtained from 15 counties selected at random.

One of the assumptions made in this investigation was that previous experience and location of the student had no effect on the score if the matched trio pretest scores were similar. In an attempt to reduce the effects of these variables, an analysis of covariance was used to adjust posttest mean scores for differences in the pretest scores in three groups. Table I in Appendix C shows the pretest and posttest raw scores of each individual in the study. These data are used in the "t" test evaluation.

Note a comparison of ranges, average scores, and standard deviations of the experimental and control groups. When these scores were examined, it was noted that they were very similar in the degree of variance, the range, and the mean scores. Table I exhibits evidence of the closeness of scores in pretest and posttest evaluation.

A correlated design using the "t" test was conducted for the purpose of knowing whether the students within a group improved their scores significantly by the end of the training period. In this particular situation, this analysis involves correlated samples. A comparison of pretest and posttest scores of each individual within a group are computed; and using a "t" test, an analysis was run to determine if there was a significant improvement in scores during this period of instruction.

Table I shows all "t" tests were significant when compared to critical value of "t".[4]

TABLE I

COMPARISONS OF RANGES, MEANS, AND STANDARD DEVIATIONS

	Pretest			Posttest			
	Range Low - High	Mean $\bar{X}$	$\pm$S.D.[a]	Low - High	Mean $\bar{X}$	$\pm$S.D.	t[b]
Project	14 - 57	41.25	9.30	32 - 67	49.89	10.25	8.56
Organizational	15 - 54	39.95	7.47	24 - 66	42.93	7.66	3.97
Control	24 - 56	42.58	6.66	22 - 61	44.40	8.69	3.42

$t_{56df \text{ at } .01 \text{ level}} = 2.67$

a = Standard Deviation = $\sqrt{\frac{\Sigma x^2}{n - 1}}$ [5]

b = $t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\Sigma d^2}{N\,(N-1)}}}$ [6]

$\Sigma d^2 = \Sigma D^2 - \frac{(\Sigma D)^2}{N}$ $\quad \Sigma D^2 = (T_2 - T_1)^2$

N = 57

[4]Bernard Ostle, Statistics in Research (2d ed., Iowa State University, Ames, Iowa, 1963), p. 61.

[5]Ibid., p. 528.

[6]James E. Wert, et al., Statistical Methods on Educational and Psychological Research (New York, 1954), p. 141.

Statistical analysis by means of an analysis of covariance appears in Table II. It is concluded from the analysis that the null hypotheses is rejected and that there is a significant difference among the mean posttest scores of the project, organizational, and control groups at the .01 level.

TABLE II

ANALYSIS OF COVARIANCE COMPARISON OF EXPERIMENTAL AND CONTROL GROUPS

Source of Variation	Sums of Products			Y Adjusted for X			
	df	Σx^2	Σxy	Σy^2	df	S.S.	M.S.	F
Total	170	11,855	7,978	14,969				
Treatment	2	1,404	748	1,536				
Error	168	10,451	7,230	13,433	167	8,431	50.48	11.58
Treatment + Error	170	11,855	7,978	14,969	169	9,600		
					2	1,169	584.50	

Tabulated $F_{2,\ 167\ df} = 4.61$ at .01 level

Following the application of an "F" test, a meaningful interpretation of the data often requires a comparison of pairs of means. The differences between some pairs may be significant, while others may not be. A number of methods exist for the making of such

comparisons. The method used here is described by Scheffe'.[2] This method is a very rigorous criterion. The recommendation by Scheffe' is to use the .10 level instead of the .01 or .05 level. Table II reports the results of comparisons of each pair of the means by Scheffe'. The test indicates that the final test scores on the project method were significantly higher than the organizational and control group methods, and that the final test scores on the organizational method were not significantly higher than the final scores of the control group.

Thus, it can be stated that for this group of boys and girls, teaching by the project method did have a significant difference in the effectiveness of teaching animal science to older 4-H Club boys and girls as compared to organizational-type clubs.

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[2] George A. Ferguson, Statistical Analysis in Psychology Education (2d ed., New York, 1966), p. 297.

TABLE III

COMPARISON OF ALL POSSIBLE PAIRS OF MEANS
FOLLOWING A SIGNIFICANT F TEST

Group	F[a]	F'[b]	Degree of Significance
Project vs. Organizational	17.14	4.60	Significant
Project vs. Control	10.69	4.60	Significant
Organizational vs. Control	.766	4.60	Not Significant

"a" refers to $F = t^2 = \dfrac{(\bar{X}_1 - \bar{X}_2)^2}{\frac{\text{Error M.S.}}{N_1} + \frac{\text{Error M.S.}}{N_2}}$

"b" means that for any difference to be significant at the .10 level, F must be equal to or be greater than F' . $F' = (K - 1) F_{tabulated}$.[3]

[3] Ibid., p. 296.

CHAPTER IV

INSTRUCTORS EVALUATION OF ANIMAL SCIENCE PROGRAMS

Information obtained from the unsigned evaluation reports of individual instructors after the completion of the training series seems to reflect true individual thinking and provide a reliable composite of group thinking. The evaluation form designed and used was not planned for a statistical analysis but was designed to be used in evaluating the educational program and to aid in developing additional 4-H Club programs in the area of science emphasis. Personal evaluation by persons involved in the training program can be an effective tool in program development.

Thirteen evaluation forms were completed and compiled from the ten experimental counties. There were five project-type counties and five organizational-type counties that presented educational material as outlined in the study. The experimental counties were selected at random from the seventy-seven counties in Oklahoma. Therefore, the extension staffs were also selected by random. The adult leaders were selected and asked to be instructors by the respective county youth advisory committees and county extension staff.

The evaluation forms were received from seven individuals associated with the project club approach and six from the organizational-type club. There were five county agents, three assistant

county agents, three ranchers, one school teacher, and one dairyman reporting. Nine of this group received college training in animal science. Only one of the thirteen instructors stated he had taught this type of course before.

Appendix D expresses a summarization of the data obtained on evaluation forms. Near unanimous approval of the science emphasis approach of 4-H Club training is evidenced by the fact that all (100 percent) of the instructors felt that there was a need to emphasize the science approach in youth activities; and 92 percent recommended that educational material of a similar nature be prepared for other areas of 4-H Club work.

Further study of the summarization of the leader evaluation forms supports that the project method can be effective in teaching science to older 4-H Club boys and girls. Seventy-seven percent of the instructors stated that they felt this course offered the students as much information as expected. When asked to what age group the science approach of teaching should be directed, nine instructors stated junior high and high school age; and the remaining four persons suggested that it be taught to all school-age children. One instructor made the suggestion to have courses designed for different levels of achievement and to permit students to graduate from level to level.

In summarizing the evaluation forms, it is concluded that one of the keys to an effective training program is the adequate training materials available to the adult leaders and a leader training program to meet the needs of the adults assisting in various capacities. Relative to the question "Were the materials given sufficient in

helping you teach the course?" eleven of the instructors acknowledged with the affirmative and two instructors reported a negative response. From the general comments made toward this particular question, the leaders felt adequate time for training was important and that special assistance was needed by some instructors in particular phases. For example, one stated he had difficulty in teaching the last session on rations and students lost interest. In this situation, a small amount of additional training by the leader trainer would have been advantageous and would have improved the effectiveness of the training program. Another point of emphasis disclosed was the fact that more time was needed in training adult leaders who were unfamiliar with teacher training programs, as compared to extension personnel who were actively involved in educational activities. It was implied that a leader training program would be more effective if adult leaders and extension personnel had separate training sessions.

The people making the evaluation were asked, "If you were a 4-H Club adult leader, how could the county agent and extension specialist best help you?" Eighty-four percent of them felt the extension service role was to furnish training material and to train the instructors.

The group was questioned relative to time required for presenting material and if they had adequate time for the presentation. Ten instructors said yes, two said no, and one had no comment. The amount of time recommended varied from one-half hour to two hours. Of those offering a time suggestion, over one-half suggested from one to two hours per lesson and suggested allowing time for the individual student to participate in the training program.

It is realized that certain biases are involved and the number of evaluations is small. Despite these variables, the information can be helpful in the planning of future programs. Some of the constructive suggestions offered were:

1. The material should be given to interested 4-H Club members only. Therefore, project clubs would be suited best for this type of lesson.
2. Since there are so many other activities during the school year, keep the number of lessons to a minimum.
3. Some instructors thought the course was too advanced for their group, but would be all right for older students.
4. The course could be designed for different levels and students could graduate from level to level.
5. The minor points should be left out and the major points stressed more. (Too much material was presented to the group.)
6. The 4-H Club members would like to know their pretest and posttest scores.
7. The 4-H Club leader should be allowed to run the show rather than the county agent.

CHAPTER V

DISCUSSION OF FINDINGS

Summary

Education is a quest and not an accomplishment. The search for scientifically-proven superior methods of teaching fortunately has no ending since education itself is continuous. The findings in this study has value proportional to their use and application in developing more effective training programs for youth.

The Cooperative Extension Service has been interested in initiating a science approach in educational programs throughout the nation. The short-course system, often called the "project club" approach, has recently received wide acclaim as a superior extension teaching method. This method of teaching is a carefully planned and conducted "in-depth" series approach to teaching in a specific area of knowledge. This study was undertaken because of the keen interest in this area of science emphasis, which is teaching by project methods and using volunteer adult leaders. Very little empirical evidence was available, and a study was needed to compare the value of the new approach to the conventional teaching methods used.

This study was designed to determine the effectiveness of teaching animal science to older 4-H Club boys and girls through project-type clubs as compared to the organizational-type club (Conventional type).

A critical and empirical analysis was made of the teaching methods being compared. Effectiveness was measured by gains in knowledge of the students determined by pretests and posttests scores related to the animal science short-course. The knowledge gain was statistically analyzed for significance by means of analysis of covariance and application of Scheffe's test to two means.

A reasonable expectation postulated on the results of the academic learning variables was that the project method of instruction was effective. The comparison presented in this study did suggest that the indicated results were substantiated and teaching by the project method was more effective than the conventional approach.

The unsigned evaluation instrument by the instructors was used as a tool in providing direction and guidance for future program planning.

Conclusions

The findings of this study reject the null hypothesis and indicate there was a significant difference in the effectiveness of teaching animal science to older 4-H Club boys and girls through project clubs and organizational clubs. The following conclusions can be drawn from the study.

1. Boys and girls in 4-H Club work thirteen years of age or older, gained in knowledge in all three groups studied. For this group of boys and girls, teaching by the project method did have a greater significant

difference in the effectiveness of teaching animal science as compared to organizational and control groups.

2. Science emphasis educational programs can be conducted effectively and aid in attaining one of the major objectives of 4-H Club work; which is helping boys and girls develop trained minds, sound bodies, skilled hands, and good citizenship. Evidence to support this thought was presented by the gain in the amount of individual knowledge (Appendix C). The response of adult leaders to the question, "Do you feel we need to emphasize the science approach in our youth activities?" was affirmative.
3. Adult volunteer leaders were effective in teaching youth if the program was planned in depth and a leader training program was conducted prior to the training sessions of the youth. This fact was concluded because the project-type instruction was conducted by local leaders. The leader evaluation summarization verified the conclusion by implying that one of the keys to a successful educational program was adequate training of leaders conducting the meetings.

Limitations and Recommendations for Further Study

The implications drawn from the data presented in this study must be viewed in light of the limitations of the study. Generalization

of findings to other fields and the geographical locations other than described in this study can be undertaken only with caution. Sample size may be questioned as being too small in number for general conclusions. There may be other potential intervening variables that influenced the results such as other media or stimuli concerning the area of animal science during the testing program. Therefore, the results obtained should be considered as indicators or trends rather than definite or absolute criteria. Further experimental studies providing comparable data are needed to support these findings in terms of generalization and greater scope of application.

Recommendations

There is an unlimited field for further study in this area of 4-H Club work. In extension education, there has been very little work conducted on the process of learning. The investigator would encourage further study in the communication of knowledge from the 4-H Club leader-instructor to the 4-H Club members. Improved techniques of teaching should be studied and adopted wherever they may be applied.

Additional studies are needed to improve leader training programs. It has been concluded that leader training programs are effective in teaching youth. However, information relative to leader training is limited and there are many viewpoints as to the best method of conducting the leader training program.

John Dewey,[1] the well-known contemporary philosopher, defined education as the "reconstruction or reorganization of experience which add to the meaning of experience, and which increases ability to direct the course of subsequent experience." The investigator agrees with Dewey that it is a personal challenge to all educators to continually strive to improve their teaching techniques and offer a learning environment to maximize the learning process for young people.

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[1]Joe Park, The Philosophy of Education (2d ed., New York, 1965), p. 109.

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APPENDIX

APPENDIX A

Instrument of Evaluation

For

Animal Nutrition Phase

(Complete all questions below before starting to answer nutrition questions.)

Name_____
First Middle Last

Address_____, County_____

Age_____, Sex_____, Grade in School_____
(Present) Example: 9th, 10th

I live in town - farm, I am - am not owning or caring for an
(circle one) (circle one)
animal.

I am - am not particularly interested in animal science.
(circle one)

ANIMAL NUTRITION
INSTRUMENT OF EVALUATION

Instructions:

Select one best answer for all questions, except matching questions. Place a check (x) in front of the letter than designates the correct answer. Answer all questions.

1. A group of students are engaged in the study of animal nutrition. They have been told that animal nutrition is a science. What is science?

   __X__ a. Science is a study of systematized knowledge derived from observation, study, and practice.

   _____ b. Science is accepting facts and figures and applying them to personal situations.

   _____ c. Science is a scientific method and technique used only in developing new ideas.

   _____ d. Science is a study of the history of animal nutrition.

2. Why is it important to learn about research in animal nutrition?

   __X__ a. We have been using research information in our livestock projects.

   _____ b. We have not been using research information and it is necessary we start.

   _____ c. There is a lot of knowledge in this area, and we should learn it.

   _____ d. It is a new area, and interesting.

3. The digestive tract of an animal is sometimes thought of as an assembly-line in a factory, but there is a major difference. What is it?

   _____ a. Nutrients are combined to make a product.

   __X__ b. Nutrients are taken apart.

   _____ c. Its only purpose is to reduce the food to smaller particles.

   _____ d. It has no resemblance in purpose to an assembly-line in a factory.

4. Which animal has a digestive tract more nearly like yours?

_____a. Calf

__X__b. Pig

_____c. Sheep

_____d. Chicken

5. In ruminant animals there are tremendous large numbers of bacteria in the stomach. There bacteria break down cellulose in plants into organic acids and possibly to a simple sugar. In this process gases are formed. If gases cannot escape from the rumen, the calf will become bloated. On which side would you stick a bloated calf?

_____a. Right side in parenatial cavity.

__X__b. Left side in parenatial cavity.

_____c. Either side in parenatial cavity.

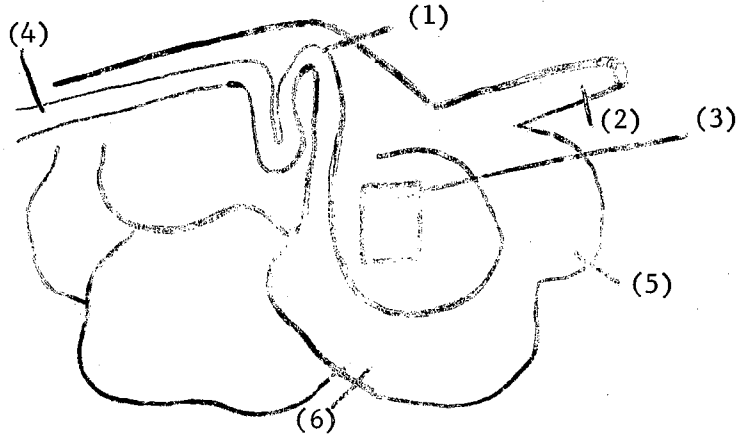
_____d. Neither side.

6. There is no particular reason that cattle can utilize more fiberous feed than hogs.

_____a. True

__X__b. False

7.-13. The ruminant digestive system is similar to the sketch below. Identify the major divisions as indicated by the arrows. From the list of ten terms below, select the six correct terms and place the number of the correct term in the appropriate parenthesis.



1. Rumen
2. Esophagus
3. Omasum
4. Small intestine
5. Reticulum
6. Abomasum
7. Large intestine
8. Caecum
9. Liver
10. Bile

14. A cattle feeder in Illinois purchased a group of feeder steers in Oklahoma. He made arrangements to have the cattle shipped by truck. It would take approximately 30 hours to haul the cattle from Oklahoma to the purchasers feed-lot. Would it be necessary to stop enroute and feed the cattle?

_____a. Yes

__X__b. No

15. In the example used above, if the cattle-feeder also purchased a truck load of feeder-pigs, and he wanted to move them to the same feed-yard, would you recommend the truck stop enroute and feed the pigs?

__X__a. Yes

_____b. No

16. All feed is regurgitated by cattle.

_____a. True

__X__b. False

17. From your knowledge of the digestion system and time required for digestion, steers on a high concentrate fattening ration would have a better appetite than one on an all-silage ration?

__X__a. True

_____b. False

_____c. Makes no difference

18. It has been discovered in research that ruminants can consume urea in small amounts because of the bacteria action in the digestive tract. In what compartment would you say the bacteria absorbs the urea?

__X__a. Rumen

_____b. Omasum

_____c. Abomasum

_____d. Reticulum

19. Feeds are divided in five main types of nutrients. Four of the nutrients are: (1) energy nutrients (2) proteins (3) vitamins (4) minerals. What nutrient is missing?

_____a. Carbohydrates

_____b. Fats

_____c. Calcium

__X__d. Water

20. If 40% protein supplement costs 4½¢ per lb., milo 3¢ per lb., corn 3½¢ per lb., and silage 2½¢ per lb.; which would be the cheapest source of energy?

_____a. Protein supplement

__X__b. Milo

_____c. Corn

_____d. Silage

21. With the exception of water, the energy nutrients usually make up the largest portion of a feed.

__X__a. True

_____b. False

22. Proteins supply the material from which body tissue is made. Proteins are sometimes described as bricks and mortar from which bodies are built. The individual building bricks would be:

_____a. Fatty acids

__X__b. Amino acids

_____c. Glycerols

_____d. None of these

23. Research has shown that in feeding of mature cattle, sheep and horses, much less attention need be given to the kind or quality of protein in the ration than is needed in feeding of swine and poultry. Which of the following is the most correct statement?

_____a. Ruminants do require a complete protein.

__X__b. Ruminant animals can produce complete proteins in their digestive systems.

_____c. Swine and poultry eat less, therefore need a higher quality protein.

_____d. Protein is not as important in the ration of cattle, sheep, and horses as compared with swine and poultry.

24. Animals can obtain vitamins from other sources than in feed consumed.

__X__a. True

_____b. False

25. Nearly all the states have laws regulating the sale of commercial feeds. It is required by most states that a tag be attached to the bag of feed showing the minimum amount of

_____a. Water

__X__b. Fiber

_____c. Grain

_____d. None of these

26. Which one of the following feeds would be the highest source of Vitamin A?

__X__a. Green grass

_____b. Corn

_____c. Cottonseed meal

_____d. Milo

27. - 32. Match the following and put correct numbers beside corresponding term.

(8) Vitamin A	1. Lysine
(2) Minerals	2. Ash
(3) Fatty acids	3. Gastric lipose
(1) Amino acid	4. Cellulose
(4) Fiber	5. T.D.N.
	6. Hemoglobin
	7. Oxygen
	8. Carotene

33. Nutrients are absorbed through the lining of the digestive tract. They are carried to all parts of the body by blood where the nutrients are built into body tissue, used as energy, or stored as fat. This process is called

_____a. Catabolism

__X__b. Metabolism

_____c. Digestive

_____d. None of these

34. Bacterial digestion is important in carbohydrate digestion in swine.

_____a. True

__X__b. False

35. Urea cannot be fed to hogs.

__X__a. True

_____b. False

36. A steer has to have fat in the ration to fatten.

_____a. True

__X__b. False

37. Johnny, a 4-H Club boy, purchased two weaning age pigs for his project. What will Johnny need to do to the percent of protein in his ration as his pigs increase in size?

_____a. Stay the same

__X__b. Decrease

_____c. Increase

_____d. Change the kind of protein

38. In considering a balanced ration for fattening steers, is Vitamin B_{12} needed to be considered as a supplement in the ration?

_____a. Yes

__X__b. No

39. A livestock feeder will want to change his feeding program and reduce his cost, if what conditions are met?

_____a. If each feed is high quality

_____b. If the feed is recommended by a nutritionist

__X__c. If all nutrient requirements are met

_____d. If all nutrients are available

40. If you wanted to find the nutrient requirements for fattening a 600 lb. steer, where would you find the most recent information?

_____a. Dictionary

__X__b. National Research Council Leaflet

_____c. 4-H manual

_____d. Feed analysis tag on feed purchased.

41. If certain nutrients are fed in excess, they cannot be

_____a. Stored

_____b. Excreted

_____c. Harmful

__X__d. Used for daily metabolism

Alfred owned a mature beef cow weighing approximately 1,000 lbs. which would calve in the spring. He was feeding his cow during the winter months 20 lbs. of good alfalfa hay per day. Using the Daily Nutrient Requirement Table and Nutrient Content Table attached, answer Alfred's following questions.

42. Is Alfred feeding ample protein?

_____a. Not enough

_____b. All that is necessary

__X__c. Too much

_____d. Add another supplement

43. Is he feeding ample T.D.N.?

_____a. Not enough

__X__b. All that is necessary

_____c. Too much

_____d. Add milo

44. Could he substitute 5 lbs. of milo for 1/2 of the alfalfa hay (10 lbs.) and save money? (Do not consider in the problem if ration balanced.)

_____a. Same cost

_____b. Could save money in ration cost.

__X__c. Could not save money in ration cost.

_____d. Not enough data

45. In the question in item 44, does this ration furnish adequate amounts of digestible protein and T.D.N.?

__X__a. Yes

_____b. No

_____c. Not enough information

46. From your experience, would the ration in question 44 have ample Vitamin A? (Refer to Nutrient Requirement and Nutrient Content Table.)

__X__a. Ample Vitamin A

_____b. Not enough Vitamin A

_____c. Not sure

_____d. Not necessary to consider Vitamin A requirements for beef cattle.

47. Which of the following would give a more accurate figure of the true protein in a feed?

_____a. Crude protein

_____b. Ester extract

__X__c. Digestible protein

_____d. Nitrogen-free extract (NFE)

48. The nutrient content of feed does not vary; therefore, there would be no need for additional research and testing of individual feed samples.

_____a. True

__X__b. False

49. In calculating rations for swine, certain feeds substitution can be made in balancing a ration. Select the one true statement below.

__X__a. Additional requirements need to be considered for swine as compared to beef.

_____b. Age is not a factor in nutrient requirements of a pig.

50. From your knowledge of the differing digestive tracts of animals, select the correct statement below.

_____a. Urea can be substituted for protein in swine rations.

__X__b. Milo can be substituted for corn in a swine ration.

51. This series of lessons is developed for beef and swine. If you knew the basic principles of developing rations for beef and swine, could you develop a ration for a rabbit?

__X__a. Yes

_____b. No

52.-55. Farm animals are classified as ruminant and non-ruminant animals. Place an "R" in the block beside all ruminant animals below and "N" in the block beside all non-ruminant animals.

__N__a. Pig

__R__b. Cattle

__R__c. Deer

__N__d. Chicken

56. The rumen is often thought of as a large storage vat. Which one of the following would most resemble the reticulum?

_____a. Massager

__X__b. Pump

_____c. Grinder

_____d. Purifier

57. Why do portions of the feed pass through the animal undigested?

_____a. It doesn't have time to digest.

_____b. Cattle are not equipped with teeth that will crush all feed.

__X__c. Cattle only partially chew the feed the first time.

_____d. New varieties of feed are more difficult to digest than the original varieties of feed.

58. What is unusual about the front teeth in the mouth of a cow as compared with a horse?

_____a. No teeth below

__X__b. No teeth above

_____c. She loses her teeth at early age

_____d. They are the same

The following two feed tags below were reproduced from two feeds available in local feed stores. From the information on the two tags, answer questions 59-61.

Tag "A"
100 Lbs. Net Wt.
Guaranteed Analysis

Crude Protein Not Less.....13.00%
Crude Fat Not Less.....12.00%
Crude Fiber Not More.....9.00%
Ingredients: Rolled barley, rolled milo, wheat bran, soybean meal, dehydrated alfalfa meal, linseed meal, iodized salt, low fluorine rock phosphate.

Tag "B"
100 Lbs. Net Wt.
Guaranteed Analysis

Crude Protein Not Less.....20.00%
(Includes not more than 5.9% equivalent protein from non-protein nitrogen)
Crude Fat Not Less.....1.52%
Crude Fiber Not More.....10.00%
Ingredients: Soybean meal, cotton seed meal, ground yellow corn, ground grain sorghums, cane molasses, alfalfa meal, iodized salt and rock phosphate.

59. If you had a choice of selecting one of two feeds with the above feed tag attached to the sacks, which feed would be the most desirable for a pig?

__X__ a. Tag "A"

_____ b. Tag "B"

60. If you wanted to purchase a supplement to feed mature cows on dormant native grass pasture, which of the above feeds would you select?

_____ a. Tag "A"

__X__ b. Tag "B"

61. Which of the two feeds has the highest cellulose content?

_____ a. Tag "A"

__X__ b. Tag "B"

62. Food in the digestive tract is broken down into units of which it is made. The units are absorbed through the wall of the digestive tract by the process of absorption. The nutrients are carried to all parts of the body by blood. What organ in the body regulates the nutrient content of the blood?

_____ a. Bile

_____ b. Heart

__X__ c. Liver

_____ d. Pancreas

63. One of the main sources of carbohydrates for swine is grain. What would be the main sources of carbohydrates of grass fed cattle?

__X__ a. Cellulose

_____ b. Carotene

_____ c. Fats

_____ d. Proteins

64. A steer has to have fat in the ration to fatten.

_____ a. True

__X__ b. False

65. From your knowledge of the digestive system and its functions, could a pig carry on digestion and absorption of the major nutrients without the stomach?

_____a. Yes

__X__b. No

66. Which of the following would be the best protein supplement to use in a swine ration?

_____a. Cottonseed meal

__X__b. Soybean meal

_____c. Tankage

_____d. Linseed meal

67. What is the main purpose of protein in the body of an animal?

_____a. Build bone tissue

_____b. Build pigment

__X__c. Build muscle tissue

_____d. Build nerve tissue

68. What is a good source of Vitamin D?

_____a. Green hay

_____b. Yellow corn

__X__c. Sunshine

_____d. Wheat germ

69. If you lived in a large city and you could not have an animal to care for, would a knowledge of animal science be helpful?

__X__a. Yes

_____b. No

70. Johnny sold his 800 lb. steer that he was fattening after the Junior Livestock Show. He purchased a registered heifer weighing approximately 825 lbs. He plans to keep the heifer in good reproductive condition. Johnny wants to know if you would recommend a change in the ration that he fed the steer?

__X__ a. Yes

_____ b. No

71. If you purchased a mixed grain ration and the tag shows the digestible protein of the ration is 13.0% and the T.D.N. is 78.6%, using the daily nutrient requirement table attached, how many pounds of this ration would you need to feed per day to meet the protein requirement so that a 600 lb. steer will gain 2.4 lbs. per day?

_____ a. 5 lbs. of ration

__X__ b. 10 lbs. of ration

_____ c. 15 lbs. of ration

_____ d. 20 lbs. of ration

72. Using the grain mixture described in item 71, if you fed your steer 10 lbs. of the ration, would the T.D.N. requirements of the 600 lb. steer be met?

_____ a. Yes

__X__ b. No

73. Johnny, who purchased the registered heifer, discovered that the ration he was feeding met the protein requirements, but the ration was low in T.D.N. and he needed 2.2 lbs. more T.D.N. a day. He has ample good prairie hay and cottonseed meal available. In comparing the cost of the two feeds and the amounts needed to meet the daily T.D.N. requirements, which food (hay or cottonseed meal) would you recommend he use? (Refer to the average nutrient content of a feedstuff table and select the most correct answer below.)

__X__ a. Prairie hay

_____ b. Cottonseed meal

74. From your knowledge of food nutrients and the importance of each, which can an animal live longer without?

__X__ a. Food

_____ b. Water

75. Anemia is a nutritional disease of baby pigs caused by a lack of iron and cooper in the sows milk. Which one of the five main nutrients listed below would be the best to give the baby pigs to correct the anemia?

_____a. Energy nutrient

_____b. Protein

_____c. Vitamins

__X__d. Minerals

_____e. Water

DAILY NUTRIENT REQUIREMENTS

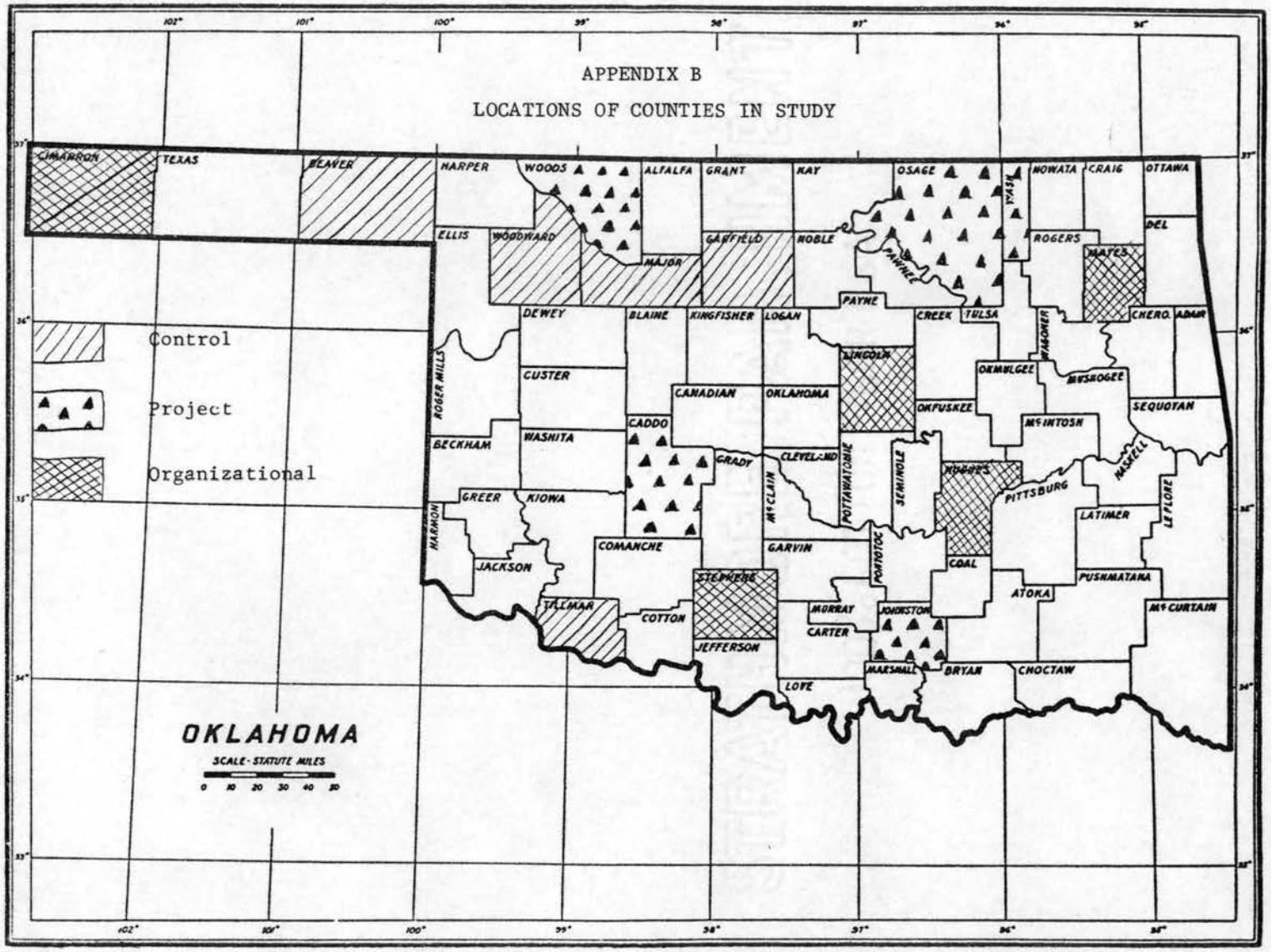
Body Weight Lb.	Average Daily Gain Lb.	Digestible Protein Lb.	T.D.N. Lb.	Vitamin A IU	Daily Feed Per Animal Lb.
Wintering Mature Cows 1,000 Lb.	0.4	0.8	9.0	18,000	18
Fattening Calves 400 Lb.	2.3	1.0	7.8	8,850	11.8
600 Lb.	2.4	1.3	10.9	12,300	16.4

AVERAGE NUTRIENT CONTENT OF FEEDSTUFF

Concentrated	Total Dry Matter %	Digestible Protein %	T.D.N.%	Vitamin A IU/Lb.	Cost Lb.
Corn, dent, No. 2	85.0	6.7	80.1	2,167	.02 Lb.
Milo	89.0	7.0	79.4	167	.015 Lb.
Cottonseed 41%	91.5	32.5	63.3	-	.04 Lb.
Silage					
Corn, dent, well-matured & eared	28.5	1.3	19.8	0,667	.005 Lb.
Roughage					
Alfalfa Hay	90.5	11.7	51.2	33,000	.015 Lb.
Prairie Hay	91.0	3.7	45.7	15,167	.01 Lb.

APPENDIX B

LOCATIONS OF COUNTIES IN STUDY



APPENDIX C

TABLE I

INDIVIDUAL TRIO MATCHING

Trio No.	Sex	Age	Project Scores X_1 Pretest	Project Scores Y_1 Posttest	Project Scores D Score Difference	Organizational Scores X_2 Pretest	Organizational Scores Y_2 Posttest	Organizational Scores D Score Difference	Control Scores X_3 Pretest	Control Scores Y_3 Posttest	Control Scores D Score Difference
1	M	17	27	34	7	47	41	-6	27	24	-3
2	M	17	42	47	5	43	59	16	43	25	-18
3	M	17	41	43	2	40	41	1	37	40	3
4	M	16	34	37	3	43	44	1	35	41	6
5	M	14	46	61	22	36	42	6	52	51	-1
6	M	15	27	39	12	40	41	1	41	51	10
7	M	13	34	34	0	30	43	13	44	46	2
8	M	16	35	18	-17	45	39	-6	38	45	7
9	M	14	31	32	1	26	40	14	43	53	10
10	M	17	24	38	14	21	31	10	56	53	-3
11	M	17	22	42	20	38	52	14	41	53	12
12	M	13	27	42	15	36	48	12	45	45	0
13	M	17	28	39	11	38	28	-10	44	53	9
14	M	13	41	43	2	33	28	-5	47	44	-3
15	M	16	46	50	4	29	34	5	36	38	2
16	M	17	49	47	-2	38	24	-14	50	53	3
17	M	17	54	65	11	32	31	-1	33	27	-6
18	M	16	51	62	11	32	43	11	43	41	-2
19	M	15	51	53	2	31	45	14	43	53	10
20	M	16	48	53	5	35	39	4	35	37	2

(I CONTINUED)

Trio No.	Sex	Age	Project Scores X_1 Pretest	Project Scores Y_1 Posttest	Project Scores $\underline{D}$ Score Difference	Organizational Scores X_2 Pretest	Organizational Scores Y_2 Posttest	Organizational Scores $\underline{D}$ Score Difference	Control Scores X_3 Pretest	Control Scores Y_3 Posttest	Control Scores $\underline{D}$ Score Difference
21	M	14	39	51	12	54	46	2	39	41	2
22	M	15	41	54	13	37	41	4	30	22	-8
23	M	15	45	64	19	43	43	0	24	29	5
24	M	15	41	57	16	47	51	4	51	46	-5
25	M	15	53	57	4	33	38	5	51	39	-12
26	M	15	41	51	10	38	44	6	39	37	-2
27	M	14	42	57	15	35	42	7	42	40	-2
28	M	14	49	65	6	36	51	15	42	43	1
29	M	14	51	65	14	47	49	2	48	34	-14
30	M	14	50	60	10	32	40	8	42	48	6
31	M	14	39	46	7	35	54	19	51	57	6
32	M	16	53	55	2	30	40	10	43	57	14
33	M	13	35	34	-1	44	48	4	40	43	3
34	M	16	56	67	11	41	44	3	54	61	7
35	M	16	39	53	14	15	29	14	38	43	5
36	M	16	53	57	4	37	49	12	41	46	5
37	M	15	43	52	9	35	42	7	50	57	7
38	M	16	54	61	7	44	46	2	38	42	4
39	M	13	48	52	4	34	49	15	54	49	-5
40	M	13	46	51	5	23	34	11	50	58	8
41	M	14	36	42	6	31	42	11	41	55	14
42	M	13	39	43	4	38	40	2	40	47	7
43	M	14	46	48	2	37	50	13	47	45	-2

(I CONTINUED)

Trio No.	Sex	Age	Project Scores X_1 Pretest	Project Scores Y_1 Posttest	Project Scores $\underline{D}$ Score Difference	Organizational Scores X_2 Pretest	Organizational Scores Y_2 Posttest	Organizational Scores $\underline{D}$ Score Difference	Control Scores X_3 Pretest	Control Scores Y_3 Posttest	Control Scores $\underline{D}$ Score Difference
44	M	14	41	46	5	38	39	1	35	39	4
45	M	14	46	54	8	41	44	3	49	48	1
46	M	14	38	42	4	34	37	3	46	42	-4
47	F	14	45	66	21	31	44	3	42	46	4
48	F	14	43	50	7	39	46	7	38	40	2
49	F	15	35	62	27	47	66	19	42	43	1
50	F	14	14	54	40	23	36	13	34	32	-2
51	F	14	49	53	4	26	45	19	48	52	4
52	F	14	57	61	4	25	44	19	50	51	1
53	F	14	41	41	0	39	46	7	46	48	2
54	F	14	41	60	19	28	47	19	38	39	1
55	F	14	41	43	2	49	41	-8	41	44	3
56	F	14	25	40	15	34	47	13	42	46	4
57	F	14	38	52	14	36	50	14	48	49	1

APPENDIX D

SUMMARIZATION OF THE EVALUATION OF 4-H ANIMAL SCIENCE SHORT COURSE

1. Were you an Instructor in a Project Type Club or Organizational Type Club? (Circle one)
   Project Type Club = 7
   Organizational Type Club = 6

2. What is your profession?_____
   (Example: rancher, teacher, or County Agent)
   County Agent = 5
   Assistant County Agent = 3
   Rancher = 3
   Teacher = 1
   Dairyman = 1

3. Have you had college training in Animal Science? Yes or No (Circle one)
   Yes = 9
   No = 4

4. Have you had an opportunity to teach this type of course before? Yes or No. (Circle one)
   Yes = 1
   No = 12

5. Would you be willing to assist with additional courses in this area? Yes or No. (Circle one) Please tell us what you like or dislike about the course.
   Yes = 11
   No Comment = 2
   Excellent materials and visuals. Helps explore in detail than just bare facts. Course too advanced. Too much detail. Easy to present material.

6. Did the course offer to the students what you expected from the course? (Check one)
   Much better than I expected 2
   Better than I expected 2
   As well as I expected 6
   Not as well as I expected 3

   Comments: Club members developed an appreciation for animal science plus better understanding of subject. Could not explain last section on rations.

7. Do you feel we need to emphasize the science approach in our youth activities? Yes or No. (Circle one)
   Yes = 13
   No = 0
   Comments: More difficult to say than do. Need to keep up changing times. Young people need to know more about why we do certain things. This should stimulate new interest in 4-H Club.

8. To what age group should the science approach of teaching be limited? (Check one)
   All school age children 4
   Junior High and High School age 9
   High School age _____
   None _____

9. Were the materials given to you, such as the leaflets, teacher's guides, slides, etc. sufficient in helping you teach the course? Yes or No. (Circle one)
   Yes = 11
   No = 2
   Comments: Anyone could take material and do a good job. Need more information on rations, need more teacher training time. Need more charts.

10. Was the teacher training program adequate with respect to organization, total program presentation and time devoted to training you as a teacher? Yes or No. (Circle one)
    Yes = 9
    No = 4
    Comments: Have to spend more time with adult leaders than extension personnel. Need to give additional help to leaders who need help in certain areas, such as rations.

11. Was the material designed for the age group of your students? Yes or No. (Circle one)
    Yes = 7
    No = 6
    Explain your answer: Project groups material seemed adequate, but organizational groups too advanced for some students. The chemistry was too deep.

12. Did you have enough time to present each lesson as you would have liked to present it? Yes or No.
    Yes = 10
    No = 2
    How much time per lesson would you recommend?
    2 hrs. = 3
    1½ hrs. = 2
    1 hr. = 2
    ½ hr. = 1
    No Comment = 5

13. If you were a 4-H Adult Leader in charge of a group of boys and girls and you were planning to teach this short course to the group, how could the County Agent and Extension Specialists best help you?
Comments: Eleven felt Extension personnel should furnish material needed and train instructors. Two persons said to let agent teach courses; it takes too much time to train leaders and material is too technical for local leaders.

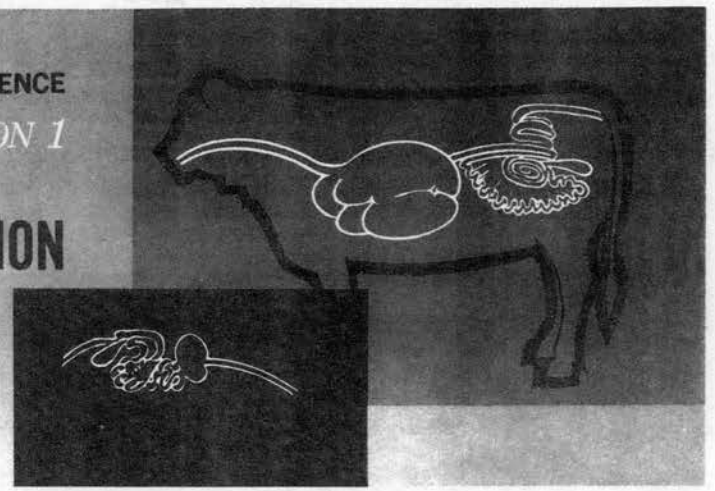
14. Would you recommend educational material of this nature be prepared for other areas of 4-H Club work. An example would be Soil and Plant Science, Farm Records, etc.. Yes or No. (Circle one)
Yes = 12
No Comment = 1
Comments: Work better in some areas, particularly plant science. Our educational programs need to be directed in this approach. Good for project type clubs.

15. Do you have constructive suggestions to improve the course?
Comments: Let the leader run the show rather than county agent. Biggest problem will be getting group together because there are so many other activities. Therefore, limit the number of lessons to minimum.
This material should be given to those interested, and project clubs are best suited.
Kids would like to know their before and after scores.
Drop out minor points and concentrate on major points. (Too much material.)
Course too advanced for my group, needs to be for older kids.
Have courses designed for different levels, and let students graduate from level to level.

ANIMAL SCIENCE

LESSON 1

INTRODUCING ANIMAL NUTRITION



Something amazing happens when you feed your 4-H pig or calf. Forage is turned into beef. Grain becomes pork. A quiet-looking scoop of grain becomes bursting energy as a calf romps in the feedlot.

You feed your animal every day. It is something you do automatically, probably without thinking about what you are really doing. You are giving your animal the energy it needs to move around and to fatten. You are giving it needed vitamins and minerals to keep healthy. You are giving it the "building blocks" of protein to grow. When the animal is grown, the feed you give it will help it reproduce and provide milk for its young.

In other words, you are giving your animal nutrients. You are part of the world of animal nutrition.

Animal nutrition is a science. It is the science of all the processes which take place when feed is given to animals.

Chemistry is very important in animal nutrition. Biochemistry—the chemistry of life—is largely involved.

The feed you give your animal is made up of various combinations of chemical substances. After the feed is eaten, more materials are added to it by the animal's body. These materials bring about reactions which break the feed down into very small particles—so small they cannot be seen by the naked eye.

These particles are then taken into the blood stream, where they are carried to all parts of the body. Here the particles are "burned" for energy, form body tissue, or are stored as energy in the form of fat.

These first reactions—where the food is broken down—are called digestion. Digestion takes place in a special system called the digestive tract. This tract begins with the mouth and teeth, where food is broken into fine particles by chewing. The mouth is connected to the stomach by the esophagus. The stomach empties through a valve into the small intestine. The small intestine empties into the large intestine, which terminates at the anus.

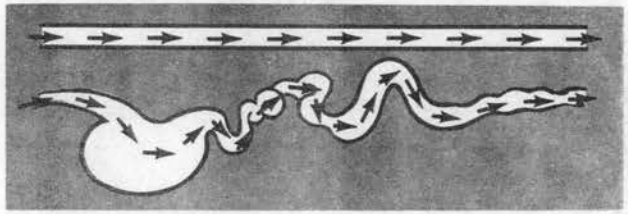
IOWA STATE UNIVERSITY of Science and Technology
COOPERATIVE EXTENSION SERVICE
Ames, Iowa . . . . . April 1964. . . . . AS-65

Prepared by T. W. Wickersham, extension animal scientist, Iowa State University
Counsel and assistance was provided by Animal Science, 4-H and County Extension staff members; editorial assistance by Richard Doak; art and layout by Larry Loomis.

The Digestive "Factory"

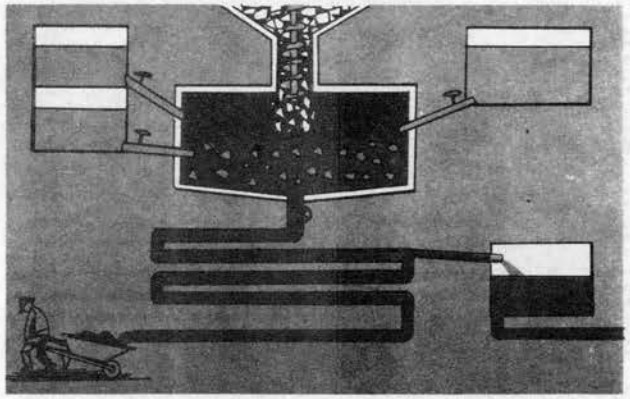
Think of the digestive tract (or gastrointestinal tract) as a hollow tube.

The digestive tract is like an assembly line; but instead of building something, this factory takes something apart. Food entering the mouth is broken down by the teeth. As it passes through the rest of the tract, the chewed feed is gradually broken down into smaller and smaller units.



There are four main parts of the digestive tract where chemical reactions take place. In each chamber, different chemicals — digestive juices — are added to the food. These will be explained in detail later.

The job of the digestive tract is the same in all animals. But there are important differences in the digestive tracts of different animals. Cattle are fed much hay or other materials high in fibers. Pigs are fed grain or other materials low in fiber. The reason for this is that cattle are able to more efficiently digest fibrous materials than pigs. The differences in the digestive tracts of cattle and pigs largely explain this.



Through the Digestive Tract

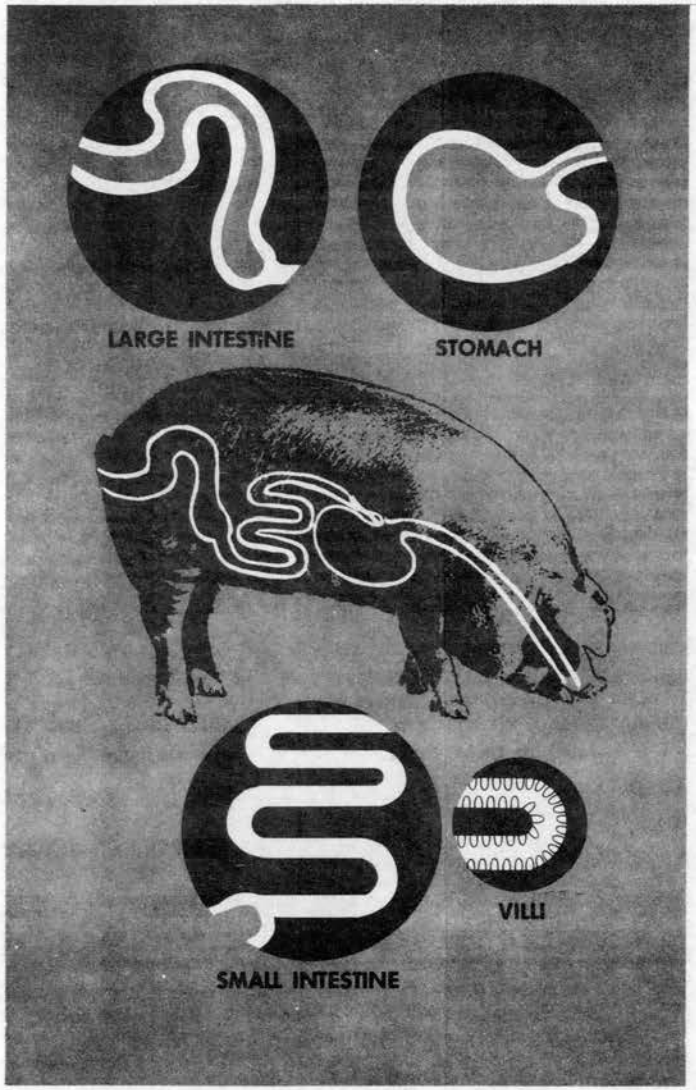
The first part of the tract is the *mouth.* This, of course, is the place where food enters the digestive tract and where the food is broken into small particles by the teeth. In pigs an enzyme is added by the saliva in the mouth to start carbohydrate digestion. Digestion of food by man starts in the mouth too. The second part of the digestive tract is the *esophagus.* It is a tube which carries food from the mouth to the stomach. A series of muscle contractions move the food through the digestive system. The first of these is referred to as swallowing and is responsible for moving food from the mouth to the stomach. (This works about like pinching toothpaste out of a tube.)

The *stomach* is the first reaction chamber. It is a kind of vat where chemicals are added to the food. Certain cells of the stomach wall produce hydrochloric acid. Other cells secrete gastric (stomach) enzymes.

The stomach is where carbohydrate and protein digestion gets underway and fat digestion starts (except in ruminant animals). Digestion produces very small particles of protein, carbohydrates and fats. Some of these pass through the stomach wall into the blood stream. Food which the stomach is not designed to completely digest and absorb passes on to the small intestine.

Food from the stomach passes through a valve into the *small intestine,* which is the next chamber. The intestine is a very complex tube which lies in a spiral. In some animals, it is 130 feet long. Digestion and absorption continues in the small intestine, where more digestive juices are added. The cells lining the walls of the small intestine produce enzymes that aid digestion as well as absorb the digested feedstuff. In addition, two important glands deposit their juices in the small intestine. The first of these is the *liver.* The bile duct runs from the gall bladder (which is closely associated with the liver) to the small intestine. Through it pass bile secretions. These react with fats to help digest them. The second gland is the *pancreas.* Through the pancreatic duct, it delivers several digestive juices to the small intestine. These juices help digest several food components, including carbohydrates, fats and protein. More food nutrients are absorbed from the small intestine than from any other organ.

A "blind gut" called a caecum is found at the junction of the small and large intestine. In most animals, the caecum is small and has little function. But it is very important in some animals such as horses and rabbits. In these animals fibrous feeds are digested in the caecum.



The next part of the digestive tract is the *large intestine*. It is the fourth major part of the tract. This intestine is shorter but larger than the small intestine. Its main function is to absorb water. It is also the site of some bacterial digestion, as in the caecum. Another job of the large intestine is to add mucus material to the remaining food. This is a lubricant that makes passage through the tract easier. Just as in the small intestine, muscle contractions move the food.

The last part of the digestive tract is the *anus*. It is simply an opening through which the undigested portion of the feed taken in at the mouth is eliminated.

So this is our "hollow tube." Its main job is to digest and absorb food.

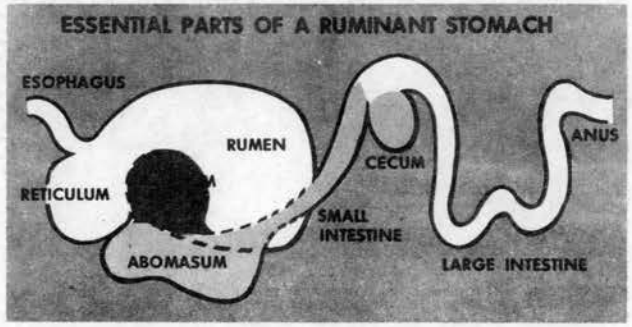
Cattle Have Special Stomachs

We mentioned that cattle can digest large quantities of fiber while pigs cannot. How do cattle digest roughage?

The answer lies in the cow's special kind of stomach.

Cattle are ruminants. This means they have compound stomachs. Sheep, goats, deer and many other grazing animals are also ruminants.

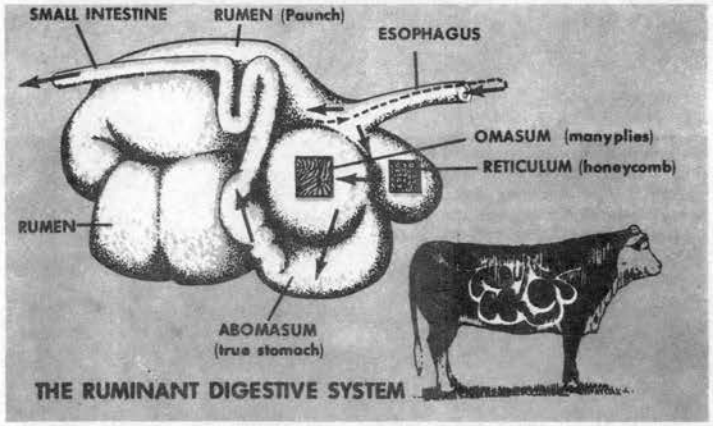
A ruminant animal's stomach has four compartments. The first compartment is the *rumen* or paunch. Next is the *reticulum* (reh-tik-u-lum) or honeycomb. There is no division between the rumen and reticulum. They are generally thought of as one compartment. In the adult cow,



the rumen and reticulum can hold 40 to 60 gallons of feed material. They almost completely fill out the left side of the middle part of the animal.

The rumen and reticulum make up a huge "vat." In it, food is agitated, fermented and digested. Many bacteria and protozoa are found in these two compartments. The feeds high in fiber (roughage) eaten by cattle is digested in the rumen and reticulum with the help of these bacteria. (Bacteria and protozoa are really small animals.)

This is not the only job of the rumen and reticulum. Muscle movements in the two compartments help break up food into smaller particles so bacteria and protozoa can do their job better. Also, digestion is aided in these compartments by the addition of much saliva and water.



THE RUMINANT DIGESTIVE SYSTEM

The third compartment of the ruminant stomach is the *omasum* (o-may-sum) or manyplies. It makes up about 8 percent of the stomach. Scientists do not yet know the exact role of the omasum. For one thing, it acts to grind up food. But just how much grinding it does is uncertain. The omasum may also squeeze water out of food that has come from the rumen.

The fourth compartment is the *abomasum* (ab-o-may-sum) or "true stomach." It is about the same size as the omasum. This is the only compartment of the stomach where digestive juices are produced. It works similarly to the stomach in nonruminant animals such as the pig. From the abomasum on, the ruminant digestive tract is the same as the nonruminant tract.

Together, the omasum and abomasum make up about one-fifth of the adult ruminant's stomach. They are mostly on the right side of the animal.

A FEW NUTRITION TERMS

DIGESTION (di-jes'chun) is the process which breaks down food before it is absorbed from the G. I. tract into the body. It includes all the activities of the digestive tract and its glands.

METABOLISM (meh-tab'o-liz'm) concerns food after it has been digested. It is the changes which take place in digested food after it has been absorbed from the digestive tract. In metabolism body tissue is built and energy is used.

RUMINANTS (roo-mi-nants) are animals with more than one compartment in their stomachs. They are sometimes thought of as having four stomachs. Cattle and sheep are ruminants. Only ruminants chew a "cud."

NONRUMINANTS are animals that have one stomach. Pigs and horses are nonruminants.

ENZYMES (en'zimes) are digestive juices which act as catalysts. They speed up chemical reactions in digestion.

MECHANICAL FACTORS in digestion include chewing and swallowing. Regurgitating the "cud" and muscle action in the stomach and intestines are other mechanical factors.

SECRETORY FACTORS (see-kre-to-ri) have to do with glands. Glands do not act directly in digestion. They secrete enzymes to help digestion.

CHEMICAL FACTORS are chemicals that aid digestion. They include both enzymes and other chemicals. Hydrochloric acid is one of the others.

MICROBIAL FACTORS (mi-kro'bi-al) are bacteria that play a part in digestion. Sometimes protozoa (one-celled animals) are also involved.

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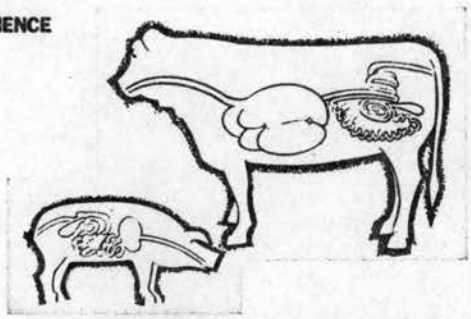
ANIMAL SCIENCE



APPENDIX F

EXAMPLE

LEADER'S TEACHING OUTLINE
Introducing Animal Nutrition

1. TEACHING OBJECTIVES

To increase members'

a. understanding of animal nutrition as a science.
b. knowledge of the anatomy of the digestive tracts of cattle and swine.
c. understanding of the essential function of the different major organs of the digestive system.
d. understanding some reasons why cattle nutrition and feeding is different from swine nutrition and feeding.
e. knowledge of nutrition terms.
f. interest in learning more about the principles involved in feeding.

2. WHAT IS TO BE PRESENTED

a. Introduction of the science of nutrition and definitions of terms.
b. Anatomy and main function of each part of the digestive tract of the pig.
c. Anatomy and main function of each part of the digestive tract of beef cattle.
d. Some practical application and reasons for knowing about the digestive system in cattle and swine.

3. HOW WILL IT BE PRESENTED?
HOW WILL THE MEMBERS BE INVOLVED?

a. Have members read the introductory page. Have them find answers to: (1) What is a definition of nutrition? (2) What uses does the animal make of feed? (3) What is feed? (4) What is digestion?
b. Show slides AS 65 (1). Use lesson material as script. (A good alternative is to enlist the assistance of the local veterinarian. Actual digestive tracts of hog, cattle, rabbit or chicken could be used. These could be secured from local locker plant. The meeting could be held in the veterinarian's clinic, clean garage or barn. Be sure the veterinarian understands that the main teaching objective is to increase members' knowledge of the digestive tract and begin to understand what function takes place in each part.)
c. Call on members to give reasons why it is important for livestock producers to have knowledge of the digestive tract.
d. Have one member review and define terms found in the lesson. This may be done with flannelgraph strips. Or a matching type quiz may be prepared, duplicated for each member and used as a teaching tool.

4. EVALUATION

a. Drawings of the digestive tracts of cattle and pigs may be prepared without the parts named. A copy may be supplied each member. He names the parts and gives the main function of each part.
b. The following quiz may be given.
   1. Which animal, the pig or calf, has a digestive tract more nearly like yours?
   2. On which side, the right or left, would you stick a bloated calf? Why?
   3. What is the first use made of feed by the animal?
   4. Do cattle have four stomachs or four compartments of one stomach?
   5. The digestive tracts of cattle and pigs are similar from the true stomach on through the tract. (True-False)
   6. "Nutrition" and "feeding" mean the same thing. (True-False)
   7. There is no particular reason that cattle can utilize more fibrous feed than hogs. (True-False)
   8. The small intestine has (more, less) important functions to perform than the large intestine.
   9. The digestive systems of horses and rabbits are alike in what respect?
   10. Hogs have a more complex digestive tract than cattle. (True-False) Explain.

Evaluation can be made from how well the members do on the quiz or in naming the parts and functions of the digestive tract.

5. OPTIONAL PROGRAMS OR ACTIVITIES

a. Lesson on human anatomy and nutrition presented by home economics teacher or home economist.
b. Short reports by members on such topics as:
   1. What is the appendix—appendicitis?
   2. What is enteritis? Where does it occur?
   3. What is bloat? Where does it occur?
   4. What is an ulcer? Where does it occur?
   5. Common parasites of the digestive tract of hogs—cattle. Describe the life cycle of one parasite and where chemical treatment would be introduced and why.

VITA

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Candidate for the Degree of

Doctor of Education

Thesis: A COMPARISON OF TEACHING METHODS OF ANIMAL SCIENCE TO OLDER 4-H CLUB BOYS AND GIRLS

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Professional Experience: Upon completion of Bachelor of Science degree he managed Parcel's Hereford Ranch, Coldwater, Kansas. Served in United States Army from 1952 to 1954; Assistant County Agent at Fairview, Oklahoma, for eleven months. Transferred to Beaver, Oklahoma, as Beaver County Agent from 1955 to 1964. He was granted sabbatical educational leave from that position to attend graduate school at Oklahoma State University to present time. He has accepted a position effective July 15, 1966 as 4-H Club Program Specialist, Oklahoma Extension Service, Stillwater, Oklahoma.