A COMPARISON OF TWO METHODS USED IN TRAINING 4-H TEACHER LEADERS

By

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A COMPARISON OF TWO METHODS

USED IN TRAINING 4-H

TEACHER LEADERS

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ACKNOWLEDGEMENTS

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Special thanks is extended to Dr. George Newell, Extension Specialist, Poultry Science for conducting the training schools for Extension Agents and 4-H teacher leaders; Dr. Pete Williams, Assistant Director, 4-H and Other Youth Programs, for suggesting the Problem Area and furnishing equipment necessary for the study; and Extension County Directors, 4-H teacher leaders, and 4-H'ers involved in the study.

A special note of thanks to my wife, Ann, for her help and patience; to Mrs. Laura Baggs for typing the rough draft; and to Parkin Hatchery for supplying high quality fertile eggs used in the study.

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CHAPTER I

INTRODUCTION

The use of 4-H volunteer leaders has long been recognized as a successful approach for working with 4-H youth in Oklahoma. If volunteer leaders are going to create a meaningful experience for the 4-H member (4-H'er), they must be properly informed on the subjects that they are presenting.

The Oklahoma State University Extension Service employs many Extension Specialized Agents (Specialists) and Professional Extension Agents (Agents) to conduct training for the 4-H volunteer leader. Because of the man hours involved and the rising costs of the instruction, it seemed reasonable that an indepth analysis be made to determine the degree of effectiveness of two approaches for instructing 4-H teacher leaders (leaders).

Problem

With the introduction of new, short term 4-H programs and the increased demands on extension agents' time, more than ever a study of methods for disseminating information to leaders was deemed important. The problem of this study was identified through the experience and interest of the author. In addition, the limited number of studies in this area have indicated the need for further research in comparing methods of 4-H leader training; furthermore, this study made material

and leader training of the Chick Embryo Program possible in the geographical area that had not been previously available.

Hopefully, the given information will be valuable to other extension administrators, agents, and specialists working with 4-H'ers.

Statement of the Purpose

To achieve effective instructional 4-H program of this type, an effort to provide training of 4-H Leaders was deemed necessary. The purpose of this study was to compare two different methods of training 4-H Leaders in order to determine which approach could be judged the most successful. Findings of this study will hopefully contribute information needed for the evaluation of the present methods and will serve as a reference for further 4-H Leaders' Training.

Objectives of This Study

In order to accomplish the purpose of the study, the following objectives were formulated:

1. To determine the knowledge gained as indicated by test scores of 4-H'ers instructed by leaders trained by agents and those trained by a specialist.
2. To compare the post-test scores for the two groups of 4-H'ers to determine if one method resulted in significant differences over the other.

Hypothesis

Because this study was designed to compare different methods of 4-H Leader Training, the following null hypothesis was developed:

...There would be no significant difference observed upon comparing the post-test scores of 4-H'ers taught by 4-H Leaders receiving their training from an agent as compared to those of 4-H'ers taught by leaders receiving training from an extension poultry specialist.

Scope of the Study

This study was conducted in the Northwest Extension District of Oklahoma to determine which approach to 4-H Leaders' Training would be most successful. The Chick Embryo Science Program, as exhibited in Appendix D, was selected as the instructual materials to be presented to sixth grade 4-H'ers.

Alfalfa, Ellis, Harper, and Major counties were the counties in which agents would train two 4-H Leaders in each county. Eight 4-H Leaders from Blaine and Woods counties were trained by the Extension Poultry Specialist. Agents in all counties were responsible for selecting 4-H Leaders and receiving and disseminating materials.

A letter of confirmation, as exhibited in Appendix B, was deemed necessary in order to conduct this study within the state extension structure.

Assumptions

For the purpose of this study, the following assumptions were accepted by the investigator:

1. That counties selected for the study were similar in social and economic conditions.
2. That learning capabilities of the sixth grade 4-H'ers were similar.

3. That the Agents' knowledge of and experience with the Chick Embryo Program were similar.
4. That leaders presented to 4-H'ers only the knowledge they gained through the training program.

Limitations of This Study

The investigator recognized at least the following limitations of the study effort:

1. The background knowledge, teaching ability, experience, and interest in the Chick Embryo Program varied with the different Leaders. This limitation is present in studies of this nature involving more than one leader.
2. Groups sampled were not randomized.

Definition of Terms

The following definitions are necessary to clarify for the reader the terminology used in this study.

4-H Teacher Leader (Leader) - A volunteer adult public or private-school teacher who assumes the leadership and is responsible for teaching of 4-H members.

4-H Member (4-H'er) - For the purpose of this study, 4-H membership indentifies those classroom students enrolled by youth participation enrollment. This membership did not participate as a member of an organized local 4-H club, but as a member of a special project club.

Professional Extension Agent (Agent) - An employee of the Cooperative Extension Service in Oklahoma employed on a county basis with responsibilities for implementation of the 4-H programs.

Extension Specialized Agents (Specialist) - An employee of the Cooperative Extension Service in Oklahoma employed on an area or state basis with expertise in a particular subject area.

Leader Training - A program to provide 4-H leaders with education to increase their competencies necessary for them to effectively carry out their responsibilities as a 4-H leader.

Chick Embryo Program - An indepth training program for 4-H'ers describing the embryology of domestic poultry. The program includes training, visual aids, incubator, fertile eggs, and instructual materials.

Agent-Taught Leader - A Leader of sixth grade students educated in the Chick Embryo Science Program by an agent.

Specialist-Taught Leader - A Leader of sixth grade students educated in the Chick Embryo Science Program by a poultry specialist.

Agreement

For the purpose of this study, the poultry specialist agreed not to conduct additional training programs upon request by the involved agents.

CHAPTER II

REVIEW OF LITERATURE

This author found in his review of literature that there were limited studies on training methods; therefore, ideas of recognized specialists in the field of leadership development were used to establish a need for new programs that will train leaders adequately and efficiently.

Need for Training

Wilson and Gallup (1), as described by Sanders (2), pointed out that lay leaders increase the teaching volume by contributing to Extension 4-H programs. Also in Sanders, Sabrosky (3) tells us that lay leaders should posses the same essential qualities as other educators. They must have a knowledge of the subject area and be able to communicate this knowledge.

Tyler (4) suggests that youth organizations have a common problem when using lay leaders. They must be trained initially and continually. In general, the training programs of volunteers are inadequate.

Trent (5) says there is nothing more frustrating to an individual than to be given a responsibility and not be trained to complete that responsibility.

Harlow (6) pointed out the purpose of a 4-H leader was to relate to the 4-H member in such a way that a desired behavioral pattern change

would be brought about.

Cassel, as interpreted by Sanders (7), proposes that adults learn by a few fundamental ways. Adults must want to learn the material presented. Motivation is required. Sanders says the first psychological desire of man is the desire to maintain and perpertuate the human race. It may not always be at the conscious level, but this drive can influence a person to serve as a 4-H leader.

Adults must have the opportunity to use what they have learned soon after exposure. What a person hears, he may doubt; what a person sees may be doubted; but what a person does can not be doubted.

Experience in adults may have a marked difference on leader learning. They have had a number of experiences that will have conditioned their reaction to learning.

Adults are not interested in theory; they want answers to their immediate problems. Likewise, adults are interested in an informal environment not a classroom procedure for learning. A variety of teaching methods are also needed giving guidance, not grades. Competition between adults may have a negative effect on learning.

New Programs

The report by Watts (8) to the Joint USDA and National Association of State Universities and Land Grant Colleges (NASULGC) study committee, entitled "A People and A Spirit", gave some strong recommendations on pages 65 and 66 as to the direction to be taken in the 4-H program:

> ...at the minimum, Cooperative Extension Service programs of youth and family education should be doubled by 1975 and that new cooperative relationships with other agencies be developed.
>
> ...Cooperative Extension Service maintain the 4-H program

> as a youth development activity for youngsters from all walks of life and all economic levels. The program should become neither a poverty program nor a strictly middle-class activity.
>
> ...Cooperative Extension Service strives to have more of the organizational and operational aspects of 4-H handled by leaders and the private sector with Extension professionals increasing amount of time they spend in education rather than in service to the organization.

In conversation with Dr. Eugene Williams, Director of Oklahoma 4-H Program, it was discussed that short term projects such as the Chick Embryo Program would be instrumental in increasing 4-H enrollment and programs in Oklahoma.

As increase in program requires an increased demand for leaders and resources. Sanders (2) tells us that volunteer leaders can be appointed by agents as one method of recruiting needed leaders. Increased investments in professional time and materials can only be realized by the performance of leaders.

Summary

In reviewing the literature of different authors, it was found that there was a definite need to present new programs, use leaders effectively, and train them adequately to perform their role as a 4-H leader.

CHAPTER III

METHODOLOGY OF THE STUDY

With increased importance placed on reaching a greater audience of 4-H'ers through Extension programs, new and different programs are necessary to reach this audience. The researcher felt the Chick Embryo Program qualified as such a program to furnish a meaningful experience for the 4-H'er.

This program required the use of 4-H leaders who needed training. This chapter contains a description of the comparison of two methods of training leaders and methods used in collecting and analyzing data statistically for accomplishing the purpose of the study.

Study Population

When initiating the study, the population was defined after consulting with appropriate personnel of the Oklahoma State University Extension Service and Department of Agricultural Education. It was decided that the counties chosen should be those which were similar in social and economic conditions and number of Extension staff. Training efficiency required the counties be grouped by geographical location and population of county. Blaine and Woods counties were selected as those in which a poultry specialist would train leaders directly. Alfalfa, Ellis, Harper and Major counties were selected as those in which to train agents who would in turn train leaders in their counties.

Leader and Student Selection

The recruiting of leaders was left to the agent of each county. However, the agents' selections were restricted to sixth grade public or private school teachers. The 4-H population was then the sixth grade students of the selected 4-H leaders.

Training Materials

Training materials used in this study were developed and purchased by agents and specialist from the Oklahoma State University Extension Service.

The materials included (1) lesson plans - designed for a short term program to be incorporated into the class curriculum, (2) visual aids - slides showing the development of the chick embryo from fertilization until hatching, (3) transparent hen - an incubator designed for the observation of the hatching process, (4) twenty-one fertile eggs - required for use with the program, (5) candlers - used to observe embryo development without damaging the embryos, (6) procedure for conducting experiments with the developing embryos, and (7) instructional training for leaders and agents conducted by a Specialist. Most of these materials were in a pre-assembled Chick Embryo Science Program package which is exhibited in Appendix D.

Administration of Training

The Specialist conducted equal training sessions for agents in Alfalfa, Ellis, Harper, Major counties and leaders in Blaine and Woods counties at different times and locations. The training of leaders was conducted once in each county. This training was presented at the start

of the fall semester 1974. Data were collected during the months of September, October, and November of that term.

Collection of Data

The method of collecting data was by pre-testing, using the instrument in Appendix A, the 4-H'ers upon delivery of the materials.

A letter of instruction was sent to each leader along with the pre-test giving the leader instructions for testing the 4-H'ers. This letter is exhibited in Appendix C. The same instrument with items rearranged was used for post-testing the 4-H'ers upon completion of the program. The leaders were instructed to return the tests by mail to the author after each testing. A mean score was computed for each grouping of 4-H'ers.

Design

The research design selected was "Design 10" as labeled by Campbell and Stanley (9) who stated on page 47,

> One of the most widespread experimental designs in educational research involves an experimental group and a control group both given a pre-test and post-test, but in which the control group and the experimental group do not have pre-experimental sampling equivalence. Rather, the groups constitute naturally assembled collectives such as classrooms, as similar as availability permits but yet not so similar that one can dispense with the pre-test. The assignment of X to one group or the other is assumed to be random and under the experimenter's control.

Experimental	O_1	X	O_2
Control	O_3		O_4

Because the two groups were similar but not randomized and were

trained by different treatments over which the researcher had control, the control group was the 4-H'ers whose leader was trained directly by Specialist, and the experimental group's leaders were trained by Agents.

The independent variable of the study was the method of training administered to the leaders in the experimental group. The dependent variable was the differences in scores as computed from the pre-test and post-test of the control and experimental classes.

Analysis of Data

After the pre-test and post-test were administered, a mean score was found for the pre-test and post-test of each grouping of 4-H'ers. From this pre-test and post-test mean score a knowledge gain score was computed by finding the difference. The observation method was the best method of analyzing the resulting data comparing the pre-test and post-test data.

In order to accept or reject the hypothesis, the post-test results from the agent trained 4-H'ers and the specialist trained 4-H'ers were analyzed statistically. Kerlinger (10) stated on page 259, "Unless there is good evidence to believe that populations are rather seriously non-normal and that variances are heterogeneous, it is usually unwise to use a nonparametric statistical test in place of a parametric one."

To describe statistically through a model the difference between the two groups, the t test was employed. This test allowed for variability of sample size, mean difference, and a related sample group. Popham (11) suggested the separate variance formula be used with different sample sizes and variance as indicated in the example below:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Data from groups used in this study would insert into the above formula as follows:

S_1^2 = Agent trained leader group variance

S_2^2 = Specialist-trained leader group variance

N_1 = Agent trained leader largest group size

N_2 = Specialist-trained leader group size

$\bar{X}_1$ = mean of agent trained leader group

$\bar{X}_2$ = mean of specialist trained leader group

To test the hypothesis, the calculated value of t was compared to the table value to determine the significance level of observed differences. If the calculated value was equal to or greater than the table value, the null hypothesis would be rejected. If the calculated value was less than the table value, the null hypothesis would be accepted and conclude that any difference was due to chance.

CHAPTER IV

RESULTS OF THE STUDY

This chapter reports the resulting scores from the pre-testing and post-testing of 4-H'ers taught by agent trained leaders and 4-H'ers taught by specialist trained leaders.

4-H'ers Population

Sixteen groups of 4-H'ers, all sixth graders in classes selected by the agent in the respective counties, participated in this study. Since only eight incubators were available for this study, this necessitated a first setting and a second setting of the eggs.

Study Findings

After scoring the pre-test and post-test, a mean score was found for the pre-test and post-test returned by 4-H'ers taught by agent trained leaders and 4-H'ers taught by specialist trained leaders. Table I was developed to report the number of tests returned by county for each of the two egg settings and the mean scores of the respective groups of 4-H'ers as well as the pre to post-test gain scores for the agent-trained groups. For the first setting a total of 131 pre-tests were returned as compared to 227 for the second setting. The mean scores of 4-H'ers on the pre-test prior to the first setting ranged from 45.72 to 60.80. For the second setting the range was 56.00 to

TABLE I

PRE-TEST AND POST-TEST RETURNS AND COMPARISONS OF MEAN SCORES OF 4-H MEMBERS TAUGHT BY AGENT TRAINED LEADERS

First Egg Setting	Pre-Test N	Mean Score	Post-Test N	Mean Score	Pre-Test Post-Test Gain
Alfalfa County	26	57.47	27	71.70	14.23
Ellis County	20	60.80	19	68.42	7.62
Harper County	27	60.74	27	69.78	9.04
Major County	58	45.72	60	64.13	18.41
SUB TOTAL	131		133		
Second Egg Setting					
Alfalfa County	25	58.72	23	73.39	14.67
Ellis County	18	56.00	18	68.00	12.00
Harper County	44	59.09	44	68.91	9.82
Major County	9	67.11	10	68.80	1.69
SUB TOTAL	96		95		
OVERALL	227	55.87	228	68.42	12.55

to 67.11. Overall the mean pre-test score for all was found to be 55.87

The number of post-test scores received was 133 and 228 for the first and second settings respectively. First setting post-test mean scores ranged from 64.13 to 71.70. These indicated that 4-H'ers had gained from 7.62 to 18.41 points on the average from the pre-test to the post test. For the post tests of the group observing the second setting of eggs, means ranged from 68.00 to 73.39. The amount of mean gain for these students from pre to post assessments was 1.69 to 14.67 points. The overall mean post-test score for both groups was 68.42 which meant that taken together, the groups gained an average of 12.55 from the beginning to the end of the program.

The specialist trained leader group's pre and post-test scores and mean gains are compared in Table II. Inspection of these data revealed that 60 pre-tests were returned for the first setting group. These consisted of classes of sixth graders ranging in size from 5 to 84. The mean pre-test score of the two groups combined was 60.97. Post-tests were received from 64 4-H'ers for the first egg setting. Size of the classes involved was from 6 to 32 students. Mean scores for this group on the post-test were from 64.00 to 76.40. It should be noted at this point that one group had a negative score of -2.94 points. The second setting group was comprised of 138 students who represented classes ranging in size from 5 to 81 students. Mean scores for this group ranged from 63.65 to 72.00, with the overall mean being 66.43. Comparison of the amount of pre to post-test gain resulted in disclosure of a range in gain from -2.94 to 17.20.

Table III was constructed to allow a comparison of the mean post-test scores of the two groups of 4-H'ers according to the type of

TABLE II

PRE-TEST AND POST-TEST RETURNS AND COMPARISONS OF MEAN SCORES OF 4-H MEMBERS TAUGHT BY SPECIALIST TRAINED LEADERS

First Egg Setting		Pre-Test N	Mean Score	Post-Test N	Mean Score	Pre-Test Post-Test Gain
Blaine County #1		30	57.20	32	70.75	13.55
Blaine County #2		10	59.20	10	76.40	17.20
Woods County #1		5	69.60	6	66.66	-2.94
Woods County #2		15	60.00	16	64.00	4.00
	SUB TOTAL	60		64		
Second Egg Setting						
Blaine County #1		5	55.20	5	72.00	16.80
Blaine County #2		84	61.48	81	63.65	2.17
Woods County #1		26	65.69	25	69.12	3.43
Woods County #2		27	59.70	27	65.33	5.63
	SUB TOTAL	142		138		
	OVERALL	202	60.97	202	66.63	5.66

training program for the leaders. The null hypothesis was accepted because at the .01 level of significance using the derived t test value of 1.738, the difference in post-test scores was not significant. That is, there was not a significant difference in the relationship of scores between the knowledge gained by 228 4-H'ers taught by agent trained leaders and 202 4-H'ers taught by specialist trained leaders. Table III exhibits the findings of the statistical procedures.

TABLE III

COMPARISON OF POST-TEST SCORES OF 4-H'ERS TAUGHT BY THE TWO GROUPS OF LEADERS

Leader Group	Number 4-H'ers	Variance	Mean Score	t Value
Agent trained	228	113.23	68.42	
				1.738*
Specialist trained	202	113.38	66.63	

*NOTE: Not significant

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

The purpose of this study was to compare two methods of training 4-H teacher leaders by testing the accomplishments of their 4-H'ers. Four Agents were to receive training in the Chick Embryo Program and in turn train two leaders in their respective counties. The control group leaders received training similar to that of the agents presented by the same specialist. A total of 228 4-H'ers were tested in the counties when agents presented training. The control group of 4-H'ers completed 202 tests which corresponded to the number of students comprising the group. Pre-testing and post-testing was used to test the knowledge gain of each method of training 4-H leaders.

Data from the six grade 4-H'ers in Northwest Oklahoma indicated a definite gain in knowledge as observed from mean scores of the pre-test and post-test. This author could not verify whether or not these were statistically significant differences due to the lack of computable variances between the pre-test and post-test. This was brought about because it was not possible to identify and match up individual student's pre-tests and post-tests.

Observation of the mean scores indicates the 4-H'ers taught by specialist trained leaders had a better knowledge of the subject before the program began than did the 4-H'ers taught by agent trained leaders.

These scores also indicated a slightly elevated post-test for the 4-H'ers taught by agent trained leaders. However, this higher score proved to be of no significance after analysis by the t test.

Conclusions

Data from 4-H'ers indicated there was not a significant difference in the knowledge gain in the Chick Embryo Program of 4-H'ers taught by an agent trained leader compared to those taught by a specialist trained leader. Therefore, both methods of leaders training are effective and neither is superior to the other as a method of training. Based on the increase of scores from pre-test to post-test and the exceptance of the hypothesis the author concluded the teaching materials used were complete and instructional. The limited scope and training materials used in this study make generalizations to other 4-H groups impossible. Additional studies using other subject matter areas would be necessary before generalizations could be stated.

Recommendations

This author recommends the following studies be accomplished before generalizations can be stated:

(1) Replications of this study be completed state wide.

(2) Replications of this study in different age groupings of 4-H'ers.

(3) Replication of this study using a differnet subject matter area for testing.

This author recommends the continual employment of both methods of leaders training tested in this study.

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APPENDIX A

INSTRUMENTS USED IN STUDY

CHICK EMBRYO PRE-TEST
(TRUE - FALSE)

1. *All chicken eggs will hatch.* _____
2. *Fertile chicken eggs need to be incubated for 21 days before hatching.* _____
3. *The embryo develops from the air space inside the shell.* _____
4. *The air cell of an egg is always in the small end of the egg.* _____
5. *Double yolked eggs will hatch two chicks.* _____
6. *The yolk contains the fats, vitamins and minerals essential for normal growth.* _____
7. *There are normally more pores in the large end of the shell than other parts of the shell.* _____
8. *Water is not necessary in hatching eggs in an incubator.* _____
9. *The yolk sac begins to enter the body cavity on the fifth day of incubation.* _____
10. *The infundidulum is a part of the chicken reproductive tract.* _____
11. *As we eat the egg, it is natures most complete food.* _____
12. *The Blastoderm is located on the yolk.* _____
13. *The egg is natures way of reproducing avian species.* _____
14. *We turn the eggs each day to aid development of the embryo.* _____
15. *If you are going to turn the eggs, you would use hand cream on your hands to protect the eggs.* _____
16. *The Chalozae holds the Blastoderm (germ spot) in the center of the yolk.* _____
17. *The Chick Embryo does not breath before it breaks the shell.* _____
18. *The Chick Embryo develops in the Ammiotic Cavity during incubation.* _____
19. *Eggs will not hatch unless they are incubated at 110°F.* _____

(over)

20. *Air and water can pass through the holes in the shell of an egg.* _____

21. *The heart develops out side of the body of the embryo until the 10th day of incubation.* _____

22. *The air cell can move from end to end and it will always be on the top end.* _____

23. *The Albumen in fresh eggs is much thicker than in three day old eggs.* _____

24. *The Chalazae are like small ropes attached to the yolk.* _____

25. *White chickens come from white eggs and colored chickens from colored eggs.* _____

CHICK EMBRYO POST-TEST

(TRUE - FALSE)

1. *The yolk sac begins to enter the body cavity on the fifth day of incubation.* _____

2. *If you are going to turn the eggs, you would use hand cream on your hands to protect the eggs.* _____

3. *The yolk contains the fats, vitamins and minerals essential for normal growth.* _____

4. *The air cell can move from end to end and it will always be on the top end.* _____

5. *The Albumen in fresh eggs is much thicker than in three day old eggs.* _____

6. *Eggs will not hatch unless they are incubated at 110° F.* _____

7. *The air cell of an egg is always in the small end of the egg.* _____

8. *The heart develops out side of the body of the embryo until the 10th day of incubation.* _____

9. *Air and water can pass through the holes in the shell of an egg.* _____

10. *The Chalozae holds the Blastoderm (germ spot) in the center of the yolk.* _____

11. *All chicken eggs will hatch.* _____

12. *As we eat the egg, it is natures most complete food.* _____

13. *The egg is natures way of reproducing avian species.* _____

14. *The Chalazae are like small ropes attached to the yolk.* _____

15. *Water is not necessary in hatching eggs in an incubator.* _____

16. *The Chick Embryo develops in the Amniotic Cavity during incubation.* _____

17. *We turn the eggs each day to aid development of the embryo.* _____

18. *Fertile chicken eggs need to be incubated for 21 days before hatching.* _____

19. *White chickens come from white eggs and colored chickens from colored eggs.* _____

20. *There are normally more pores in the large end of the shell than other parts of the shell.* _____

21. *The Blastoderm is located on the yolk.* _____

22. *The embryo develops from the air space inside the shell.* _____

23. *The Chick Embryo does not breath before it breaks the shell.* _____

24. *Double yolked eggs will hatch two chicks.* _____

25. *The infundidulum is a part of the chicken reproductive tract.* _____

APPENDIX B

LETTER OF AUTHORITY

COOPERATIVE EXTENSION SERVICE

OKLAHOMA STATE UNIVERSITY
4-H AND YOUTH DEVELOPMENT PROGRAMS

UNIVERSITY EXTENSION
STILLWATER 74074

July 5, 1974

Dr. J. C. Evans
Vice President for Extension
Oklahoma State University
201 Whitehurst
Campus

Dear Dr. Evans:

This will confirm our conversation of last Wednesday morning concerning the research study planned in the Northwest district. As I indicated, George Salwaechter, 4-H Agent in Woodward County, will be conducting a study on effectiveness of teaching methods relating to the Chick Embryo program. This study will involve six counties in the district, four of them with Extension personnel teaching leaders and two of them using leaders, instructed by Dr. George Newell.

The study will be a part of the thesis for George in completing his Masters degree in the department of Agricultural Education. Both Dr. Newell and I will be working with him as well as Dr. Terry. Howard Powell is informed of the study and is cooperating in the selection of counties to be used in the study. As we discussed, this is the direction we have been encouraged to take in selecting studies and I am pleased that George has taken the lead.

Thanks for your cooperation and support.

Sincerely,

Eugene Williams

Eugene Williams, Director
4-H & Youth Development Programs

EW:rh

cc: Mr. Howard Powell
Mr. George Salwaechter

APPENDIX C

LETTER OF INSTRUCTION

AND EXPLANATION

COOPERATIVE EXTENSION SERVICE

OKLAHOMA STATE UNIVERSITY
Division of Agriculture

UNIVERSITY EXTENSION
P. O. Box 946, Woodward, Okla. 73801

September 17, 1974

Dear Teacher:

Enclosed is the Pre-Test for the Chick Embryo program to be given at the beginning of the program in your school to the 6th graders. Please note that there are questions on the front and back of the paper. After completing the test, return in the enclosed self-addressed envelope.

Please do not put names on tests or envelopes.

A Post-Test will follow at end of project.

The testing is being done to determine the best method of conducting training in 4-H and related projects.

I thank you for your cooperation and wish you great success and enjoyment with the Chick Embryo program.

Sincerely,

George R. Salwaechter
Extension 4-H Agent
Woodward County

GS:lb

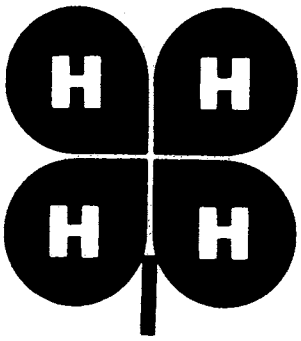
Enclosures

APPENDIX D

TRAINING MATERIAL FOR CHICK EMBRYO PROGRAM

CHICK EMBRYO SCIENCE PROGRAM

LESSON PLANS



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INSTRUCTION GUIDE I

THE AVIAN EMBRYO - OKLAHOMA STATE UNIVERSITY EXTENSION

Aim of the lesson

1. To develop the understanding that a newly hatched chick is the result of a gradual growth which has occurred inside of an egg.

2. To improve the students power of observation by having them see for themselves the changes which take place as a chick embryo grows.

What is needed

1. Overhead transparency describing the parts of an egg.

2. If possible, arrange students into groups of 3 and give each group 3 paper towels, 1 small paper plate and 1 egg.

   (Cracked eggs may be used and very often can be obtained from a local poultryman or an egg packaging plant.)

3. Bucket to collect eggs at the end of class. If shells and paper towels disposed of by placing in waste baskets, liquid eggs may be flushed down a toilet or the waste disposal in the kitchen or use for dog or cat food, but certainly not for humans.

Background Information

Definition:

Avian - bird.
Embryo - a young living animal as it forms inside an egg or a young living plant inside a seed.
Embryology - study of the growth of any plant or animal from a single cell until birth.
Egg - a cell produced by a female organism (animal-plant). When sperm from a male unite with an egg, the egg can grow into a new organism.
Porous - full of pores (tiny holes).
Fertile - capable of breeding or reproducing.
Fertile eggs - an egg capable of developing into an embryo.
Very important as you teach them the lesson that students realize they are not eating a baby chicken when they eat eggs!!!!
All living things come from parents like themselves: i.e., frogs come from frogs, humans come from humans, chickens from chickens.
Why do chickens lay eggs?
What other animals lay eggs? (all birds, frogs, turles, alligators, some snakes, some fish).
Features all birds have - feathers, beaks, 2 legs, 2 wings and female birds lay eggs.

Demonstration

Students should examine eggs and decide what they see. They should answer on what they actually believe to be true.

Is it round like a ball?
Oval - what do they mean by oval?
What color is it?
Is the shell hard - smooth?
Is the shell glazed like a dish or like glass, or is it porous?
How can we prove the shell is porous? (number of pores in shell number from 6,000 to 8,000)

An experiment that someone in class can do at some other time.
Have druggist mix a solution of 3 grams of Methyline Blue to 1 liter 95° ethyl alcohol. Place eggs which have been held at room temperature for at least 4 hours in cold dye for 3 minutes. Remove - allow to dry and break open - dye should be present on inside of shell. Notice more holes in big end than small. (Why?)

Students should crack the shell - (hitting the egg against edge of desk very carefully) - peel off a chip or two of the shell and notice the skin or membrane beneath. Air can pass through this membrane.

Now break open the egg and empty contents into the paper plate.

Look at empty egg shell - many will see large bubble at large end of egg. This is called the air cell.

Students should describe what they see (also refer to overhead transparency).

Yellow or orange ball = Yolk

White cord or string near each end of yolk = chalazae or rope - The yolk is enclosed in a membrane and the chalazae are the ends of the membrane - (This can be demonstrated by using a candy kiss which is a piece of candy wrapped in paper twisted at both ends.) The chalazae holds the yolk in the center of the egg.

Clear liquid - sticky, etc. = White or albumen.

White spot on yolk = germ cell or a blastodisc this is where the embryo grow. All yolks will have this spot and if student cannot see the spot, it will be necessary to turn the yolk over. This can be done by gently picking up the yolk in the hand and turning over. If a yolk is broken, it is difficult to find germ cell. Cannot tell by looking at germ cell with the naked eye if it is fertile or not - almost all eggs produced by poultrymen today are infertile eggs.

Red or blood spot - see Instruction Guide II, Page 2.

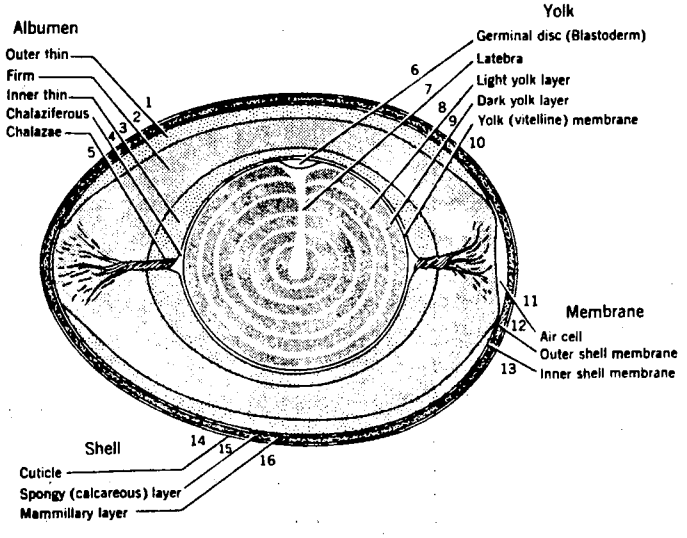
Other points

3 things all living animals must have
Air
Food
Water

How can a baby chicken obtain these since it is "boxed" inside a shell?
Air - can pass through shell and membrane ⟷ chickens use O^2 ⟶
give off CO^2 ⟵
Food - yolk is mostly protein, protein builds muscles, etc.
Water - albumen which is about 85% water
also yolk is about 50% water.

The Yolk

The yolk contains large amounts of fat and is also a reservoir of vitamins and minerals that are essential for normal growth. The fat in the yolk combines with oxygen that is taken in through the pores of the shell and together they provide tremendous amounts of energy. The by-products of this combination are water, which is used by the embryo to replace the water lost by evaporation, and carbon dioxide. The carbon dioxide combines with water to make a weak acid that dissolves the shell. The calcium portion of the dissolved shell passes through the shell membranes and is used by the embryo to make its bony structure or skeleton. The removal of calcium to make the bony skeleton weakens the shell and ultimately assists the chick embyo in making its exit from the shell.



INSTRUCTION GUIDE II
Dissecting A Hen

This lesson can be done 2 ways. One by teacher dissecting a hen or just refer to overhead transparencies.

What is needed

1. Using overhead transparency or Figure 2 of this Lesson Guide. Perhaps draw on board a large drawing and refer to drawing throughout lesson.

1a. Dissecting a Hen (4th grade and above).
   a. Obtain hen from local poultryman. (Very often you can obtain a hen going out of production at a very low price.)
   b. Do not kill the hen in front of the students. Hen may be killed by breaking the neck as follows:
      1. Place thumb on back of neck close to head, and finger under beak. Left hand holds legs and tips of wings to prevent flapping.
      2. Hand is closed around head and neck is bent back around thumb and stretched at the same time. Bird is humanely dispatched quickly and easily. (Bird can be killed 1 to 2 hours ahead of class if necessary.)
      3. Dissecting tools.
         1 pair of sharp scissors.
         1 very sharp knife - a scalpel.
      4. Place hen on paper on table so students can see the bird. (See Page 4.)

Demonstration

1. In the ovary there are many, yolks (ova) (perhaps thousands). The hen is a product of 3,000 years of breeding by man. The original chicken is the jungle fowl found in Africa and the Far East. She lays up to 30-40 eggs a year compared to our hen of today which lays about 240 eggs a year.

   In the laying, the ovary is seen as a cluster of developing ova (yolks) varying from very small to full size (Figure 2-A - the Avian Embryo) usually not more than half dozen of the larger ones which are yellow, whereas the small white ones number in the hundreds.

   The oviduct is a tube (or tunnel) having many loops through which the yolk passes for fertilization and the addition of the white and surrounding membranes. The oviduct extends from its attachment at the base of the ovary to the cloaca. The oviduct varies in structure throughout its length in accord with its varying function, the different portions of this tube being specialized for the secretion of the different parts of the eggs.

The oviduct has the following five major parts (Figure 2 - The Avian Embryo).

a. The infundibulum or funnel which picks up the yolk after release from the ovary. (Yolk remains for about 18 minutes) Most of time fertilization will take place in the infundibulum. (Sperm deposited by the male swim their way up to the infundibulum, stored in "tiny ducts" and enter the "germ cell" which is on the yolk as the yolk falls into the funnel). Since the sperm can be stored in ducts, mating may occur only every 7-10 days and the eggs will be fertile.

b. The magnum where most of the egg white is secreted (remain about 3 hours).

c. The narrow isthmus where the shell membrane is formed. (Remain about 1 1/2 hours.)

d. The egg enters the uterus (remains about 19 hours) where the shell is formed. The shell is added last; its calcium and other minerals are put on by glands in the uterus. (Remain about 21 hours in uterus and vagina.)

   Shell color is added in the uterus and takes place the last five hours. It has been found that turkey eggs acquire their speckles very nearly at the time of laying. Chickens, depending on the breed, lay white, brown, green or blue eggs.

e. The vagina which leads from the uterus to the cloaca (#6) from which the egg is expelled.

Questions - to ask the class - or information for you if the student asks.

What causes a double yolked egg?

Double-yolked eggs result from two ova ripening at the same time, or one ovum being pushed back into the oviduct at the same time that another ovulation takes place. Eggs with double yolks are more common among young birds than among older birds. It takes time for the newly functioning ovary and oviduct to become properly adjusted and to work normally.

What causes a blood spot in eggs?

They result from the hemorrhage of a small blood vessel in the ovary or oviduct. A blood spot on the yolk indicates a hemorrhage in the follicle at the time of ovulation. The follicle probably did not rupture along the stigma where there are normally no blood vessels. If the spot is in the white of the egg, it indicates a hemorrhage in the wall of the oviduct. Bloody eggs are probably the result of more severe hemorrhages. The reproductive system of the female is easily ruptured when in production. Fright, high perches and nests, and a deficiency of Vitamin K may result in an abnormal number of blood spots.

Ovulation - is the process of release of the yolk or avum from the ovarian follicle

A mature yolk shows a space or streak where there are normally no blood vessels. It is along this streak that the rupture occurs for release of the yolk.

Streak showing clear area known as the stigma along which rupture (or tear) occurs to release the yolk.

What causes a soft shelled egg?

Soft shelled eggs may result from failure of the shell glands to secrete; or they may result from the peristaltic constrictions becoming so violent as to hurry the egg through the uterus. Most shell-less eggs are probably laid at night. This would indicate that certain ways in which birds roost may cause abnormal pressure on nerves leading to the oviduct.

What causes a small yolkless egg?

Small yolkless eggs may result from the stimulus produced by some foreign substance, such as a blood clot or piece of membrane, gaining entrance to the oviduct and passing along in the same manner as the yolk. The passage of the particle will stimulate the albumen, shell glands to secrete their particular products.

What causes an egg within an egg?

An egg within an egg is sometimes found. After an egg has been formed, it may be forced back up into the funnel region by reverse peristaltic action. As it again traverses the oviduct, albumen, shell membranes and shell are added. When the egg is opened, a complete egg is found where the yolk is normally present.

Dissecting the hen as follows:

After killing the bird, place the hen on her back on the table. Cut the skin between the vent and rear of the keel around on both sides near the thighs and across the ribs. Press the legs away from the body until they are thrown out of joint. Pull the skin forward and to the sides to expose the entire breast and abdominal surface.

A cut should then be made through the muscles just back of the breast bone and forward through the ribs on each side in the direction of the attachment of the wings. Raise the rear of the keel and push it forward to expose the viscera. (Keel = breast bone)

The organs should be examined carefully before removal.

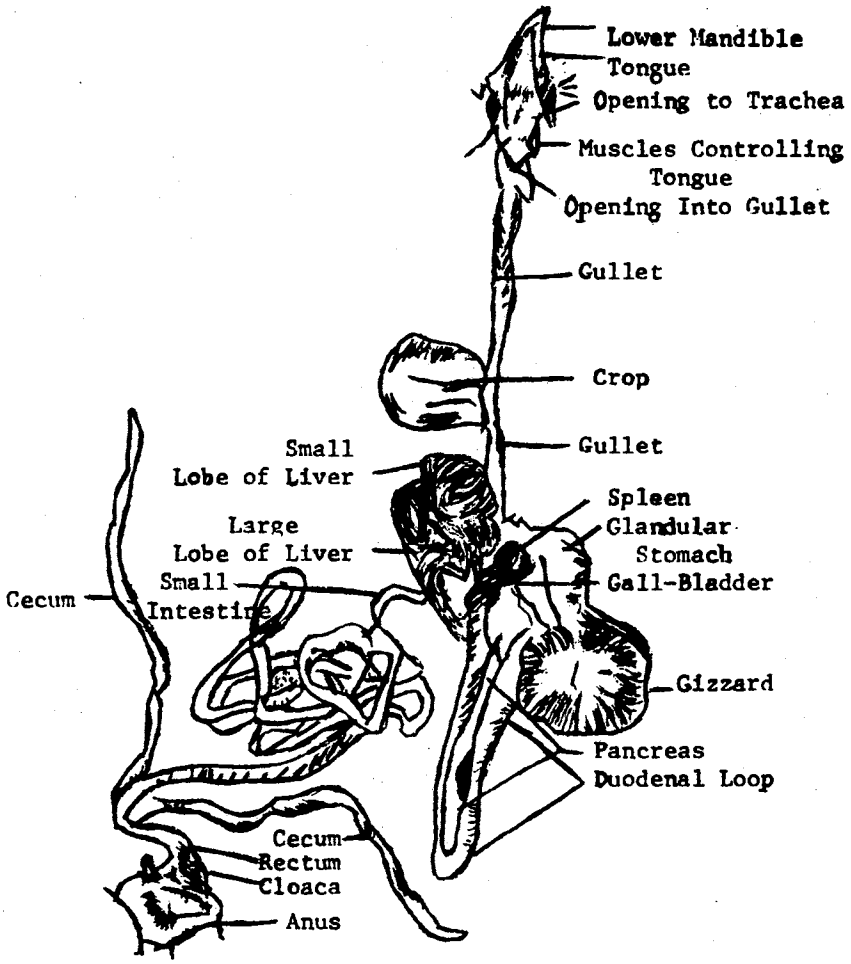
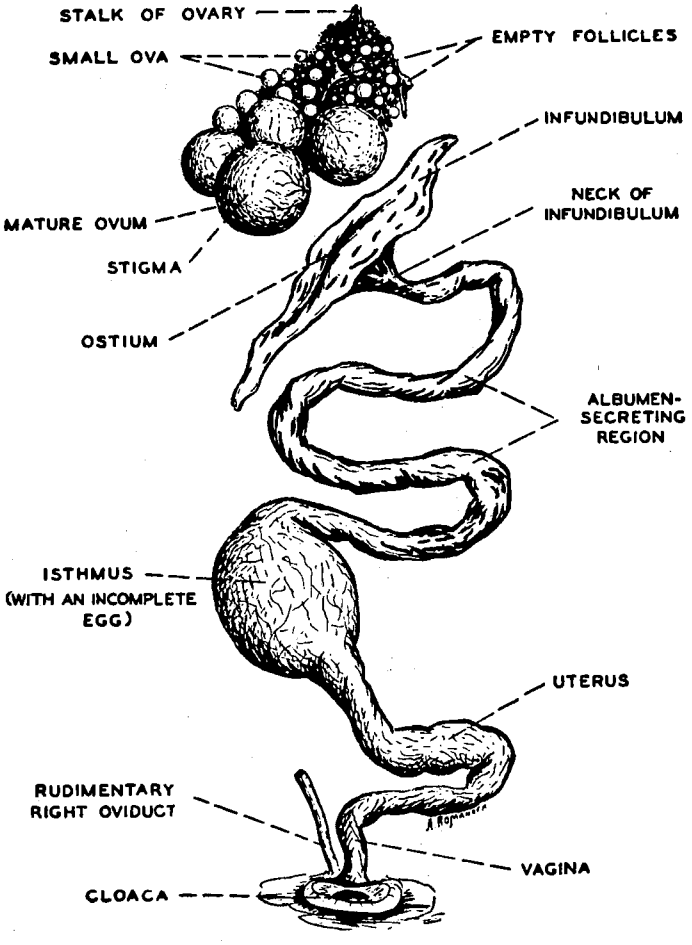


FIGURE 1. - The intestinal tract and accessory organs.



Reproductive organs of the hen.

Figure 2. Enlarged Drawings of A, ovary; B, oviduct

INSTRUCTION GUIDE III
Development of the Chick Embryo

A set of 41 slides showing the development of the chicken embryo may be requested from George W. Newell, Extension Poultryman, OSU, Stillwater. Following is the script for the slides. However, we recommend that you use the script only for reference. Allow the students to tell you the difference that they see in the embryo by looking at the slides.

Photographs in this series were prepared by D. K. Abbott and R. M. Craig, Department of Poultry Husbandry, University of California, with the cooperation of the University of California Agricultural Extension Service.

1. Credits

2. Title Slide

3. Diagram of a Fertile Unincubated Egg. The blastodisc, located on top of the yolk, is the future embryo. At the time the egg is laid it consists of several thousand cells. The air cell forms in the large end of the egg between the inner and outer shell membranes. This egg is shown in cross section to illustrate the layers of white and yellow yolk and also the site of migration of the blastodisc to its location on top of the yolk. The chalazae are composed of twisted strands of thick albumen; they help maintain the yolk in its central position.

4. Fertile Unincubated Egg. The fertile egg may be recognized by its characteristic donut-shaped blastodisc. The clear central area is the area pellucida; the ring-shaped opaque region, the area opaca. The diameter of the fertile blastodisc is greater than that of the infertile disc in the slide following.

5. Infertile Unincubated Egg. Here, in the area corresponding to that of the fertile blastodisc in Slide 4, only a dense rather flocculent mass can be seen. The ring structure, characteristic of the fertile egg, is missing and the shape of the disc tends to be irregular. Under magnification many lacunae are evident.

6. 1 Day of Incubation. The donut-shaped ring has expanded and now is quite prominent on the yolk. The embryo lies within the thin area pellucida and is surrounded by the thicker area opaca.

7. 1 Day of Incubation, Under Candling Light. This is the appearance of the previous egg under the candler. The dark spot is the one-day old embryo.

8. Unincubated Egg, Under Candling Light. Compare this egg with the previous one. A clear appearance and a complete absence of the dark spot on the yolk mark the unfertilized egg.

9. 2 Days of Incubation. In the two-day embryo the formation of blood has begun in structures called blood islets.

10. Diagram of 3 Days of Incubation. By this stage of incubation the blood vascular system is well developed. The parts of the brain and associated neural structures are evident. The amnion will soon enclose the embryo. It fills with fluid and serves to protect the embryo from external shock and dessication. Later its contents provide a nutrient source to the embryo.

11. 3 Days of Incubation. Notice that the embryo has turned so that its left side faces the yolk.

12. 3 Days of Incubation, Under Candling Light. Here the blood vessels show quite clearly and the orientation of the embryo in the egg can be determined.

13. 4 Days of Incubation. By the end of the fourth day of incubation the primordia of all organs are present. Compare the size of the brain and heart with the body; also, notice that the allantois has appeared as a small outpouching of the gut to the right of and above the tail. The allantois serves both as a waste receptacle and as an embryonic lung until just before hatching. The limb buds can be distinguished as small lateral swellings, one pair near the allantois and one near the heart.

14. 5 Days of Incubation. Further development of the brain and a change in the relative proportions of body and trunk can be noticed. Rapid growth of the allantois is characteristic of this and the next several stages.

15. 5 Days of Incubation, Under Candling Light.

16. Typical Early Dead (Candled on the 5th Day of Incubation). This embryo probably died on the fourth day of incubation as evidenced by the extent to which the terminal sinus has grown. Upon death blood drains from the embryo and the vessels of the extra-embryonic circulatory system into the terminal sinus, giving the characteristic "blood ring" appearance seen by hatcherymen.

17. Infertile, Incubated 5 Days, Under Candling Light. Compare the yolk shadow of this egg with the unincubated egg in the following slide. Notice the increased density of the yolk shadow and the increased shell porosity in this incubated egg.

18. Unincubated Egg, Under Candling Light.

19. 6 Days of Incubation. Rapid development of the limb buds during this and following days takes place. Limb bud stages are used to determine the age of an embryo during this period.

20. 7 Days of Incubation. Notice the size of the eye - the most obvious part of the embryo. The egg tooth is beginning to develop at the tip of the beak.

21. 8 Days of Incubation. Look carefully for the feather germs along the back. The toes are apparent; feet and wings are well developed now.

22. 9 Days of Incubation. A large egg tooth and feather follicles on all tracts are typical of the nine-day embryo.

23. Diagram of 10 Days of Incubation. Observe the complicated relationships of the extra-embryonic membranes (the amnion, chorio-allantois, yolk sac and the forming albumen sac) to each other and to the embryo proper.

24. 10 Days of Incubation. The wing finger and the toes show quite clearly. Down feathers have erupted in the tail region and feather papillae are evident above the eye and on the eyelid.

25. 11 Days of Incubation. The embryo's body is growing rapidly and the proportions of head to trunk are changing. The eyelid is overgrowing the eye.

26. 12 Days of Incubation. Down feathers are present on thighs and wings, over the eye and along the back of the neck. Footpads and scales are developing and calcification of the bones is well underway. Notice the toenails.

27. 13 Days of Incubation. The embryo has begun to swallow the protein containing amniotic fluid. The comb and wattles have appeared. From this stage on the increases in size of the embryo is very rapid.

28. 14 Days of Incubation. The body proportions are more chick-like. Between thirteen and seventeen days changes in size and extent and length of feathering are the main visible features. In addition, the rapid utilization of fat from the yolk changes the nature and coloring of the skin.

29. 15 Days of Incubation.

30. 16 Days of Incubation.

31. 17 Days of Incubation. Between seventeen days and hatching the embryo has many changes to undergo. All remaining fluid from the amion and allantois will be taken in along with the residual albumen and yolk. The normal hatching position will be assumed with the beak beneath the right wing. As the future chick changes from allantoic, the pulmonary respiration, the blood vessels of the allantois and the yolk sac will gradually regress. The embryo normally will pip first into the air cell and finally begin to crack the shell.

32. 18 Days of Incubation. Normally, the embryo has its head between its thighs; all its albumen has been used and yolk retraction is beginning.

33. 18 Days of Incubation, Under Candling Light. The air cell is greatly enlarged.

34. 19 Days of Incubation.

35. 20 Days of Incubation.

36. 20 Days of Incubation, Under Candling Light. This embryo is in the normal hatching position and has piped into the air cell.

37. 21 Days of Incubation. The embryo has piped the shell.

38. Chick Hatching. This struggle usually lasts from 10 to 20 hours.

39. Hatched Wet Chick.

40. Chicks 1 Day After Hatching. Notice the bright eyes and alert appearance in these healthy 1 day old chicks.

41. Empty Shell.

SUMMARY OF EVENTS IN EMBRYONIC DEVELOPMENT

BEFORE EGG LAYING	Fertilization Division and growth of living cells Segregation of cells into groups of special function (tissues)
BETWEEN LAYING AND INCUBATION	No growth; stage of inactive embryonic life.

DURING INCUBATION

FIRST DAY:
- 16 hours - first sign of resemblance to a chick embryo.
- 18 hours - appearance of alimentary tract.
- 20 hours - appearance of vertebral column.
- 21 hours - beginning of formation of nervous system
- 22 hours - beginning of formation of head
- 24 hours - beginning of formation of eye.

SECOND DAY:
- 25 hours - beginning of formation of heart.
- 35 hours - beginning of formation of ear.
- 42 hours - heart begins to beat.

THIRD DAY:
- 60 hours - beginning of formation of nose.
- 62 hours - beginning of formation of legs.
- 64 hours - beginning of formation of wings.

FOURTH DAY: - beginning of formation of tongue.

FIFTH DAY: - formation of reproductive organs and differentiation of sex.

SIXTH DAY: - beginning of formation of beak.

EIGHTH DAY: - beginning of formation of feathers.

TENTH DAY: - beginning of hardening of beak.

THIRTEENTH DAY: - appearance of scales and claws.

FOURTEENTH DAY: - embryo gets position suitable for breaking shell.

SIXTEENTH DAY: - scales, claws, and beak becoming firm and horny.

SEVENTEENTH DAY: - beak turns toward air cell.

NINETEENTH DAY: - yolk sac begins to enter body cavity.

TWENTIETH DAY: - yolk sac completely drawn into body cavity; embryo occupies practically all the space within the egg except the air cell.

TWENTY-FIRST DAY: - hatching of chick.

INSTRUCTION GUIDE IV
Caring For The Eggs

1. Caring for Eggs Prior to Incubation.
2. Operation of the Lyon Transparent Hen Incubator.
3. Hatching Failures.
4. Maintenance of Incubator.
5. Use of the Egg Candler.

1. Caring for Eggs Prior to Incubation.

Fertile eggs should not be held longer than one week. If it is necessary to hold them for any length of time, they should be kept in a location where the temperature is around 50° F. and a relative humidity of 70%. The vegetable section of the refrigerator may be used for holding eggs until it is time to place them in an incubator. Do not store eggs at room temperature for embryo will begin to develop when the temperature reaches about 80°.

2. Location of Incubator.

Since the incubator is not too well insulated and will be opened frequently when eggs are inspected and turned, it is desirable that the machine be kept in a room where the temperature is between 70° and 75°. Do not place the incubator near windows where it will be exposed to the direct rays of the sun or near cold walls.

3. Incubator Operation.

a) Place the egg tray with moisture pan beneath on a layer of cardboard, blotter paper or cloth placed on table at suitable height, then lower incubator over tray so the tray is centered. Plug incubator cord into 115 volt outlet and allow sufficient time for the incubator to warm up.

b) To adjust temperature, make sure both lamps are on and then wait until thermometer shows approximately 102° in case of Standard Model (103° for L.A. Model). Now open vent adjustment at center of top, insert finger and turn notched wheel in LOW direction as indicated at base of handle until one light goes off. The first heat up will cause an overshoot of temperature. Adjust again and allow several hours for temperature to stabilize before putting eggs in tray. Always move vent cover back to original position after a temperature adjustment. Avoid handling the "TRANSPARENT HEN" roughly after adjustment. Note: The upper area of the plastic will appear quite warm to the hands. This condition is normal and necessary to keep this portion of plastic clear of fogging (water condensation) for good visibility. (Excessive fogging at first heat-up will soon disappear.) (If fogging persists, open vent slightly.)

c) To adjust ventilation, change position of white circle at center top. This vent-hole-cover can be kept closed during early stages of incubation.

Very little opening of top center hole is required thereafter. Do not open vent too much. Even an opening of 1/8th inch is effective in increasing size of egg air cell in accordance with chart. During incubation, check air cell development with a candler to determine whether air change is required to "dry down" (enlarge air cell). In cold rooms (such as during the night) the vent should be closed if incubation is progressing normally.

d) To control humidity, increase or decrease area of water under egg tray. For average requirements, the 7-inch pan is usually ample. In very dry rooms, the "TRANSPARENT HEN" can be placed in a 12-inch pan of water about 1/2 inch deep. All the area under the eggs will help provide moisture and the incoming air through the small holes in rim will flow directly over the water. For high humidity, keep vent almost closed. High humidity helps hatching, but too much moisture during incubation prevents proper enlargement of egg air cell.

e) Egg Handling. Prior to placing the eggs in the incubator, mark them with a pencil in such a way that you can tell when they have been turned. For incubation, lay eggs in tray. Remove cracked eggs as they will not hatch. If eggs are packed tightly, keep large end higher. Turn eggs three times each day. (Some operators wear cotton gloves when handling eggs.) On the 13th day, remove the infertile eggs and dead embryos by checking all the eggs with a light. (White eggs are preferred for display because they are easier to candle.)

For hatching, lay pre-incubated eggs flat in tray. Eggs need not be turned after the 18th day. Chicks should break out of shell by themselves. If helped out, they generally are cripples.

4. Use of Candler.

To see the movement of the developing embryo in the egg can be a highlight of the project. The embryo can be seen by means of a candling light. A candler will be furnished with each incubator. To use the candler, darken the room as much as possible and hold the large end of the egg up to the light. The contents of the egg is shown by means of shadows created by light passing through the shell. Very little of interest to the students is seen until the 4th or 5th day of incubation. White-shelled eggs allow more light to pass through than do brown eggs, so therefore, it is easier to observe embryo development in the white-shelled eggs. A candler can also be used to eliminate infertile eggs or eggs without developing embryo due to other causes.

5. Hatching Failures.

Chicks fail to hatch for a number of reasons. Ordinary handling does not hurt the egg due to the protection of the embryo by the amniotic fluid. Excessive handling and jarring of the hatching egg may be harmful. The incubation temperature needs to be just right, and it has to be kept as nearly constant as is possible to do so. Too little humidity in the incubator is a serious matter, especially at hatch time. Excess moisture is better than too little moisture.

Some chicks will fail to hatch due to inherent weakness. This is natural and in a way it is nature's way of weeding out the weak. Weakness of the chick may be due to the improper nourishment of the parent stock. This is why proper and correct nutrition is a must for all--be it bird, or mammal. If the eggs are not held under proper temperature and humidity before incubation, the hatch may prove disappointing.

It is always best to follow the instructions given for the kind of incubation being used in order to obtain satisfactory results. After the 21st day, if some eggs are pipped but not yet hatched, adding boiling hot water in the moisture pan to steam up the incubator may help. If, after another 2 or 3 hours, the chicks have not yet emerged, it is all right to try to help them by carefully picking away the shell. Such chicks are usually weak. Hatches delayed until the 23rd day can be counted on to be a failure.

One should expect a hatch of 50 percent or better if 95 percent of all the eggs placed in the incubator are fertile. Chicken eggs require 21 days to hatch.

Check List

a) Keep water in pan at all times. Three days prior to hatching, place paper towel over filled water pan. Towel should touch water and become soaked. This will increase the evaporation surface.

b) Temperature should range between 97° and 103°, as close to 101° as possible.

c) Turn eggs a half turn at least 2 or 3 times a day to include weekends. During school hours eggs can be turned in the early morning, at noon and prior to leaving in the afternoon.

d) Chicken eggs which hatch in 21 days do not or in fact should not be turned after the 18th day of incubation.

e) After the baby chicks are completely dry, they can be removed from the incubator and placed in a brooder.

INSTRUCTION GUIDE V

Brooding Unit For Small Numbers Of Birds

Equipment: One cardboard box approximately 28 inches long x 25 inches wide x 14 inches high.
One goose neck lamp with 60 to 75-watt bulb or other appropriate apparatus for keeping chicks warm.
One water fountain.
Pebbles, marbles or 1/4" screen.
One feed tray.
A welded wire cover.
Shavings, straw, peat moss, sand or other appropriate litter material.

Procedure: For those who want to raise a few chicks for a short period of time here is a simple brooding unit. The principles of brooding are the same regardless of the number of chicks in the flock. Whether there is one chick in the brooding unit or 1,000, they have to be kept warm, well fed and watered, protected from predators and dampness, and provided with plenty of fresh air without being exposed to drafts. This unit, when used in a warm place such as the home or school, will do the job.

Here you see the cardboard box which is to be the home, the brooder house, for the chicks. The size and shape is not important as long as it is big enough to properly house the chicks and the equipment needed to take care of them.

The goosenecked lamp provides the heat. A 60 to 75-watt bulb normally provides enough warmth. The neck of the lamp can be bent to move the bulb, the source of heat, closer to the chicks if they are cold or straightened to move it away if the chicks are too warm. If the side of the box is very high, a slit can be made in the box so that the base of the lamp can be placed outside while the gooseneck of the lamp fits in the slit and the lamp shade is inside the box.

When the chicks are cold, they huddle together and "cheep" plaintively. When they are too warm, they stand with wings partially outspread, beak open, throat rapidly pulsating and in essence pant like a dog.

The walls of the box serve as a chick guard and keep drafts off the chicks.

Notice the two to three inches of litter. This serves as an insulation and as an absorptive material. Materials such as peat moss, shavings, straw or sand can be used. Never place birds, especially young birds, on a smooth surface, such as

newspaper. They cannot grip a slippery surface and their legs tend to go out to the side. This disjoints the legs at the acetabulum and cripples the chicks. This condition is commonly called "spraddle leg."

Each unit should contain at least one waterer and one feeder. Place the waterer on a wooden block or stand to help keep the litter out of the water. IMPORTANT: Place pebbles, marbles or a screen in the water dish so that quail cannot get wet. They should be able to get their beaks in the water and that's all. Feed can be obtained at the local feed store. Chickens should be fed chick starter; quail should be fed game starter or turkey mash. Do not feed grain. If these are not available, some of the newer high protein, vitamin and mineral cereals for human consumption may be satisfactory. Feed and water chicks as soon as they are transferred from the incubator to the brooder.

Finally, after the chicks have been put in the brooding unit, cover it with a welded wire screen. This will keep the chicks in and predators such as cats and dogs out. The illustration shows a 1" x 1" welded wire screen. Other sizes from 1/4" x 1/4" to 1" x 4" mesh can be used.

If you do all these things, you will have a comfortable home for your baby chicks. Now you must follow through to be sure that they are kept warm and well fed. This means checking the feeders, waterers and the brooder unit each morning before you catch the school bus, and checking them again as you get home from school and again just before you go to bed. If in school, check them morning, noon and before school lets out.

Each time you get yourself a jelly sandwich, a glass of milk, or feel that the house is either too warm or too cold, you should think of your chicks. In this way you will have the healthiest, happiest and best chicks in your area and the reward that comes from doing a superior job.

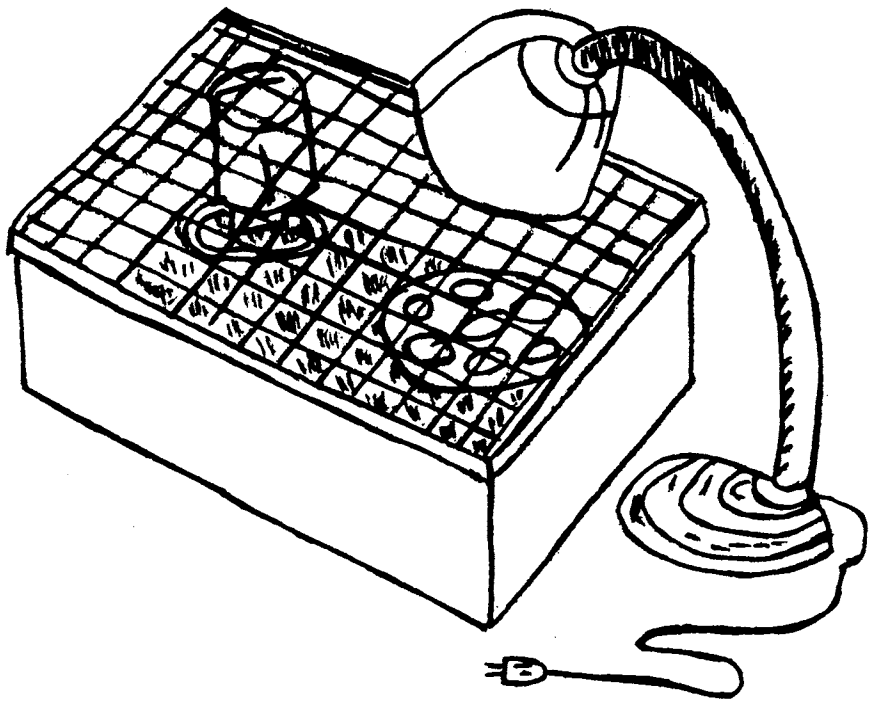


Figure 3. The Brooding Unit

INSTRUCTION GUIDE VI
Mating of Chickens

The following is information for the teacher - often the students will ask how chickens mate. If the student desires more information and it cannot be found in the library, have him write Oklahoma State University Extension Center, Claremore.

The mating behavior of chickens follows a definite pattern. This pattern can be best described as follows. The mating procedure is initiated by the rooster approaching the hen. The rooster does a dance known as a waltz. This dance is one in which the rooster walks around the hen with his one wing extended. After the dance, the hen sets down and the rooster walks on the hen's back and holds on by grabbing a feather on the hen's neck. She moves her tail to one side and extends her oviduct. The rooster moves his tail down and his rudimentary organ touches the oviduct and deposits the male germ cell (sperm). The sperm swims to the upper end of the oviduct and fertilizes the egg which, if placed in the right temperature and humidity after laying, will produce a chick.

INSTRUCTION GUIDE VII
Dyeing Baby Chicks Before Hatching

Eggs can be dyed which have been incubated from 16 to 20 days. The 19th-day embryo may give best results. Use a vegatable of 2-3 percent concentration. Such dyes can be found on the super-market shelf. Use one-half to one CC of the dye. Several different colors can be mixed, or separate colors can be injected. Carefully insert the hypodermic needle about 1/2 inch into the small end of the egg after a small hole has been drilled through the shell. Inject the dye slowly into the egg. A drop of wax for fast drying glue will seal the opening made for the injection needle. Any avian embryo can be colored in the same way.

INSTRUCTION GUIDE VIII

The Beating Heart

By using the expedient of a simple technique it is possible to demonstrate visually, the first sign of life and the exposed, beating chick heart. This technique can be used in the classroom, in 4-H meeting, scout meetings and with other groups.

The technique is simple. About 4 fertile eggs should be incubated for 48 hours. A small hole is made in the blunt end (air cell) of the egg. Slowly, the shell is picked away by means of tweezers or forceps until the shell is down to the covering, inner membrane and an opening roughly the size of a quarter has been made. Using forceps or tweezers, the membrane is very carefully peeled away. If a blood vessel bursts at this point, the procedure will need to be repeated on another egg. If the membrane is uncovered successfully, the contents of the egg is exposed. The yolk is covered with a mass of blood vessels, the vitelline circulation, and there lies the tiny heart pulsating with life!

Exposed to the room temperature, the heart will beat for several hours, if the egg is placed in an upright position. The exposed portion of the egg can be covered with Saran Wrap. Under incubating conditions, the heart may pulsate for up to 15 hours and perhaps longer. Truly, a fine training and learning experience.

INSTRUCTION GUIDE IX

Preservation of the Avian Embryo

1. A series of stages of avian embryo development can be easily prepared. Such a series of embryos can provide a ready reference set for use by the student. Specimens from two days to hatching can be used for this purpose.

2. The following equipment is needed to preserve the embryos, (a) alcohol, ethyl 70% or, Isopropyl 70%; (b) glycerine C.P.; (c) 37% C.P. or Reagent Grade Formaldehyde; (d) bottles or vials with plastic screw caps; (e) container (other than medal) to use for mixing of a 10% solution of formalin; (f) student biology kit consisting of scissors, forceps, needles; (g) incubated, fertile eggs. A useful publication to help the student is the Michael F. Guyer, Animal Micrology, 5th Revised Edition.

3. Procedure:

   Crack the shell of the egg at the broad end with a sharp knife, or scalpel and pick away the pieces until an opening about the size of a quarter is made. Remove the outer and inner shell membranes. The embryo in the blastoderm will be uppermost. Using fine-pointed scissors, cut out a circle of blastoderm about the size of a quarter, leaving the embryo at the center. With blunt forceps, pull the embryo and adherent extra-embryonic membranes away from the yolk and albumen. Remove all membranes and sever the umbilical stalk near the body wall. Rinse well under tap water. After washing clean, place the embryo into a bottle containing 10% formalin. The formalin solution is made of one part of the 37% formaldehyde and nine parts of water. This solution will preserve the specimen. After a week or so, pour off the formalin, rinse the specimen in tap water, drop 3-4 drops of glycerine onto it and place it into 70% alcohol as a final preservation agent. The glycerine keeps the specimen softer and the skin translucent.

   Dip the top of the container into melted wax to seal against evaporation of the alcohol. Label the containers with detailed information - date, variety of embryo, name of person, preservative. Note - When dealing with embryos under 5 days of incubation, the following technique is helpful in harvesting the embryo - after the embryo is exposed from under the shell membranes, place about 4 drops of the formalin solution onto the embryo. The solution coagulates the protein and makes it easier to do the harvesting of the embryo.

INSTRUCTION GUIDE X

Living Embryos With See-Through Caps

1. Prior to preparing the eggs with see-through caps, the handler should wash his hands to the elbows thoroughly and rinse and wipe dry on clean towel. Soak a small piece of cotton in an alcohol iodine mixture and wipe the egg carefully; then allow to dry. The egg should be placed in an egg flat with the pointed ends down for at least 24 hours prior to preparation. In most instances this will cause the germinal disc to be on top facing the air cell.

2. Crack or drill a small hole through the shell above the air cell with a small pair of forceps. Do this with caution in order to not cause large cracks in the egg shell. Carefully remove small bits of shell until a circular disc 2-3 cm. in diameter is opened. Then carefully remove the inner shell membrane. If the germinal disc is facing the air cell, it will be clearly visible. Smear a small amount of petroleum jelly on the inner edge of a plastic "see through" cap. (It should have small holes pierced in the top. Make certain the holes are not plugged.) Drop the plastic cap over the top of the egg. Place the egg in an egg flat with exposed end up and incubate as previously directed. If no egg flat is available, use a portion of a molded egg carton for this purpose. This preparation should enable the embryo to live for at least 10 days. For a closer look one may remove the cap, but this will shorten the time the embryo will live.

VITA

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