Virginia 4-H School Enrichment

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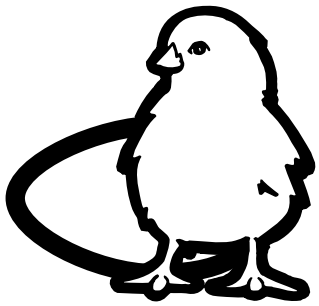

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Virginia Cooperative Extension

Publication 388-801

VirginiaTech
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VIRGINIA STATE UNIVERSITY

POULTRY

Beginning of Life

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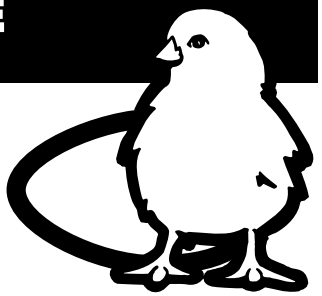
BEGINNING OF LIFE



Introduction

The Beginning of Life 4-H project is designed to help students obtain a better understanding of life and embryonic development. This publication will help you – the teacher, the project leader, or the individual doing an independent study – become more familiar with the details of embryonic development and the Beginning of Life project. This manual will provide you with enough information to demonstrate the basic processes of development. It is important for you to be able to explain what is happening and why it is happening as an embryo develops.

The bird egg is an excellent educational subject for the study of embryology. First, unlike most animals, the embryonic development of the birds takes place within the egg and outside of the body of the female. Second, the egg is small and readily available. Third, the incubation period is short enough to maintain the interest of even the youngest student.

Extension professionals, teachers, and students should feel free to contact the poultry science faculty at Virginia Tech with specific questions that may arise. However, it is important that students understand that part of science projects and research is learning to strengthen their library skills. This means that they need to learn how to research available reference material as they proceed with their science projects.

Standards of Learning (SOLs)

Students can and should address as part of this project:

4th Grade

Math	Science	English
4.2, 4.4, 4.8, 4.11, 4.12, 4.13, 4.19	4.1, 4.4, 4.8	4.1, 4.2, 4.5, 4.9

5th Grade

Math	Computer/ Technology	Science	English
5.3, 5.7, 5.9, 5.10, 5.11, 5.12, 5.17, 5.18	C/T 5.4	5.1, 5.5	5.1, 5.2, 5.3, 5.7, 5.8, C/TS.4

6th Grade

Math	Science	Life Science	English
6.9, 6.10, 6.18, 6.19	6.1, 6.2, 6.8	LS.1, LS.2, LS.3, LS.4, LS.8, LS.7	6.1, 6.8, 6.9

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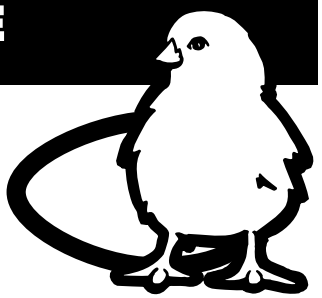


Life Skills Taught for Overall Program/Project

Learning to learn	Planning/organizing	Teamwork
Decision making	Record keeping	Self responsibility
Problem solving	Cooperation	Goal setting
Critical thinking	Communication	Concern for others
Contribution to group effort	Wise use of resources	Managing feelings
Social skills		

This Project Should

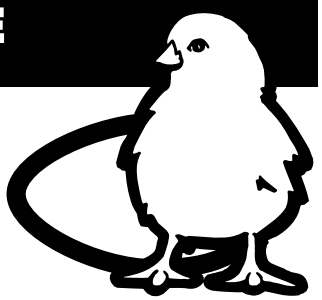
- Teach responsibility and caring for a living thing.
- Teach respect for life and the value of living things.
- Emphasize a "hands-on" experience with living things.
- Help students grasp developmental processes and stages of growth.
- Introduce and explain the topic of reproduction to the students.
- Introduce students to scientific processes and other areas of science.

Everyone involved in this detailed experiment of incubating the eggs should be fascinated by the wonders of the Beginning of Life.

A special note about this material: This manual will use the chicken as the basis for discussion. However, with only slight variations, it could be used for any bird; in fact, the coturnix quail is often used.

Planning and Scheduling the Project

Planning is crucial to the success of the Beginning of Life project. This section is designed as a checklist to help you plan the project activities in an orderly and timely manner. As you complete each part of the planning process, check it off with a pencil so you know what has been finished. Using a pencil allows you to erase the checks at the completion of the project and lets you use the same list for a number of years. Complete the following planning activities to help ensure a successful project.



Six Months Before You Plan to Start the Project

____ Plan the exact dates during which you wish to do this project, which is usually used as a supplement to a specific curriculum like biology, human sexuality, human development, or other related topic. It is extremely important that you understand that this is a continuous project for a 25-day period. Plan the project between holidays. It is usually best to plan to set your eggs on a Wednesday. This allows you to prepare on Monday and Tuesday and ensures that the chicks will not hatch on a weekend.

Dates of the embryology project: ____/_____/____ to ____/____/____.

Contact your local Virginia Cooperative Extension (VCE) office and be aware of any possible requirements for enrollment or egg procurement.

_____ Before you order eggs, plan what you will do with the chicks that hatch. Never allow students to take chicks home. Chicks must be given to a farmer or new home in groups of 6 or more if possible. Virginia law states that young fowl less than 2 months of age must not be sold or distributed in numbers fewer than 6.

_____ Order the eggs you will need as soon as possible. To ensure egg availability, order the eggs at least 1 to 3 months in advance of the day that you need them. For a basic observation and hatching project, 12 eggs per incubator are adequate. If you are planning to do an experiment, additional eggs may be required. Most private breeding farms that supply fertile eggs require notice at least a month in advance. Be certain that the arrival of the eggs coincides with the starting date of your project.

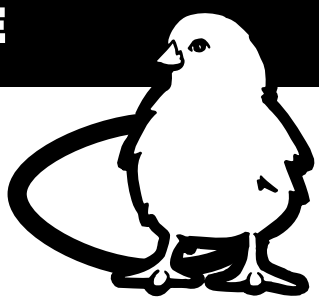
_____ Secure an incubator at least a month before the start of the project and be sure it is in proper working condition.

_____ Prepare lesson plans and order any materials you need to support the program.

Starting the Project

_____ Set up and start running the incubator 48 hours before eggs are to arrive.

_____ Prepare the students for the project at least a day before the project begins. Help them understand the principles of incubation and embryology. Discuss what you wish to accomplish and what role they will play in reaching the goals of the project. This includes preparing calendars and other project resources.



_____ Bring the eggs to room temperature at least 2 hours before putting them in the incubator.

_____ Mark the eggs with "X" and "O" on opposite sides to aid in daily turning.

_____ Set the eggs in the incubator.

_____ Turn the eggs 3 times daily.

_____ Keep water pans full at all times. Always add water that is warm to the touch.

_____ Keep daily records of all activities involving the eggs (i.e., turning, temperature, water added, and candling). These records are extremely helpful for troubleshooting causes of poor hatches.

_____ Candle the eggs every 3 days to check progress.

Hatching and Project Completion

_____ Stop turning eggs 3 days prior to expected hatch.

_____ Prepare the brooding area 2 days prior to expected hatch.

_____ Remove the chicks from the incubator and place them in a warm brooder within 4 to 6 hours after they hatch.

_____ Remove and discard all unhatched eggs within 48 hours after the first chicks hatch, then disconnect incubator power.

_____ Clean and disinfect the incubator as soon as the power is disconnected. If dirt dries to the surface, it will be difficult to remove.

_____ Let the incubator dry out. Then store in a safe, cool, and dry place.

Additional Resource Materials

Plan any activities you wish to incorporate into the project well in advance so that any materials you may need can be secured before the project begins. Once you have obtained all of the needed materials, you are ready to implement a successful project.

The following is a checklist of materials needed, where to obtain them, and the time frame required to secure them.

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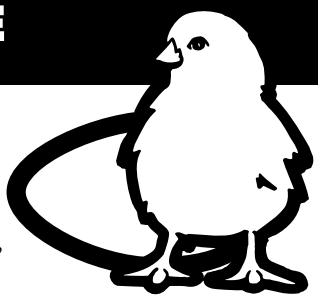


A. Incubator Recommendations:

- One with a large viewing area such as the "Picture Window Hovabator,"
- One with fans.
- One without automatic turners.

Where to Obtain:

- Purchase from local feed-and-seed store.
- Order from supply company (see Virginia Cooperative Extension Small Flock Fact Sheet #22, "List of Companies Which Deal in Small Incubators").
- Some local VCE offices have incubators available for loan.

Time Frame: Order 2 months prior to start of project.

B. Fertile Eggs. Where to obtain:

- In some cases, chicken and coturnix quail eggs can be obtained through your local VCE agent.
- Many times fertile eggs can be obtained from local farmers or hobbyists.
- Chicken eggs can be purchased from:

  Brickland Breeder Farms
  Rte. 1, Box 312-B
  Kenbridge, VA 23944
  (Attention: Victoria Martin)

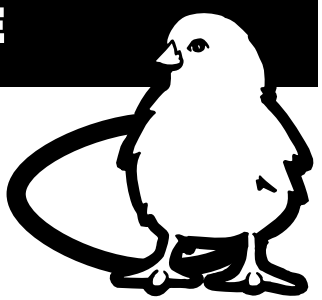
- Quail eggs can be purchased from:

  G.Q.F.
  P.O. Box 1552
  Savannah, GA 31498
  Telephone (912) 236-0651

Time Frame: Order at least 1 to 3 months prior to start of project.

C. Resource Materials Available Through Your VCE 4-H Agent. Where to obtain:

- Literature – contact your local VCE office for additional resource and supplemental literature for this and other projects.
- The specific page for Beginning of Life at *http://www.ext.vt.edu/resources/4h/4hpubs/availonline.html*



Visual aids from the Department of Animal and Poultry Sciences:

(a) Slide set and cassette tape *Embryonic Development and Brooding* is available in Beginner (ages 9 to 13) and Advanced (ages 14 to 19) levels and comes with a resource packet, cassette tape, and slides showing various stages of development from a fresh fertile egg through caring for the newly hatched chick.

(b) *Breed, Variety, and Classes of Domestic Chickens* slide set discusses the difference among breeds, varieties, and classifications of domestic poultry. It has color slides of most breeds and varieties of poultry.

Time Frame: Order 1 month prior to start of project.

D. Other Educational Aids. Where to obtain:

Carolina Biological Supply
2700 York Rd.
Burlington, NC 27212
(800) 334-5551

Wards Natural Science, Inc.
5100 West Henrietta Rd.
P.O. Box 92912
Rochester, NY 14692-9012
(800) 962-2660

Time Frame: Order educational aids at least 1 month prior to start of project.

E. Feed, Feeders, and Waterers. Where to obtain:

- Local pet stores or feed-and-seed farm-supply stores.

Time Frame: 1 week prior to expected hatch date.

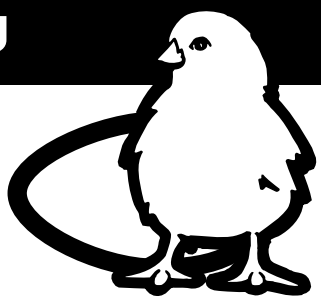
F. "Development of The Chicken Embryo" Poster by Jamesway Incubator Company. Where to obtain:

- Excellent color poster that follows the development of the embryo from the development of the egg to hatch.

Time Frame: Contact Jamesway Incubator Company for availability and pricing.

Jamesway Incubator Company
1105-C Technology Drive
Indian Trail, NC 28079
(704) 821-3168
(800) 438-8077
http://www.jamesway.com/Objectives

Lesson 1 — The Egg



Objectives

- Learn the parts of the egg
- Learn the functions of each part of the egg
- Learn which food group eggs are in
- Understand the nutritional value of the egg

Life Skills

Decision making Cooperation/communication Learning to learn

Tie to SOLs

Math	Science	English
4.11, 5.11.6.10	5.5	4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9

Time Required: 1 hour

Supply List

- 6 fresh, store-bought (nonfertile) eggs
- 2 fresh, fertile eggs
- Clear saucer or dish
- Egg Candler (can make in class, see P-34 of manual)

Background Information and Procedure

- Today we will look at each part of the egg to see what it does.
- We will learn what nutrients are provided when we eat eggs.
- We will learn how to tell if an egg is fertile or not.

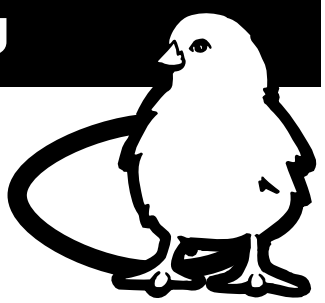
A. With a candler in a dark room, have the students observe an unbroken fresh egg. Help them identify the air cell and yolk. Refer to Figure 4 on page P-12 (use Parts of an Egg sheet).

B. Break open a fresh, refrigerated egg into a shallow saucer or dish.

Math SOL 4.11, 5.11, 6.10

Science SOL 5.5

English SOL 4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9



C. Ask the students to describe the parts of the egg they see by completing the Lesson 1 "Eggs-periment" activity sheet. Observing the egg, discuss these parts, their functions, and what nutrients they supply.

- Discuss the nutrient value of each part of the egg. "Did you know that the egg contains every vitamin except one?" (Vitamin C)
- What nutrients does the egg supply to the body? (use Lesson 1 activity sheet; "Eggs-periment": A Natural Wonder)
- Help the students find the germinal spot and determine if it is fertile or nonfertile. Refer to Figure 3 on page P-10. Most white store eggs are not fertile so compare with one of the fertile eggs you plan to incubate.

D. Pass out other Lesson 1 activity sheets and have the students complete them.

Content Background

The Reproductive System and Fertilization

The Rooster

The male fowl has 2 testes that are situated along its back. These never descend into an external scrotum, as do those of other farm animals. Some male chickens are "caponized" or castrated (surgical removal of the testes) to make them fatten more readily. The operation is relatively simple and requires no stitches to close the incision.

A **testis** consists of a large number of very slender, much-convoluted ducts, the linings of which give off the sperm. These ducts appear in groups separated by delicate membranes that extend inward from a parent membrane that surrounds the testis. They all lead eventually to the ductus deferens, a tube that conducts the sperm to a small papilla; together, the 2 papilla serve as an intermittent organ. They are located on the rear wall of the cloaca.

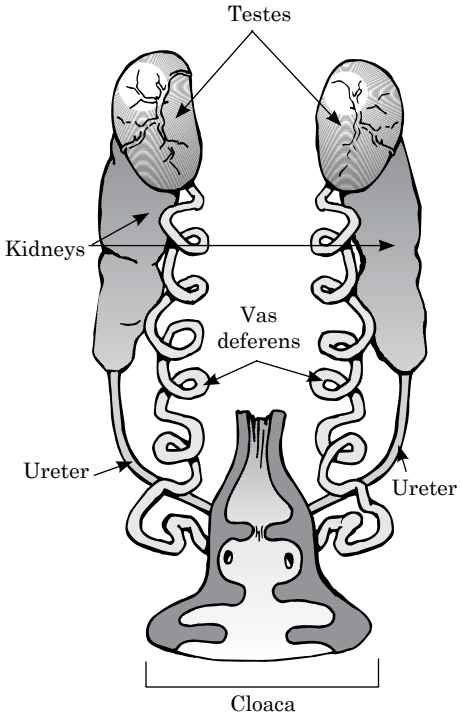


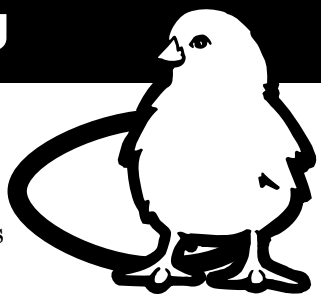
Figure 1. Reproductive organs of rooster

Math SOL 4.11, 5.11, 6.10

Science SOL 5.5

English SOL 4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9

Lesson 1 — The Egg



The rooster responds to light in the same manner as does the hen. Increasing day length causes release of hormones from the pituitary. This in turn causes enlargement of the testes, increased androgen secretion and semen production, thus stimulating mating behavior. Males used by breeders need to be lighted properly for maximum fertility and should not be lighted to stimulate gonad development until they will be used. The male should be lighted 2 weeks prior to the females for best fertility of the first eggs.

The Hen

The reproductive system of the female chicken is in 2 parts: the ovary and oviduct. Unlike most female animals, which have 2 functioning ovaries, the chicken usually has only one. The right ovary stops developing when the female chick hatches, but the left one continues to mature.

The ovary is a cluster of sacs attached to the hen's back about midway between the neck and the tail. It is fully formed when the chicken hatches and contains several thousand tiny ova, each ovum within its own follicle. As the female reaches maturity, these ova develop a few at a time into yolks.

The oviduct is a tube-like organ lying along the backbone between the ovary and the tail. In a mature hen it is approximately 25 to 27 inches long. The yolk is completely formed in the ovary. When a yolk is fully developed, its follicle ruptures, releasing it from the ovary. It then enters the infundibulum, the entrance of the oviduct (see Figure 2 on page P-9).

All of the other parts of the egg are added to the yolk as it passes through the oviduct. The chalazae, albumen, shell membranes, and shell are formed around the yolk to make the complete egg, which is then laid (see Figure 5.) This complete cycle usually requires a little more than 24 hours.

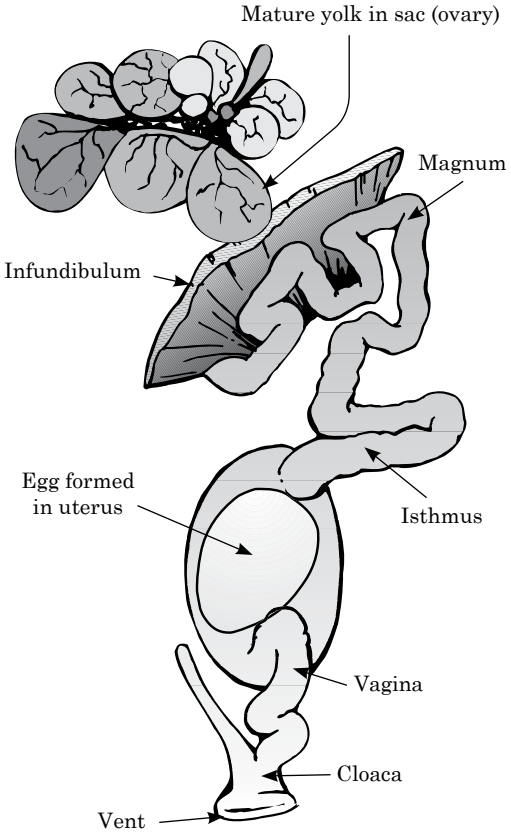
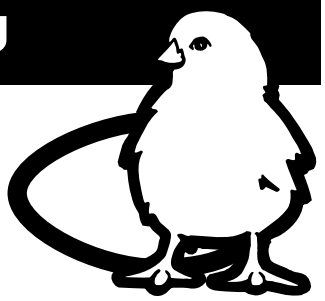


Figure 2. Reproduction organs of hen

Math SOL 4.11, 5.11, 6.10

Science SOL 5.5

English SOL 4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9



About 30 minutes after the egg is laid, another yolk is released and the process repeats itself. Development takes place as follows:

Parts of Oviduct	Length of Part	Time Spent There	Function of Part
Infundibulum	2 inches	15 min	Picks up yolk, egg fertilized
Magnum	13 inches	3 hours	40% to 50% of white laid down – thick albumen
Isthmus	4 inches	1.25 hours	10% albumen shell membrane laid down, shape of egg determined
Uterus	4.2 inches	20.75 hours	40% of albumen, shell formed pigment of cuticle laid down
Vagina and Cloaca	4 inches	–	Egg passes through as it is laid

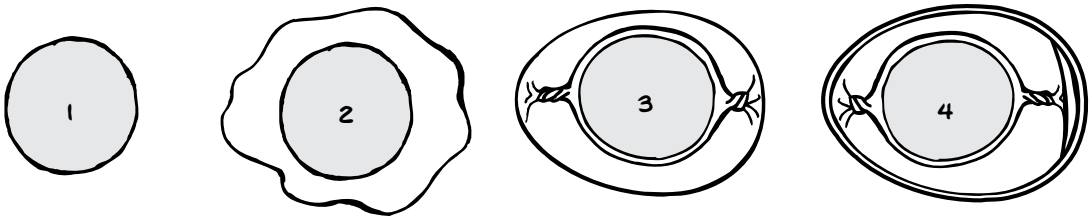


Figure 3. Order of egg formation in hen's oviduct

Math SOL 4.11, 5.11, 6.10

Science SOL 5.5

English SOL 4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9

Fertilized verses Nonfertilized

The rooster must be present for an egg to be fertilized. The eggs that you buy at the supermarket are from hens that are raised without a rooster being present. Roosters are not necessary at egg farms where eggs are produced to be consumed by people and not used for incubation. Eggs for incubation are grown at special farms called breeder farms where roosters are present with the hens.

The next time you break open an egg, look for the germinal disc. You will see that supermarket eggs are infertile (see Figure 4).

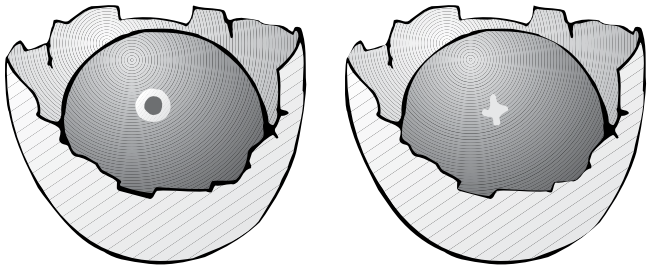
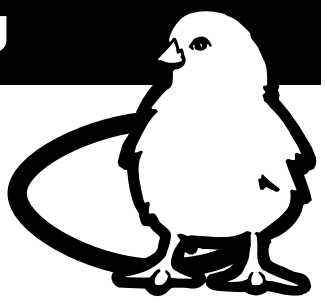


Figure 4. Fertile and nonfertile eggs

Lesson 1 — The Egg



The Avian Egg

The avian egg is a marvel of nature's architecture. A highly complex reproductive cell, it is essentially a very small center of life, a world of its own.

As we know it, the egg is the single most complete food known to man. Versatile and nutritious, it is used every day in the preparation of the most common and the most fanciful meals.

Scientifically speaking, an egg (ovum) is the reproductive cell produced by the female. It remains a single cell until the single cell (nucleus) of the male sperm fertilizes it. Once fertilized, the egg has a full complement of chromosomes and genes to start developing.

The fertilized cell (zygote) then rapidly divides into 2 cells, 4, 8, 16, 32, 64, and so on, until the faint outline of a developing embryo and a network of blood vessels surrounding the yolk and other nutrients can be seen.

What is normally called "an egg" (the chicken egg, for example) is a much more complex structure designed to nourish and protect the embryo growing from the zygote. A vigorous healthy chick can be hatched from each fertile egg. The egg needs only a warm humid environment while the embryo is maturing.

Although human nutritional requirements are not the same as those of the chick, they are similar in so many respects that the egg has become a convenient, economical source of many of the essential proteins, minerals, and vitamins necessary to our good health.

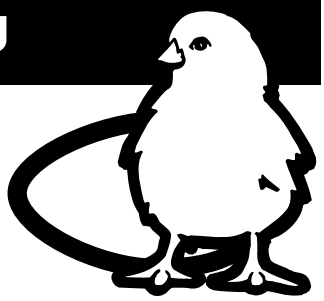
Math SOL
4.11, 5.11, 6.10
Science SOL
5.5
English SOL
4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9

The Parts of the Egg

Looking at the egg from the outside we see the shell, which is a hard, protective covering composed primarily of calcium carbonate. The shell is porous and the pores at the large end are more numerous than those at the small end. (There are about 7,000 pores in a chicken eggshell.) This permits the transfer of gases through the shell. Carbon dioxide and moisture are given off through the pores and are replaced by atmospheric gases, including oxygen (see Figures 4 and 5 on P-13).

Immediately beneath the shell are 2 membranes, the outer and inner shell membranes. These membranes protect the contents of the egg from bacterial invasion and prevent rapid evaporation of liquid from the egg.

Because the body temperature of a hen is approximately 106°F, eggs are very warm at the time they are laid. The temperature of the air is



usually much lower than 106°F, and the egg cools to the temperature of its surroundings. As cooling takes place, the contents of the egg contract more than the shell of the egg does. This creates a vacuum, and air is drawn through the pores in the large end of the shell.

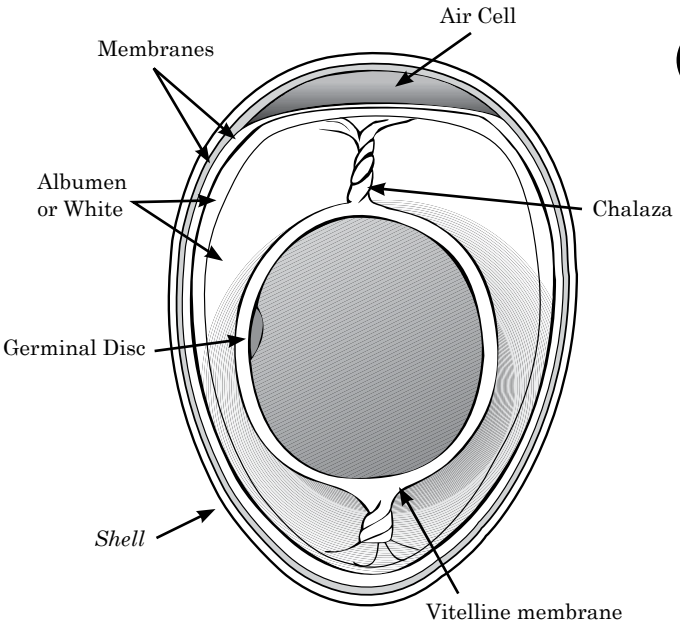


Figure 5. Parts of the egg

As a result, an air cell forms at the large end of the egg. The air cell serves as a tiny shock absorber during early embryonic development, and on the 29th day of incubation the chick pokes its beak through the shell membranes into the air cell (which by this time has enlarged greatly) and draws its first breath of air from this space.

While the embryo is growing, the shell membranes surround and contain the white, or albumen, of the egg. The albumen provides the liquid medium in which the embryo develops, but it also contains a large amount of the protein necessary for proper development.

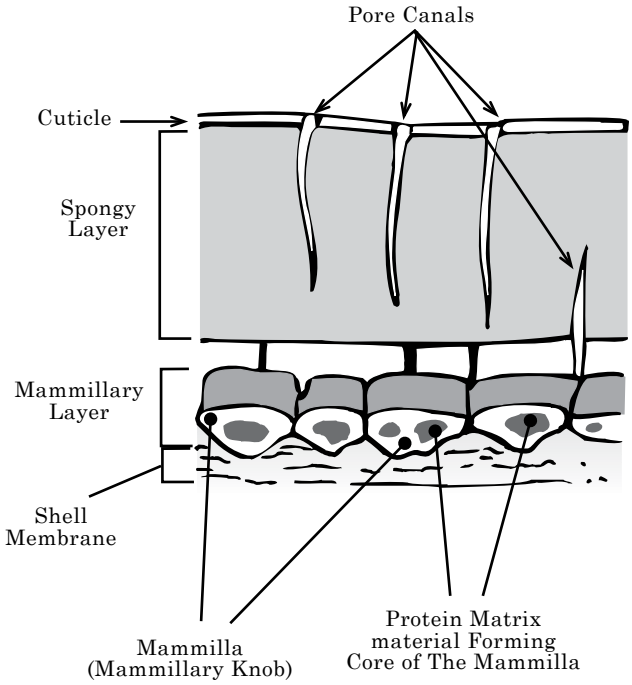


Figure 6. Magnified radial section through the shell.

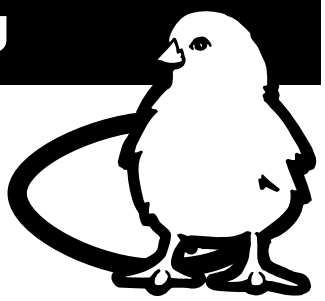
In a fresh egg, one can see 2 white cords attached to the yolk sac. These 2 cords, called chalazae, are made of twisted strands of mucin fibers that are a special form of protein. The chalazae hold the yolk in the center of the egg.

The yolk contains large amounts of carbohydrate, fat, and protein. The egg white (albumen) is almost pure high-quality protein. The yolk is also

Math SOL 4.11, 5.11, 6.10

Science SOL 5.5

English SOL 4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9



a reservoir of the vitamins and minerals that are essential for normal growth (see Table 1 below). These substances combine with the oxygen taken in through the pores of the shell and provide an abundant source of metabolic energy for the embryo. By-products of this process are carbon dioxide and water. The embryo uses water to replace moisture lost through evaporation. Carbon dioxide is transpired through the pores of the shell. Calcium is absorbed from the yolk and the shell by the embryo to make the chick's bony structure, or skeleton.

Table 1. The Nutritional Value of Eggs

Nutrition Information Per Serving
Serving Size = 2 U.S. Large Eggs (108 g edible portion)

Servings Per Carton	6	Fat (Percentage of Calories-68%)	12 g
Calories	160	Polyunsaturated	1 g
Protein	13 g	Saturated	4 g
Carbohydrates	1 g	Sodium	140 g

Serving Size = 2 U.S. Large Eggs (108 g edible portion)

Protein	30	Iron	10	Iodine	35
Vitamin A	10	Vitamin D	15	Zinc	10
Vitamin C	*	Vitamin E	6	Pantothenic Acid	15
Thiamin	6	Vitamin B6	6	Copper	4
Riboflavin	20	Folic Acid	15	Magnesium	4
Niacin	*	Vitamin B12	15	Calcium	6
Phosphorous	20				

** Contains less than 2% of U.S. RDA of these nutrients. (A Brighter Idea, Virginia Cooperative Extension publication 408-032)*

Evaluation

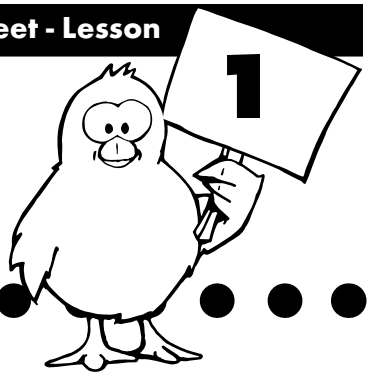
Collect student activity sheets to demonstrate learning progress.

- "Eggs-periment" for Lesson 1
- A Natural Wonder
- Beginning of Life Vocabulary Studies

Math SOL 4.11, 5.11, 6.10

Science SOL 5.5

English SOL 4.1, 4.5, 5.1, 5.6, 5.8, 6.8, 6.9



"Eggs-periment"

A. Observing the egg

Observe a fresh unbroken chicken egg.

_____ 1. What color is it?

_____ 2. What other color could the egg be?

_____ 3. How much do you think the egg weighs?

_____ 4 How long is it?

_____ 5 How wide is it?

Can you tell if the egg is fertile or nonfertile? If so, how?

_____

Observe an unbroken incubated chicken egg

_____ 1. Did the egg float?

Observe a broken-out chicken egg

1. Observe with only your eyes.

Can you identify all the parts of the egg? (Use Parts of Egg sheet.)

_____

Which part of the broken-out egg is highest off the plate?

_____

Which part of the broken-out egg is lowest on the plate?

_____

2. Which part contains the most:

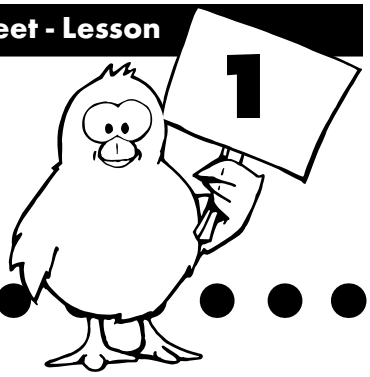
Fat_____ Protein_____ Calcium_____

Is the egg fertile or nonfertile? _____ Explain your answer:

_____

_____

"Eggs-periment"



A Natural Wonder

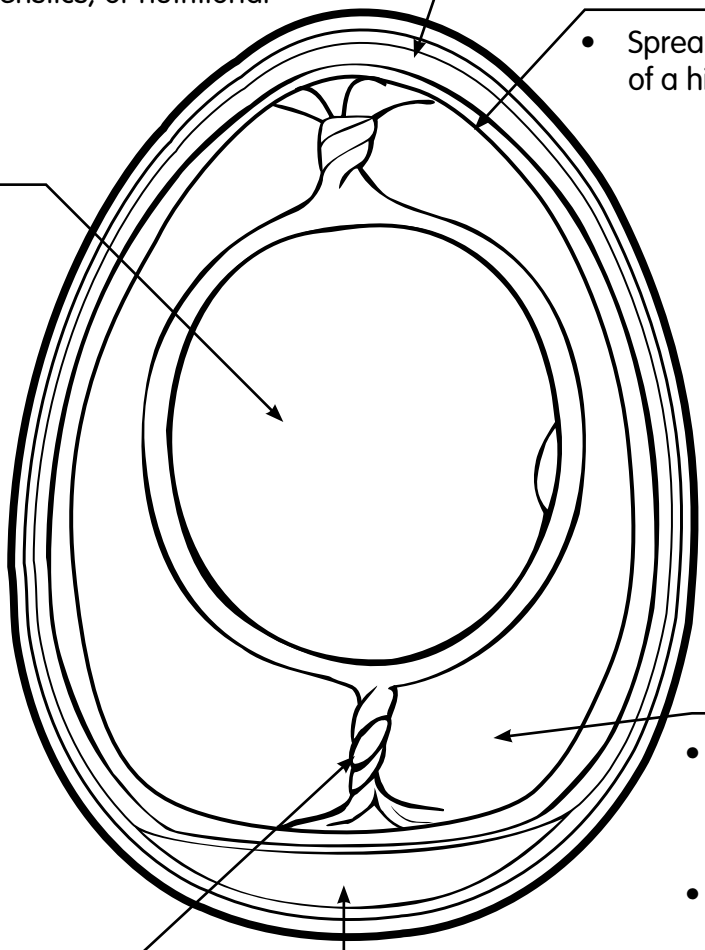
Name _____

- Outer covering of the egg is composed of calcium carbonate.
- Color does not affect its quality, cooking characteristics, or nutritional value.

- Provide protective barrier against bacteria.

- Spreads around thick white of a high-quality egg.

- Color varies with the hen's feed, but doesn't indicate nutritional content.
- Major source of vitamins, minerals, and fat.

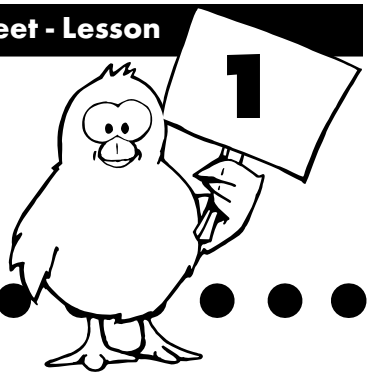


- Excellent source of riboflavin and protein.
- Stands higher and spreads less than thin white in high-quality eggs.
- Thins and becomes indistinguishable from thin white in low-quality eggs.

- Indicator of quality.

- Increases in size with age.

*18 U.S.C.707



Vocabulary Worksheet

WORD SLEUTH

Can you find the hidden vocabulary words listed below in the letter square at the right? The words run in all directions - forward, backward, up, down and diagonal.

Air cell
Albumen
Allantois
Amnion
Blood vessels
Brooder
Calcium
Chalaza
Chick
Chorion
Embryo
Fertilization
Germinal disc
Hen
Incubator
Ovum
Protein
Rooster
Shell
Thermometer
Yolk
Yolk sac

F G N 0 I N M A K J R 0 T A B U C N I
E E K S R K C D R E T E M 0 M R E H T
R T P W L D K T K A R H I A H J T B Z
T C M 0 L E L N A L B U M E N Q G N 0
I S Y L N 0 S B N S I H U J D K R Y Y
L I S W Y S K S P I N L V G C E R P M
I D K R 0 I P B E H E N 0 L T B U F W
Z L P A L 0 A K I V H T F S M S R C A
A A N Q K T D C U E D C 0 E N L 0 A Z
T N B V S N C I M B Q 0 G R U D T L A
I I A K A A P H J L R K 0 S P T M C L
0 M U I C L A C Q L M P E L L E S I A
N R R 0 F L B A R E D 0 0 R B I P U H
C E Z H B A M A K H V L Q D T R 0 M C
A G C H 0 R I 0 N S 0 A I R C E L L K

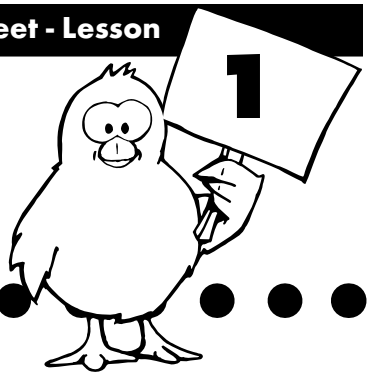
UNSCRAMBLE THE SCRAMBLED EGGS!

All words should be related to what you have studied in this project.

1. geg
2. hne
3. koyl
4. htcah
5. lehls
6. oyrmbe
7. aekb
8. iecckhn
9. orcuibtna
10. ingsw
11. tapemertrue
12. izdeltirfe

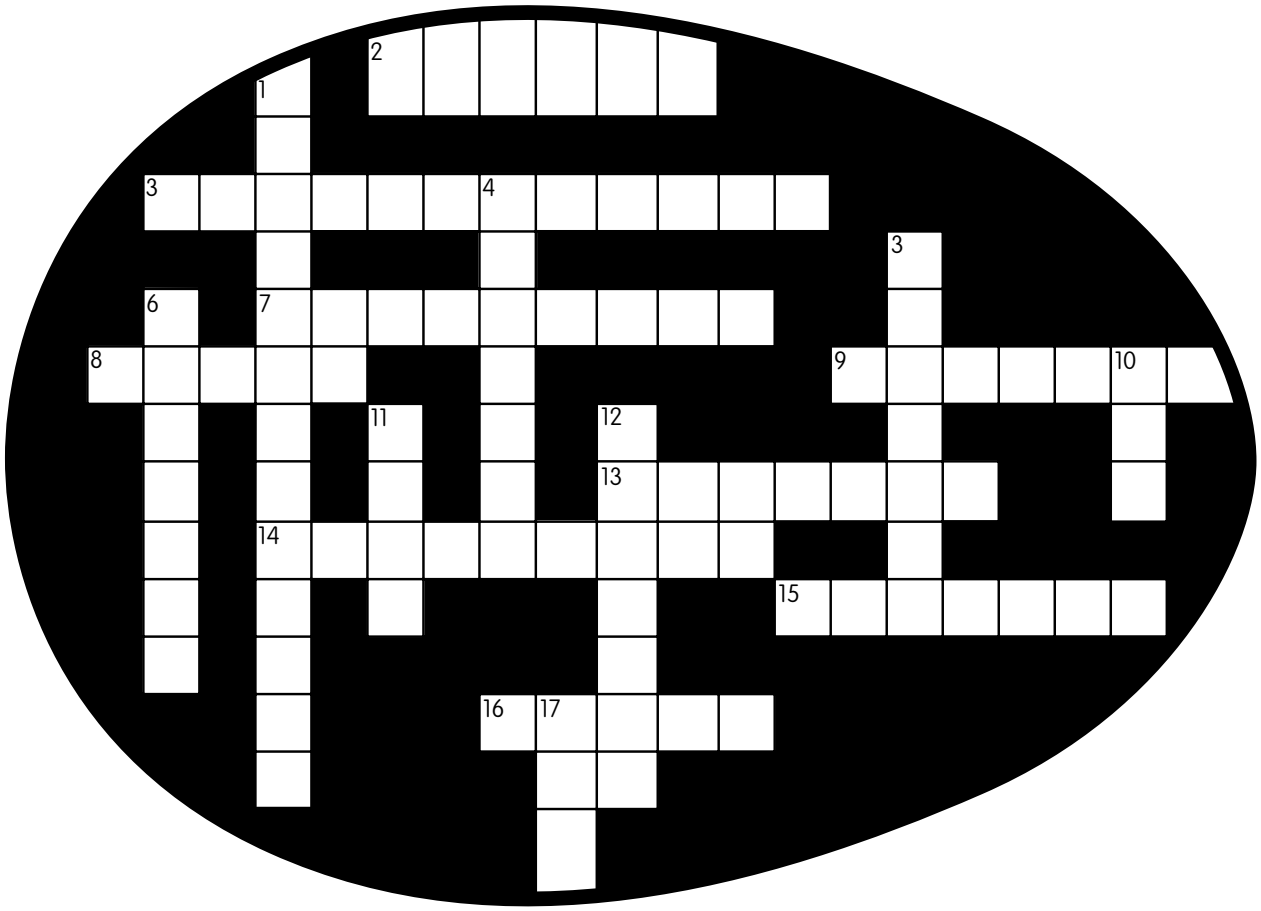
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

*18 U.S.C.707



Vocabulary Worksheet

EGG CROSSWORD PUZZLE



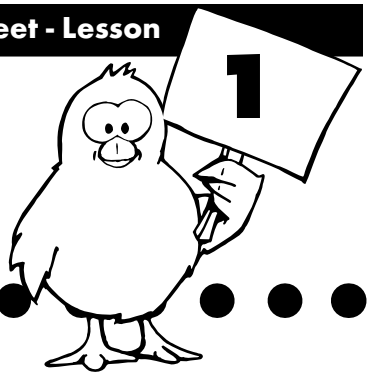
Across

2. Term for developing chick
3. Location on yolk where development begins
7. Takes the place of the mother hen
8. Hard, protective covering
9. Source of heat to keep chicks warm after they hatch
13. Term for a male chicken
14. Membrane sac that functions to provide breathing and removal of wastes
15. A component (part) of the shell
16. Term for a baby chick

Down

1. Occurs in the germinal disc
4. Term for egg white
5. Pocket of air where chick obtains its first breath
6. Protein fibers hold yolk in place
10. Made up of yolk, albumen, and shell
11. Term for the yellow-orange part of the egg
12. Albumen is water and _____
17. Term for a female chicken

*18 U.S.C.707



Vocabulary Worksheet

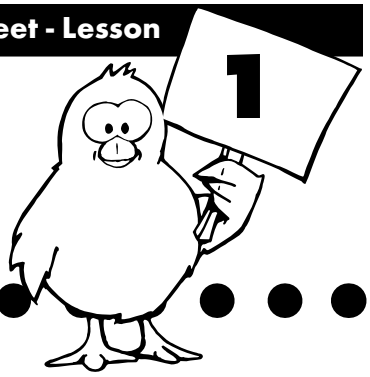
Put these words in alphabetical order:

Embryo	Yolk	Incubator	Feathers	Crack	Thermometer
Egg	White	Blood vessels	Chicken	Beak	Temperature
Hen	Chick	Embryo	Heart	Egg tooth	Wings
Rooster	Hatch	Shell	Toes	Membrane	Peeps
Fertilizer	Fluff	Development	Brooder	Sac	Comb

1. _____	11. _____	21. _____
2. _____	12. _____	22. _____
3. _____	13. _____	23. _____
4. _____	14. _____	24. _____
5. _____	15. _____	25. _____
6. _____	16. _____	26. _____
7. _____	17. _____	27. _____
8. _____	18. _____	28. _____
9. _____	19. _____	29. _____
10. _____	20. _____	30. _____

Choose 10 vocabulary words and use each in a complete sentence.

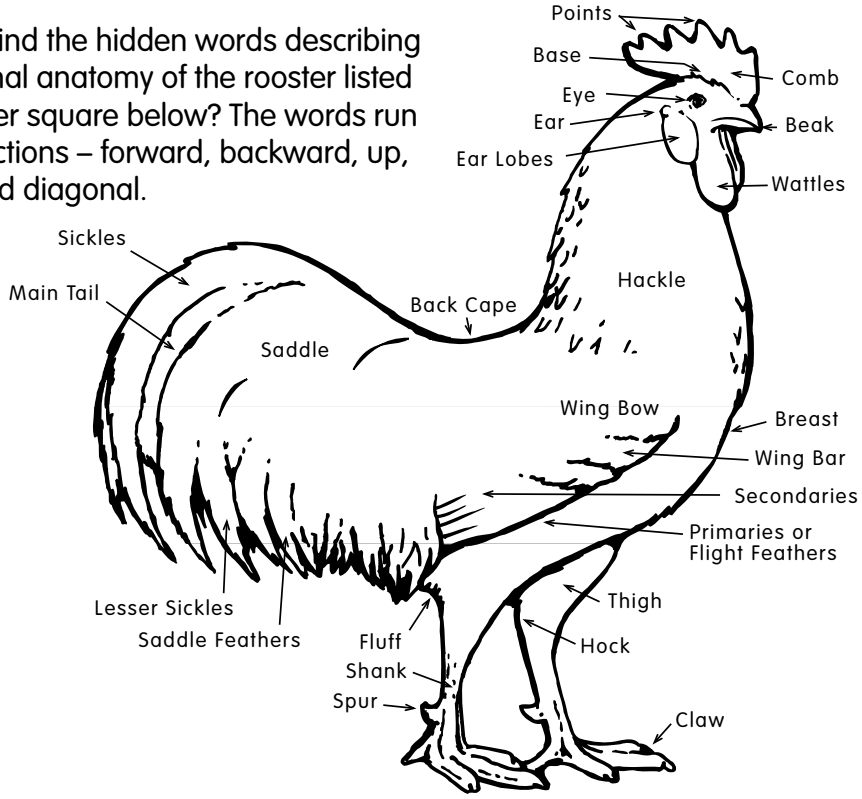
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



Vocabulary Worksheet

External anatomy of the rooster

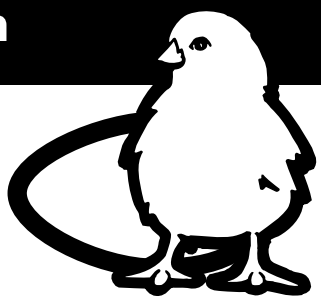
Can you find the hidden words describing the external anatomy of the rooster listed in the letter square below? The words run in all directions – forward, backward, up, down, and diagonal.



S E L K C I S T A I L C 0 V E R T S A
A A G R K U D A C G I J N D S H 0 F D
D P D E P P 0 I N T S 0 F C 0 M B L E
W S K D E J G L F U M P U I T J A U C
I F T L L 0 T H I G H 0 W R R L C F U
N G H U P E G K D A A I F K H G I F H
G E R 0 I A H Q S L N U T H A C K L E
B J 0 H P R D 0 M G P E 0 M Q L N C W
0 I A S T L T R C I V D 0 P K E A P K
W D T F S 0 K 0 M K A E B T F L H M B
K C E N A B V T I P N 0 M R U P S P 0
W H I J E E K C E N N K B H W F T R L
0 C B A R I N A M 0 B S E L T T A W N
L S R T B M H P D T F H C 0 J Q G U K
B M 0 C C D A E Y E A R B S K D A E H

*18 U.S.C.707

Lesson II — Incubation



Objectives

- Learn what is required to hatch an egg
- Learn how to hatch eggs naturally (hen) and artificially (incubator)

Life Skills

Learning to learn	Planning/organizing	Teamwork
Decision making	Record keeping	Self responsibility
Problem solving	Cooperation	Goal setting
Critical thinking	Communication	Concern for others
Contribution to group effort		

Tie to SOLs

Math	Science	English
4.11, 5.11, 5.12, 5.18	4.1, 6.1, 6.2, LS.4	4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9

Time Required: 30 minutes

Supply List

- Incubator
- Fertile eggs
- Water pan
- Thermometer

Background Information Procedure:

A. Get the incubator out. Point out the different parts and what function they serve.

Element – heat

Thermostat – controls temperature

Thermometer – reads temperature

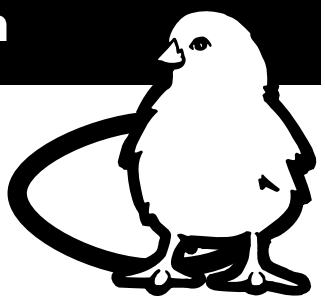
Water pan – adds humidity

Math SOL 4.11, 5.11, 5.12, 5.18

Science SOL 4.1, 6.1, 6.2, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9

Lesson II — Incubation



B. Start up the incubator.

1. Discuss why temperature is so important. Show the students what happens to the temperature when the incubator is opened for 10 seconds, 1 minute, etc. Discuss how that affects the developing embryos.

2. Discuss why water/humidity is so important. Should you add hot/cold water? How to test if water temperature is ok.

3. Discuss why turning is so important. How can you tell if you have turned the eggs (mark them). Should you be gentle? If not, what could result?

4. How does a mother bird supply heat and moisture, and turn the eggs?

5. Discuss the best place to locate the incubator in the classroom (i.e. by sunny window, air conditioner, heat vent, next to door).

6. Consider one of the suggested experiments on P-22 to prove or disprove a scientific principle.

Content Background

Science of Incubation

Incubation means maintaining conditions favorable for developing and hatching fertile eggs. Still-air incubators do not provide mechanical circulation of air. Forced-air incubators are equipped with electric fans. Their optimum operating temperatures differ slightly.

Four factors are of major importance in incubating eggs artificially: temperature, humidity, ventilation, and turning. Of these factors, temperature is the most critical. However, humidity tends to be overlooked and causes many of the hatching problems encountered by teachers. Extensive research has shown that the optimum incubator temperature is 100°F, relative humidity is 60 percent, concentration of oxygen 21 percent, carbon dioxide 0.5 percent, and air movement past the eggs is at 12 cubic feet per minute.

Math SOL
4.11, 5.11, 5.12, 5.18

Science SOL
4.1, 6.1, 6.2, LS.4

English SOL
4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9

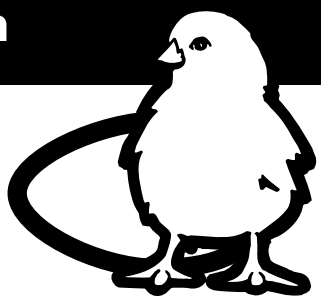


Table 2. Incubation Period and Incubator Operation for Eggs of Domestic Birds

Requirements	Chickens	Guinea, Peafowl, Turkey	Goose and Duck	Muscovy Duck	Pheasant	Bobwhite Quail	Coturnix Quail
Incubation Period (days)	21	28	28	35	24-28	23-24	17
Still-air operating temp (˚F – dry bulb)	100.5	100.5	100.5	100.5	100.5	100.5	100.5
Forced-air operating temp (˚F – wet bulb)	99.5	99.5	99.5	99.5	99.5	99.5	99.5
Humidity (˚F – wet bulb)	85-87	83-85	84-86	84-86	86-88	84-86	84-86
Do not turn eggs after	Day 18	Day 25	Day 25	Day 31	Day 21	Day 21	Day 15
Humidity during last 3 days of incubation (˚F – wet bulb)	90-94	90-94	90-94	90-94	90-94	90-94	90-94

(Incubating Eggs of Domestic Birds, Clemson University Extension)

Temperature

An incubator should be operated in a location free from drafts and direct sunlight. An incubator should also be operated for several hours with water placed in a pan to stabilize its internal atmosphere before fertile eggs are set. During the warm-up period, the temperature should be adjusted to hold a constant 101°F for still air, 100°F for forced air. To obtain reliable readings, the bulb of the thermometer should be at the same height as the tops of the eggs and away from the source of heat. Using 2 thermometers is a good idea to ensure you are getting an accurate reading.

Incubator temperature should be maintained between 100° and 101°F. The acceptable range is 97° to 102°F. High mortality is seen if the temperature drops below

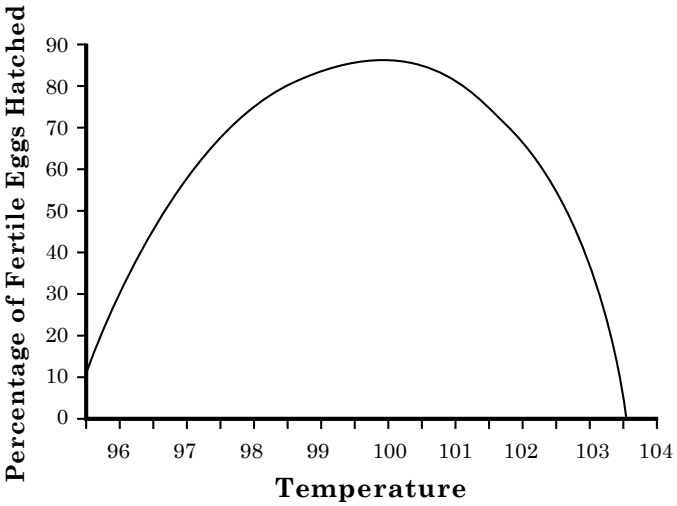
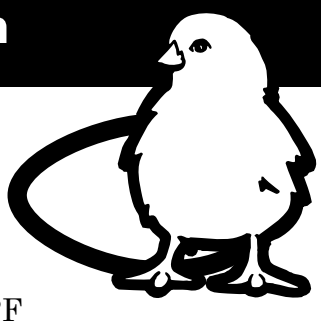


Figure 7. The effects of incubation temperature on percentage of fertile eggs hatched. Relative humidity 60%, Oxygen 12%, CO2, below 0.5%. (From Egg to Chick, Northeast States Cooperative Service)

Math SOL 4.11, 5.11, 5.12, 5.18

Science SOL 4.1, 6.1, 6.2, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9



96°F or rises above 103°F for a number of hours. If the temperature stays at either extreme for several days, the egg may not hatch. Overheating is more critical than underheating. Running the incubator at 105°F for 15 minutes will seriously affect the embryos, but running it at 95°F for 3 or 4 hours will only slow their metabolic rate (see Figure 6 on P-16).

Do not make the mistake of overheating the eggs. Many times, when the eggs remain clear and show no development, it is due to excessive heat during the first 48 to 72 hours. Do not adjust the heat upward during the first 48 hours. This practice cooks many eggs. The eggs will take time to warm to incubator temperature and many times the incubator temperature will drop below 98°F for the first 6 to 8 hours or until the eggs warm to 100°F.

Humidity

The relative humidity of the air within an incubator for the first 18 days should be 60 percent. During the last 3 days (the hatching period) the relative humidity should be nearer to 65 percent to 70 percent. Too much moisture in the incubator prevents normal evaporation and results in a decreased hatch, but excessive moisture is seldom a problem in small incubators. Too little moisture results in excessive evaporation, causing chicks to sometimes stick to the shell and hatch crippled.

Table 3 (Relative Humidity, below) will enable you to calculate relative humidity using readings from a wet-bulb thermometer and a dry-bulb thermometer.

During the hatching period, using an atomizer to spray a small amount of water into the ventilating holes may increase the humidity in the incubator (this is especially helpful when duck or goose eggs are being hatched). An 8-inch pie tin or petri dish containing water and placed on the tray of eggs should provide adequate moisture. The relative humidity in the incubator can also be varied by changing the size of the water pan or by putting a sponge in the pan to increase the evaporating surface. The pan should be checked regularly while the incubator is in use to be sure that there is always an adequate amount of water.

Table 3. Relative Humidity

Incubator Temperature	**Wet Bulb Readings**					
100˚F	81.3	83.3	85.3	87.3	89	90.7
101˚F	82.2	84.2	86.2	88.2	90.0	91.7
102˚F	83.0	85.0	87.0	89.0	91.0	92.7
Percent Relative Humidity	45%	50%	55%	60%	65%	70%

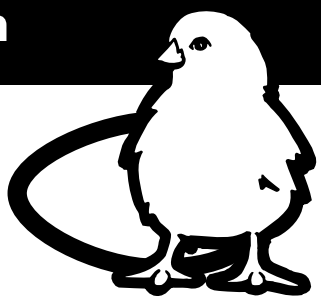
(From Egg to Chick, Northeast States Cooperative Service)

Math SOL 4.11, 5.11, 5.12, 5.18

Science SOL 4.1, 6.1, 6.2, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9

Lesson II — Incubation



Whenever you add water to an incubator, it should be about the same temperature as the incubator so you do not stress the eggs or the incubator. A good test is to add water just warm to the touch.

In the latter stages of incubation (from the 19th day on), condensation on the glass indicates the presence of sufficient moisture. However, the condensation is also related to the temperature of the room where the incubator is being operated. There will be more condensation on the glass if the room is cold, so be sure the temperature in the incubator remains steady.

Using a wet-bulb thermometer is a good learning experience for determining relative humidity. The wet-bulb thermometer measures the evaporative cooling event. If the wet and dry bulb read the same temperature, you would have 100 percent humidity. The more evaporation taking place, the lower the temperature reading on the wet-bulb thermometer and the larger the spread will be between the wet- and dry-bulb reading.

To make a wet-bulb thermometer, just add a cotton wick to the end of a thermometer. Then place the tail of the wick in water. The cotton then absorbs the water. As the water evaporates from the cotton it causes a cooling effect on the thermometer.

It is also possible to determine whether there is too much or too little humidity in the incubator by candling the eggs and comparing the size of the air cell with the diagram in Figure 8.

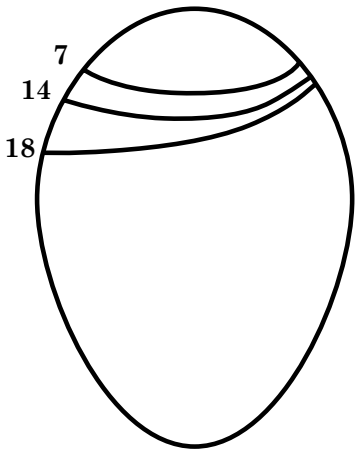


Figure 8. Diagram showing the air cell on the 7th, 14th, and 18th days of incubation (From Egg to Chick, Northeast States Cooperative Service)

Ventilation

The best hatching results are obtained with normal atmospheric air, which usually contains 21 percent oxygen. It is difficult to provide too much oxygen, but a deficiency is possible. Make sure that the ventilation holes are open to allow a normal exchange of air.

This is critical on homemade incubators. It is possible to suffocate the eggs and chicks in airtight containers.

Turning

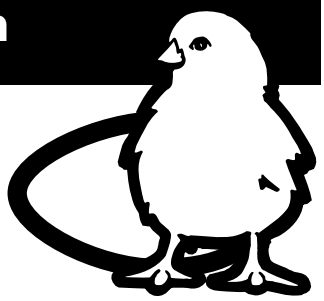
Turning the eggs during the incubation period prevents the blastoderm from migrating through the albumen and sticking to the shell membrane.

Math SOL 4.11, 5.11, 5.12, 5.18

Science SOL 4.1, 6.1, 6.2, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9

Lesson II — Incubation



Chicken eggs should be turned 3 to 5 times daily from the 2nd to the 18th day. Do not turn the eggs during the last 3 days!

To insure proper turning, mark each end of the egg with a pencil. Put an "X" on one side and an "O" on the opposite side.

Place the eggs on the welded wire platform horizontally, in a single layer, with the end marked "X" on top. When the eggs are turned all the "X's" will be on the bottom and the "O's" on top. At the next turning, the "X's" will be in view, and so on.

When incubators are used in schools, it may be difficult to turn the eggs on the weekend. If the eggs are not turned, the hatch may be somewhat slower, so it is recommended that the eggs be turned at least once daily on weekends. In some schools, the temperature is reduced on weekends and holidays, and it may be advisable to make an insulation cover for your incubator by placing a large cardboard box over the incubator.

Except for the 19th through the 21st day, it is safe to move the incubator with the eggs in it. Some teachers take the incubator with its eggs home on weekends. Rolling and cracking of the eggs can be prevented during the move by packing the eggs in a carton. The incubator should be wrapped in a heavy blanket and placed in a warm vehicle to maintain the temperature of the eggs, and the trip should not take more than half an hour.

After the 18th day, do not open or move the incubator until the hatch is completed because the chicks are in a hatching position in the eggs and because a desirable hatching humidity must be maintained.

How the Chicken Incubates Eggs Naturally

In nature, the female bird selects the nest site and lays a clutch of eggs (usually 8 to 13 eggs), 1 egg per day. Once she has a clutch of eggs, she begins sitting on the eggs full-time, leaving only for food and water.

The hen's body temperature is 105° to 106°F. When the hen sits on the eggs, this heats the eggs to 100° to 101°F. The hen turns the eggs on a regular basis by using her beak to scoop under the egg and roll it towards her. The humidity comes from the environment, the bird's body, and any moisture the female transfers back to the nest on her feathers. Brooding hens often leave their nests to feed at dawn or dusk when dew is present on the grass.

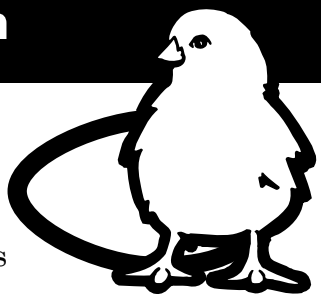
As you can see, science has simply developed mechanical boxes that supply the fertile eggs with the same environment as the hen.

Math SOL
4.11, 5.11, 5.12, 5.18

Science SOL
4.1, 6.1, 6.2, LS.4

English SOL
4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9

Lesson II — Incubation



Incubator Set-Up and Operation

The proper set-up and operation of your incubator is critical to the success of the Beginning of Life project. To help you with this critical portion of the project, a "Must" schedule and "Do Not" list are provided. Also see Table 2 on P-16 if you have questions. If you follow these instructions you will have a successful project

Embryology "Must" Schedule

A. Plan the dates to run the project. Avoid holidays. Wednesday is usually the best day to set the eggs. This eliminates any chance of eggs hatching on weekends.

B. Set up the incubator. Make sure it operates correctly for at least 24 hours before you set the eggs.
   1. Set up the incubator in a room that stays above 60°F.
   2. Adjust the incubator so it holds the desired temperature. In still-air units (without fans), adjust the temperature to 100.5°F. In forced-air units (with fans), adjust the temperature to 99.5°F. Always adjust the thermostat so the heat source comes on when the temperature drops below the desired temperature.
   3. Use 2 thermometers to ensure an accurate temperature reading.

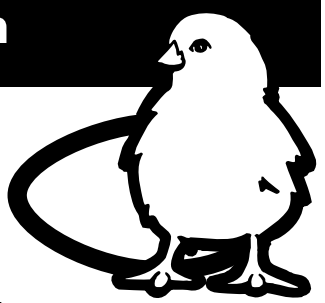
C. Make a calendar for the project.
   1. Have a place to mark when the eggs are turned.
   2. Have a place to enter the daily dry- and wet-bulb temperature.
   3. Have enough space to write down daily observations.

D. Prepare the eggs for setting.
   1. Place eggs at room temperature for 2 hours before setting.
   2. Candle the eggs for cracks. **DO NOT** set cracked eggs.
   3. Remove any excessive dirt from the eggs.
   4. Number the eggs and mark each egg with an "X" on one side and an "O" on the other side. Use a pencil. Do not use a permanent or toxic ink pen.
   5. Set the eggs in the incubator with all the "X" sides up. Turn the eggs daily. All eggs should be turned 3 times daily. You must turn them at least once a day on weekends. Be sure eggs are turned gently; rough turning for the first 10 days can be fatal.

Math SOL 4.11, 5.11, 5.12, 5.18

Science SOL 4.1, 6.1, 6.2, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9



6. Record temperatures each time before you turn the eggs.
7. Keep the water trays full. Use water warm to the touch. **DO NOT** add cold or hot water. Add water when you turn the eggs and when water gets low.
8. Only open the incubator to turn the eggs and to add water or to set the eggs at the beginning of the project.
9. Candle eggs every 4 to 6 days to check progress. Remove any eggs that are clear or contain dead embryos.
10. Stop turning the eggs 3 days before the hatch date. For chicken eggs, stop turning them on the 18th day.
11. Prepare for brooding 3 days before the hatch date. You want everything prepared before the chicks hatch.
12. Remove chicks from the incubator and place in the brooder within 4 to 6 hours after hatching. If your incubator has good levels of humidity the chicks may not dry in the incubator. They will dry once moved to the brooder.

"DO NOT" List

DO NOT set the incubator next to or on top of a heat register or in a sunny window.

DO NOT set the incubator in a drafty location (i.e., near an air conditioner, a fan blower, or an open hallway).

DO NOT store or transport fertile eggs in temperatures above 70°F or below 35°F, if possible. Do not store eggs for more than 7 days.

DO NOT expect the incubator to be in perfect operating condition the day you plan to set the eggs. Set it up and check it well in advance.

DO NOT open the incubator more than necessary.

DO NOT let the eggs go more than 24 hours without turning.

DO NOT let the water tray become low or dry

DO NOT add hot or cold water to incubator. Add only water that is warm to the touch.

DO NOT turn the eggs after the 18th day for chickens.

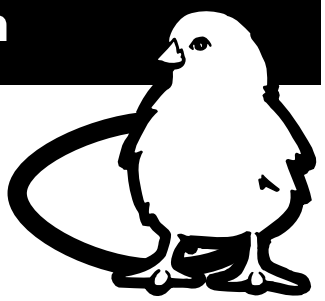
DO NOT help the chicks out of their shells at hatching time. This usually causes more problems than it is worth. Most will die or be crippled if helped out.

Math SOL 4.11, 5.11, 5.12, 5.18

Science SOL 4.1, 6.1, 6.2, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9

Lesson II — Incubation



Evaluation:

Turn in student activity sheets to demonstrate learning progress.

- Pretest/Posttest for Lesson 2
- Incubation Quiz
- Beginning of Life Record Book

Other suggested experiments related to chick incubation and embryology and projects that might be undertaken in the classroom or by individual students include:

1. **Effect of egg's age on hatchability.** Incubate eggs that are 2 weeks old or older when they are placed in the incubator and eggs that are 1 week old or less. Compare the differences in hatchability and differences in the time required for hatching.

2. **Effect of improper temperatures during the holding period on hatchability.** Keep control eggs under ideal (55° to 58°F) conditions. Similarly, some eggs could be held at room temperature or preferably above 80°F. All eggs should be the same age and from the same source. Incubate them and compare the results.

3. **Effect of turning eggs during incubation on embryo development and hatchability.** Place 2 groups of eggs that are the same age and from the same source in the incubator. Distinguish between the eggs in each group by using an identifying mark on the eggs in 1 group and a different mark on the eggs in the other group. Turn the eggs in 1 group 3 times a day for the first 18 days of incubation. Do not turn the eggs at all in the other group. Compare hatchability and development of the embryos. A third group of eggs that gets turned 5 times per day may also be added to this project.

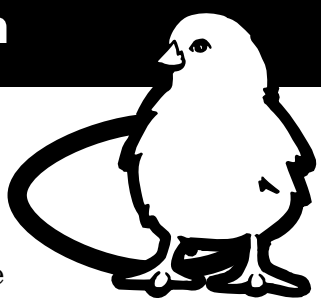
5. **Effect of egg size on the weight of the chick.** Set eggs of significantly different sizes and compare the weight of the baby chicks at a given interval of time after hatching.

6. **Effect of shell porosity on hatchability.** Set 1 group of normal eggs and another group that has had the shell pores sealed by dipping the eggs in mineral oil. Compare the hatchability and embryo development of the 2 groups.

Math SOL
4.11, 5.11, 5.12, 5.18

Science SOL
4.1, 6.1, 6.2, LS.4

English SOL
4.1, 4.5, 5.1, 5.7, 5.8, 6.8, 6.9



7. **Effect of incubation temperature on hatchability and embryo development.** If 2 incubators are available, set eggs in 1 and operate it at recommended temperature and humidity levels. Place eggs in the other and operate it at a marginal level of temperatures, such as 97°F or 103°F, throughout the incubation period. Recognizing that it is not as sound experimentally, 1 incubator could suffice. First, incubate a group of eggs at a marginal temperature level for the incubation period and record the results; then incubate a group of eggs under a recommended procedure and compare the results of the 2 groups.

8. **Effect of relative humidity on hatchability.** The same general type of plan as outlined in number 7 could be followed except that the humidity would be varied while all other procedures were kept normal.

9. **Preserving chick embryos.** Embryos can be harvested and preserved in a 10-percent solution of formalin (1 part 37 percent formaldehyde and 9 parts water). A small glass jar with a screw cap works well for this purpose. Refer to *Animal Microbiology* by Michael F. Guyer for more information.

Comments on the Above Projects

In projects 1 through 8, the developing eggs could be candled at regular intervals (perhaps every 2 days), and those that show no sign of development or blood rings can be removed, broken open, and examined. Abnormalities should be noted and recorded. Candling eggs that are not being turned (projects 3 and 4) should be done gently and with as little rotation of each egg as possible.

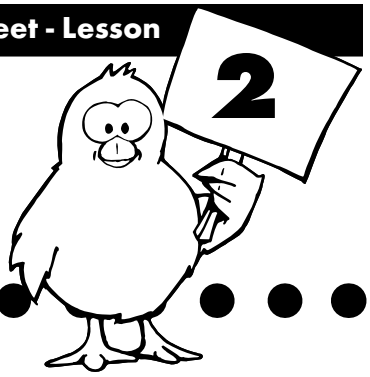
When the effect of temperatures on rate of development is being studied, the daily sacrifice and examination of living embryos is very educational. These embryos could then be preserved. The number of eggs necessary for this may present a problem. At hatching, the incidence of malformed, crippled, or late-hatching chicks should be recorded as well as the total time required to complete development. Specimens with abnormalities could be preserved.

Remember that experimental groups should contain sufficient numbers to ensure meaningful results. Replication of experimental treatments is desirable. The number of eggs in a treatment group should be based on the expectation that probably 20 percent or more will be lost through infertility and normal embryo mortality.

Math SOL
4.11, 5.11,
5.12, 5.18

Science SOL
4.1, 6.1, 6.2,
LS.4

English SOL
4.1, 4.5, 5.1,
5.7, 5.8, 6.8,
6.9



Pre–test/Post-test

Name: _____

1. All eggs are fertile and will develop into a bird when placed in an incubator.

   True **False**

2. What is an incubator? _____

   _____

3. What are three very important factors in hatching fertile eggs successfully in an incubator?

   1) _____

   2) _____

   3) _____

4. What is the ideal temperature for hatching chicken eggs? _____

5. How many times should the eggs be turned each day? _____

6. Why is humidity so important in hatching eggs?_____

   _____

7. Chicken eggs should not be turned during the last 3 days of incubation.

   True **False**

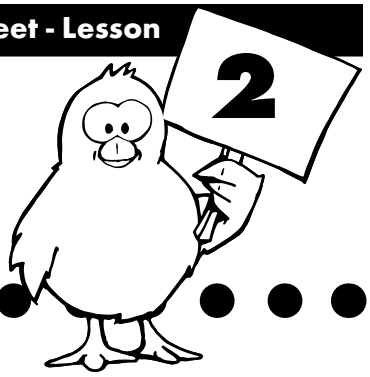
8. How should eggs be placed in the incubator?

   _____

   _____

*18 U.S.C.707

Incubation Quiz



Name: _____

Complete each sentence below by circling the correct answer.

1. Humans hatch eggs in a(n):

aquarium brooder incubator

2. The temperature in the incubator is controlled with a(n):

element thermometer thermostat

3. The _____ measured the temperature in an incubator.

element thermometer thermostat

4. We put water in an incubator to increase the _____ during incubation of eggs.

oxygen humidity temperature

5. Eggs being incubated should be turned _____ times a day

one two three

6. The incubator should be kept at ____˚F to successfully hatch a chicken egg.

95 to 96 100 to 101 103 to 104

7. Always add ____ water to the incubator during the incubation period.

cold warm hot

8. Eggs should be handled ____ while turning them during incubation

gently roughly shaken

9. The eggs are turned daily to prevent the embryo from:

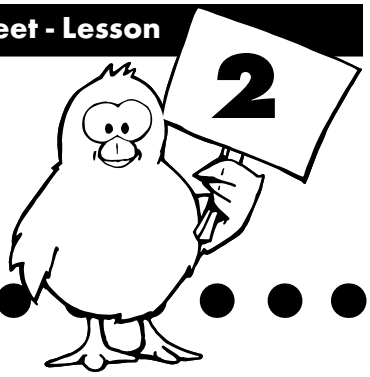
sleeping sticking to the shell getting too hot

10. The mother hen turns the egg with her _____ when incubating eggs naturally.

beak feet wing

*18 U.S.C.707

Beginning of Life Record Book



This Book Belongs To:

_____

Name

_____ _____ _____

School Teacher Extension Agent

Eggs Set In Incubator:

Date: _____

Number of eggs set: _____

Number fertile: _____

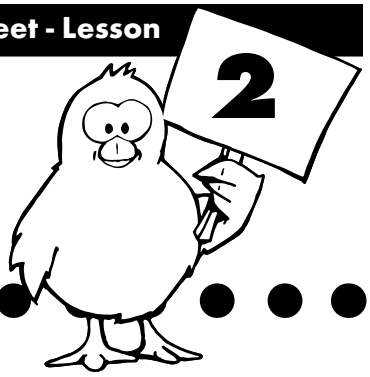
Percent fertile: _____

Number hatched: _____

Percent hatched: _____

*18 U.S.C.707

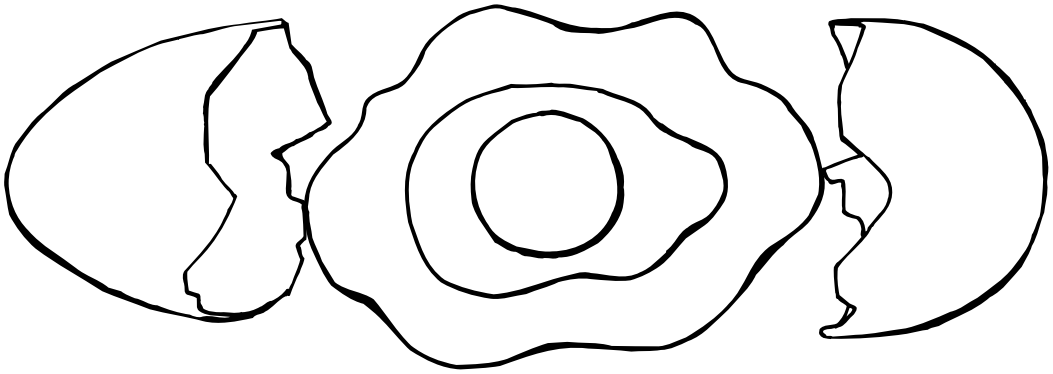
Beginning of Life Record Book



I. PARTS OF THE EGG:

a. Label the 6 parts of the egg in this drawing.

b.



c. What is an egg? _____

d. What is the function of each part of the egg listed below?

Shell

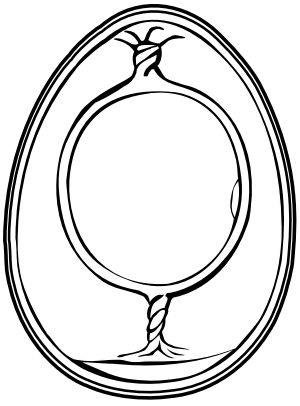
_____

_____

Germinal disc

_____

_____



Yolk

_____

_____

Albumen

_____

_____

e. NUTRITIONALLY, why are the shell, yolk, and white important to the developing chick?

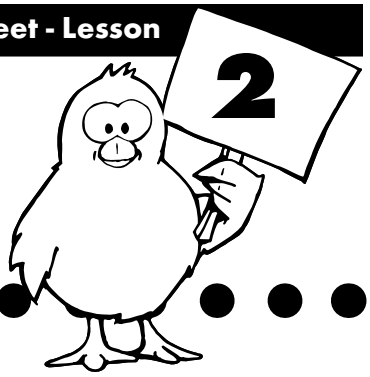
Shell_____

Yolk _____

White _____

*18 U.S.C.707

Beginning of Life Record Book



II. INCUBATOR AND ITS OPERATION:

a. What is the purpose of the incubator? How does it replace the mother hen?

b. What is the proper temperature for the incubator? _____

c. What happens if the temperature is too high or low?

d. Why is it necessary to keep water in the incubator? What happens to the developing chick if you forget to keep water in the incubator?

e. Why is it necessary to turn the eggs? At what day of incubation do you stop turning the chicken egg? Why?

III. DAILY THERMOMETER READING

a. What are the units on the thermometer? _____

b. Is the thermometer Fahrenheit or Celsius? _____

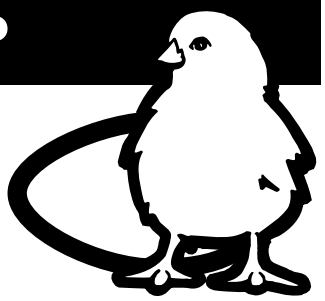
IV. INDIVIDUAL EGG PROGRESS

Number each egg on the air cell end of the egg. Keep a record of what happens to each egg.

Egg number	1	2	3	4	5	6	7	8	9	10	11	12
Not fertile												
Fertile did not pip												
Fertile pipped												
Hatched												
Died												

*18 U.S.C.707

Lesson III — The Embryo



Objectives

- Learn different methods to observe a developing embryo
- Learn the parts of the embryo
- Learn what occurs at the different stages of development
- Understand how the chick hatches from the egg

Life Skills

Learning to learn	Wise use of resources	Self responsibility
Decision making	Record keeping	Managing feelings
Problem solving	Cooperation	Concern for others
Critical thinking	Communication	

Tie to SOLs

Math	Science	English
4.11	4.1, 4.4, 4.8, 5.5, 6.1, 6.8, 6.9, 6.2, LS.2, LS.3, LS.4	4.1, 4.5, 5.1, 5.7, 5.8

Time Required: 2 hours (over the entire span of program)

Supply List

- 12 to 18 fertile eggs
- Incubator
- See sub-lessons on candling and shell window
- Illustration from manual
- Egg candler (can make in class, see P-34 of manual)

Background Information and Procedure:

A. Before beginning this lesson, read the section on embryonic development to follow, so you are comfortable with the happenings at each stage.

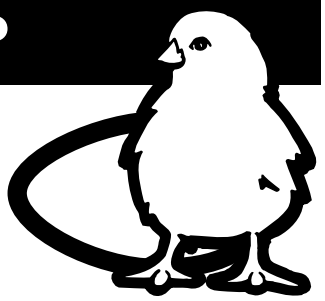
B. Prepare an overhead-projector candler.

Math SOL 4.11

Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



C. Candle a fresh egg and have the students find the air cell. Is the yolk visible? If you have not done Lesson 1, break out the egg and identify the germinal spot. Discuss cells and cell groupings: ectoderm, mesoderm, endoderm.

D. Number all the eggs on the large end of the egg from 1 to whatever number you are setting and incubate the eggs.

E. Candle 6 eggs on each of the following days:

Day 3 (heart)	Day 6 (eye)	Day 9 (growth)
Day 12 (growth)	Day 18 (air cell)	

Day 20 or when you hear the chicks peeping from inside (beak in air cell).

1. Discuss what the students see and/or should see.
2. Ask the students to draw what they think the chick looks like at given points.
3. If an egg is not fertile or is not developing, compare how the egg changes over the 21 days in the incubator, air cell size, yolk defined?
4. Why is it moving?

At Day 3, open 1 egg using the shell window method on P-35 of manual.

1. Ask the students to discuss what they see. How did they look at 1 to 2 months into their mother's pregnancy?
2. Why are the heart and eye developing so fast?
3. Ask the students to observe, draw and discuss the changes they see in the shell window embryo at least every 3 days until the embryo is 9 to 10 days old.
4. Explain the function of the membranes: amnion, allantois, yolk sac.
5. Discuss how people, reptiles, and animals develop. Where does a cat, cow, snake, human, turtle, dog develop?

Math SOL 4.11
Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4
English SOL 4.1, 4.5, 5.1, 5.7, 5.8

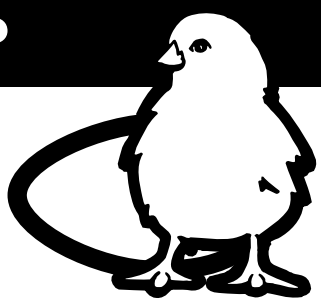
Content Background

Evaluation:

Turn in student activity sheets to demonstrate learning progress.

- Beginning of Life vocabulary studies (refer to Lesson I – Kid sheet)
- The Beginning of Life sheet for Lesson III

Lesson III — The Embryo



Chick Embryo Development

Where Chick Life Begins

The development of the chick begins in the single cell formed by the union of 2 parental cells, the egg and the sperm, in the process known as fertilization. In birds, fertilization occurs in the infundibulum about 24 hours before the egg is laid.

The newly formed single cell begins to divide into 2, then 4, 8, 16, 32, and so on. At the time of laying, hundreds of cells are grouped in a small, white spot (germinal disc) that is easily seen on the surface of the yolk. This spot in a fertilized, freshly laid egg is the beginning of the chick (see Figure 4 on P-10).

When the egg is laid and cools, the division of the cells ceases. Cooling the egg to room (40°F to 75°F) temperature does not result in the death of the embryo. It may resume its development after several days of rest if it is again heated by the hen or in an incubator.

Development During Incubation

As soon as the egg is heated again, the cluster of cells in the blastoderm begins to multiply by successive division. The first cells formed are all alike. Then, as the division of cells progresses, some differences begin to appear.

These differences become more and more pronounced. Gradually the various cells acquire specific characteristics of structure and cell groupings or layers. These cell groupings are called the ectoderm, mesoderm, and endoderm. These 3 layers of cells constitute the materials out of which the various organs and systems of the body are to be developed.

From the ectoderm, the skin, feathers, beak, claws, nervous system, lens and retina of the eye, and linings of the mouth and vent are developed. The mesoderm develops into the bone, muscle, blood, and the reproductive and excretory organs. The endoderm produces the linings of the digestive tract and the secretory and respiratory organs.

Development from a single cell to a pipping chick is a continuous, orderly process. It involves many changes from apparently simple to new, complex structures. From the structures arise all the organs and tissues of the living chick.

Physiological Processes within the Egg

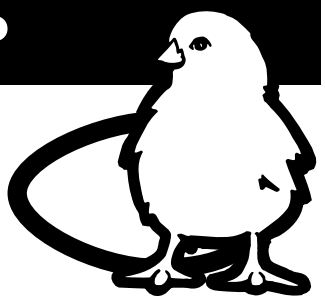
Many elaborate physiological processes take place during the transformation of the embryo from egg to chick. These processes are respiration, excretion, nutrition, and protection.

Math SOL
4.11

Science SOL
4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4

English SOL
4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



For the embryo to develop without any anatomical connection to the hen's body, nature has provided membranes outside the embryo's body to enable the embryo to use all parts of the egg for growth and development. These "extra-embryonic" membranes are the yolk sac, amnion, chorion, and allantois.

1. The yolk sac is a layer of tissue growing over the surface of the yolk. Its walls are lined with a special tissue that digests and absorbs the yolk material to provide sustenance for the embryo. Yolk material does not pass through the yolk stalk to the embryo even though a narrow opening in the stalk is still in evidence at the end of the incubation period. As embryonic development continues, the yolk sac is engulfed within the embryo and is completely absorbed at hatching. At this time, enough nutritive material remains to adequately maintain the chick for up to 2 days.

2. The amnion is a transparent sac filled with a colorless fluid that serves as a protective cushion during embryonic development. This amniotic fluid also permits the developing embryo to exercise. The embryo is free to change its shape and position while the amniotic fluid equalizes the external pressure. Specialized muscles also develop in the amnion, which by smooth, rhythmic contractions gently agitate the amniotic fluid. The slow and gentle rocking movement apparently aids in keeping the growing parts free from one another, thereby preventing adhesions and resultant malformations.

3. The chorion serves as a container for both the amnion and yolk sac. Initially, the chorion has no apparent function but later the allantois fuses with it to form the chorio-allantoic membrane. This brings the capillaries of the allantois into direct contact with the shell membrane, allowing calcium absorption from the shell.

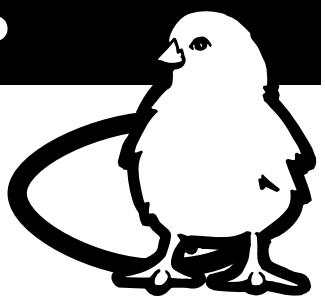
4. The allantois has 4 functions. (1) It serves as an embryonic respiratory organ. (2) It receives the excretions of the embryonic kidneys. (3) It absorbs albumen, which serves as a nutrient (protein) for the embryo. (4) It absorbs calcium from the shell for the structural needs of the embryo. The allantois differs from the amnion and chorion in that it arises within the body of the embryo. In fact, its proximal portion remains intra-embryonic through the development.

Functions of the Embryonic Membranes

Special temporary organs or embryonic membranes are formed within the egg, both to protect the embryo and to provide for its nutrition, respiration, and excretion. These organs include the yolk sac, amnion, and allantois (see Figure 14 on P-28).

Math SOL
4.11
Science SOL
4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4
English SOL
4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



Functions of the Embryonic Blood Vessels

During the incubation period of the chick, there are 2 sets of embryonic blood vessels. One set, the vitelline vessels, is concerned with carrying the yolk materials to the growing embryo. The other set, the allantoic vessels, is chiefly concerned with respiration and with carrying waste products from the embryo to the allantois. When the chick is hatched, these embryonic blood vessels cease to function (see Figure 15, below).

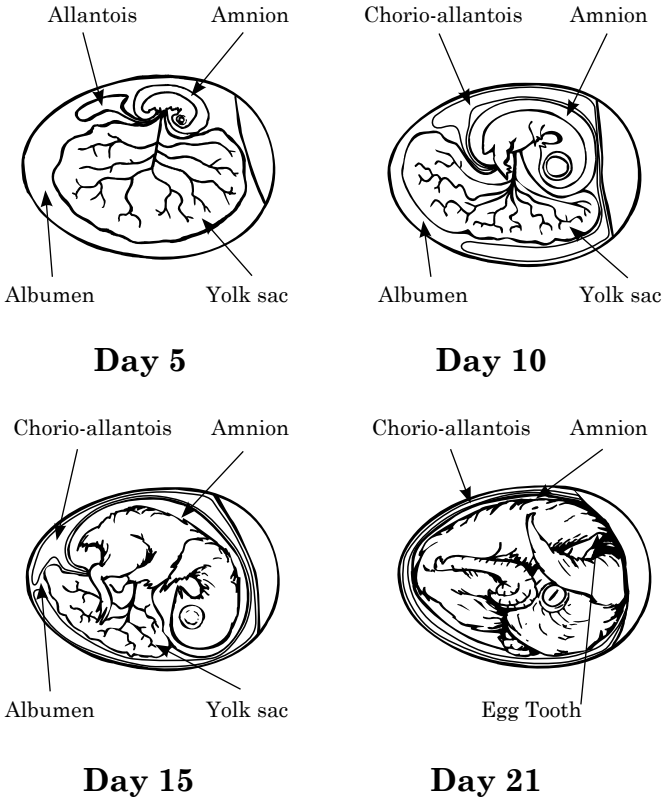


Figure 14. Successive changes in the position of the embryo and its membranes

Hatching

Several changes take place between the 18th and 21st days. The abdominal wall surrounds the residual yolk sac on the 19th and 20th days of incubation. The chick draws what remains of the yolk into its body and "takes its lunch with it" (so to speak) when it hatches. Thus, the chick really doesn't need to be fed for the first day or two after it hatches.

Fluid decreases in the amnion. The chick's head is under its right wing with the tip of the beak pointed at the air cell. The large neck muscle

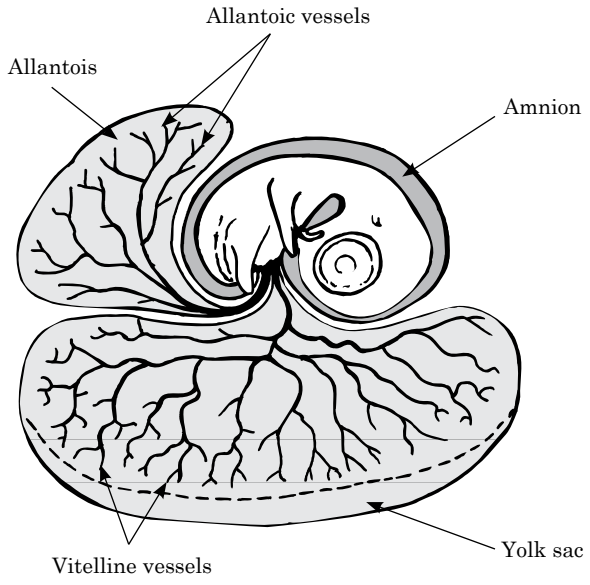
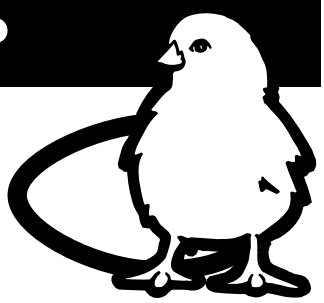


Figure 15. 7-day-old embryo with its embryonic membranes and blood vessels

Math SOL 4.11

Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8



contracts and forces the egg tooth through the air cell, and the chick takes its first breath of air. This is referred to as internal pipping. At this time, you may hear the chick peeping inside the shell.

On the 21st day, the chick finishes its escape from the shell. The egg tooth, a sharp, horny structure located near the top of the beak, makes the initial break in the shell. This is referred to as external pipping.

The hatching process can last for 4 to 12 hours before the chick completely emerges from the shell. As the chick's head rotates from under the wing, the egg tooth pips the shell and continues to break the shell in a nearly perfect circle from the inside until it is able to push the top off of the egg.

The chick, as it appears upon freeing itself from the shell, is wet and very tired. For the next several hours it will lie sill and rest. A few hours later the chick, now dry and fluffy, will become extremely active and the egg tooth will dry and fall off.

The following outline will give you the exact order to development of the embryo on a daily basis.

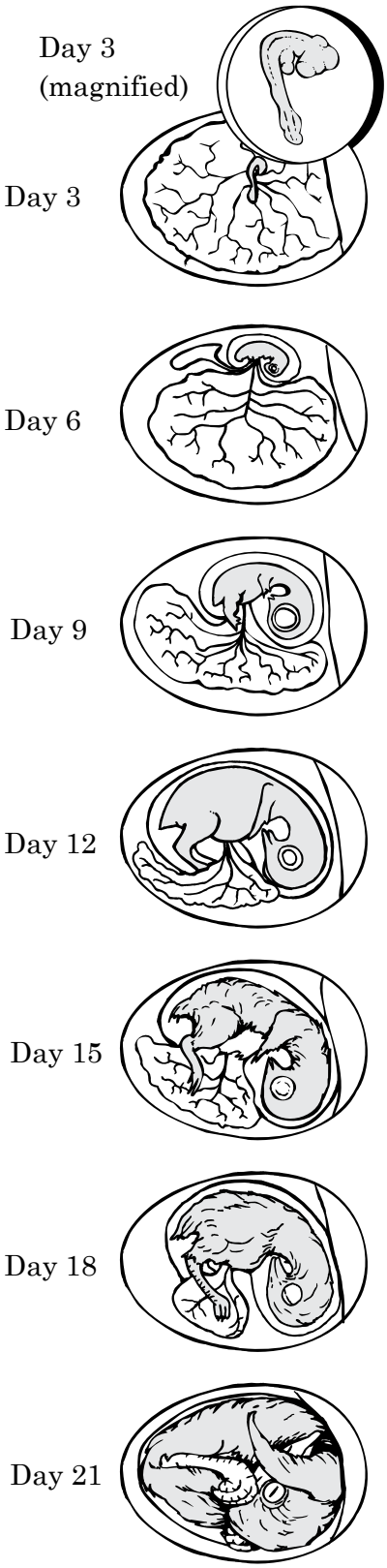


Figure 16. Stages of development

Daily Embryonic Development

Before Egg Laying

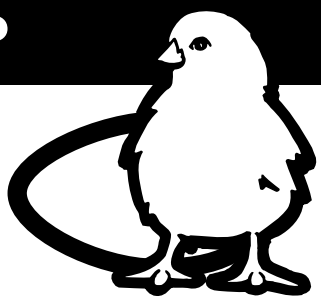
1. Fertilization
2. Division and growth of living cells
3. Segregation of cells into groups of special functions (gastrulation)

Between Laying and Incubation

1. Virtually no growth. Stage of inactive embryonic life.

Math SOL
4.11
Science SOL
4.1, 4.4, 4.8,
5.5, 6.1, 6.2,
6.8, 6.9,
LS.2, LS.3,
LS.4
English SOL
4.1, 4.5, 5.1,
5.7, 5.8

Lesson III — The Embryo



During Incubation (see Figure 16 on P-29)

Day One:

1. Development of area pellucida and area opaca of blastoderm
2. Major developments visible under microscope:
   18 hours: Appearance of alimentary tract
   19 hours: Beginning of brain crease
   20 hours: Appearance of vertebral column
   21 hours: Beginning of formation of brain and nervous system
   22 hours: Beginning of formation of head
   23 hours: Appearance of blood island
   24 hours: Beginning of formation of eyes

Day Two:

1. Embryo begins to turn on left side
2. Blood vessels appear in the yolk sac
3. Major developments visible under microscope:
   25 hours: Beginning of formation of veins and heart
   30 hours: Second, third, and fourth vesicles of brain clearly defined, as is heart, which now starts to beat.
   35 hours: Beginning of formation of ear pits
   36 hours: First sign of amnion
   46 hours: Formation of throat

Day Three: (see Figure 17 on P-31)

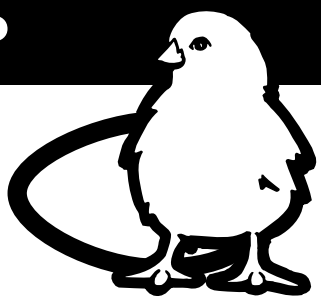
1. Beginning of formation of nose, wings, legs, and allantois
2. Amnion completely surrounds embryo

Day Four:

1. Beginning of formation of tongue
2. Embryo completely separate from yolk sac and turned on left side
3. Allantois breaks through amnion

Math SOL 4.11
Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4
English SOL 4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



Day Five:

1. Proventriculus and gizzard formed
2. Formulation of reproductive organs – sex division

Day Six:

1. Beginning of formation of beak and egg tooth
2. Main division of legs and wings
3. Voluntary movement begins

Day Seven:

1. Indications of digits in legs and wings
2. Abdomen more prominent due to development of viscera

Day Eight:

1. Beginning of formation of feathers

Day Nine:

1. Embryo begins to look bird-like
2. Mouth opening appears

Day Ten:

1. Beak starts to harden
2. Skin pores visible to naked eye
3. Digits completely separated

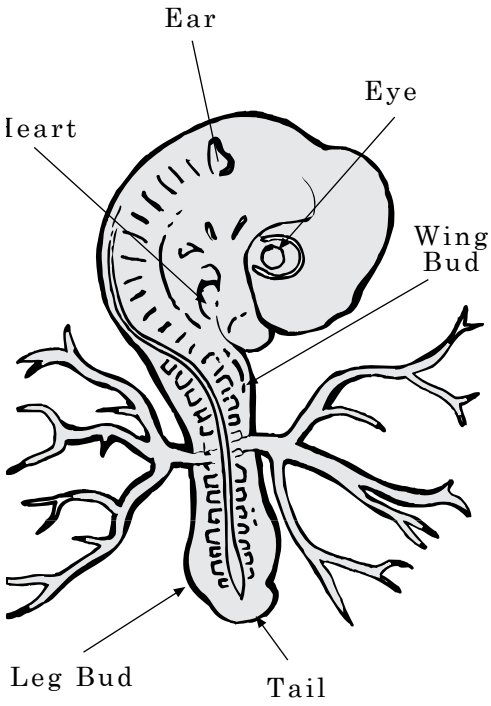


Figure 17. 3-day embryo

Day Eleven:

1. Days ten to twelve tend to run together. No different changes visible on this day

Day Twelve:

1. Toes fully formed
2. First few visible feathers

Day Thirteen:

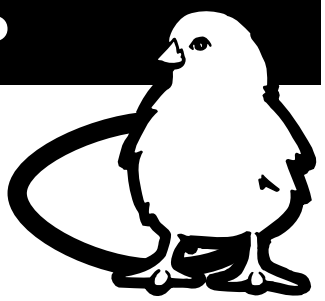
1. Appearance of scales and claws
2. Body fairly well covered with feathers

Math SOL 4.11

Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



Day Fourteen:

1. Embryo turns its head toward blunt end of egg

Day Fifteen:

1. Small intestines taken into body

Day Sixteen:

1. Scales, claws, and beak becoming firm and horny
2. Embryo fully covered with feathers
3. Albumen nearly gone and yolk increasingly important as nutrient

Day Seventeen:

1. Beak turns toward air cell, amniotic fluid decreases, and embryo begins preparation for hatching

Day Eighteen:

1. Growth of embryo nearly complete

Day Nineteen:

1. Yolk sac drawn into body cavity through umbilicus
2. Embryo occupies most of space within egg except air cell

Day Twenty:

1. Yolk sac completely draws into body cavity
2. Embryo becomes chick, breaks amnion, starts breathing air in air cell
3. Allantois ceases to function and starts to dry up

Day Twenty-one:

1. CHICK HATCHES (see Figure 18)

   Look for the egg tooth at the tip of the newly hatched chick. Although used only for a single event in the life of the chick, as a tool to crash through the shell, the egg tooth has served its critical purpose well. Its usefulness over, it will be lost within 36 to 48 hours.

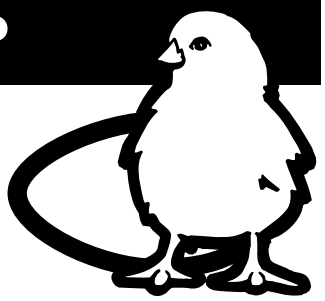
Figure 18. Chick hatches

Math SOL 4.11

Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



Observing the Developing Embryo

It is advisable to observe the development of the embryo. The following 2 methods are most commonly used. The candling method doesn't affect the hatching of the eggs, but the shell-window method normally results in the death of the embryo after 10 to 14 days of development. There is a third method, which is NOT recommended: Open 1 egg each day during the incubation period in order to observe in detail the development of the embryo (20 to 30 additional eggs are needed to complete observations). The advantage of the shell window over the breaking-out of embryos daily is that a single "window-embryo" will survive for days if cared for properly.

Candling Eggs With an Overhead Projector

Candling the eggs is an important part of the Beginning of Life project. Candling serves 3 very important functions. First, by candling the eggs before they are set you can eliminate any cracked eggs from being set. Cracked eggs will not hatch. Second, candling helps determine which eggs are fertile. Third, by candling the eggs every few days you can observe the growth and development of the embryo without breaking the egg open.

How to Construct Your Own Overhead-Projector Egg Candler

Materials Needed:

1. Overhead projector (with light source coming from below glass plate)
2. 1 foot x 1 foot piece of cardboard
3. 1 small box (at least 3 by 4 inches and 1 inch deep)

Procedure: (see Figure 19 on P-34)

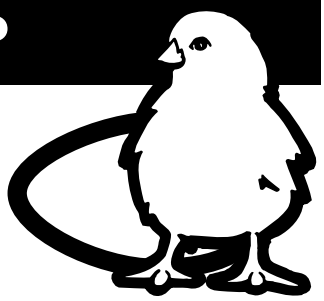
1. Cut an oval hole approximately 3 inches by 2 inches in the center of the sheet of cardboard.
2. Cut the same size (3 inches by 2 inches) oval hole in 1 side of the small box.
3. Cut an egg-shaped hole in the opposite side of the small box. Make the holes slightly smaller than the size of a small egg. An egg-shaped oval of about 1 3/4 inches by 1 inch works best. This hole is to hold the egg in place so the embryo can be observed without excessive handling.
4. Fasten the box to the cardboard base (with the egg shaped hole up) so that the holes are lined up. Use a strong wrapping tape to fasten them together.

Math SOL 4.11

Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



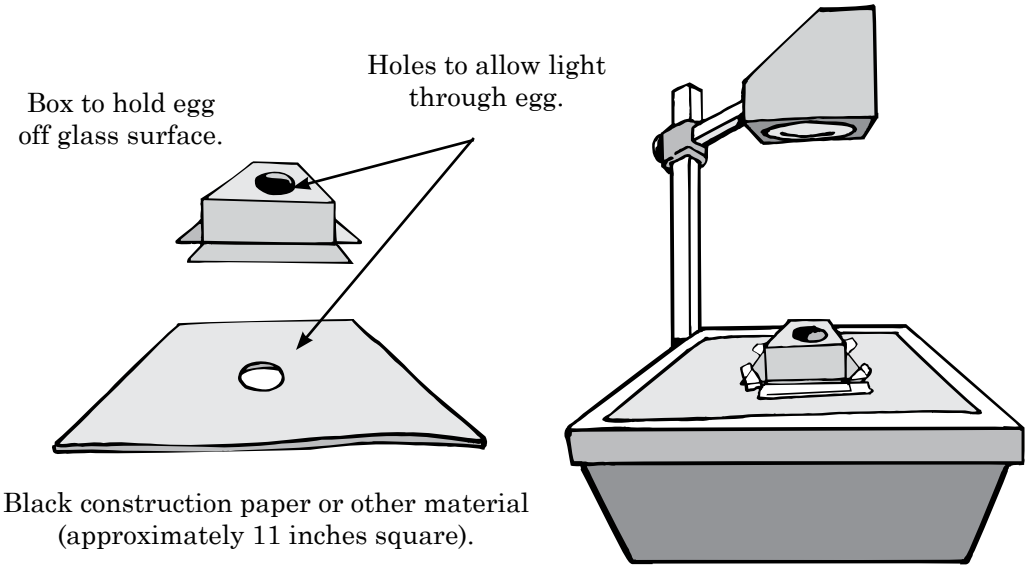


Figure 19. Overhead projector egg candler

Now you are ready to candle and observe the live embryos in their natural environment. To properly candle the egg, set the candler on an overhead projector. Place the overhead projector on the floor or on a low tabletop. Darken the room, the darker the room the better to view. Remove a fertile egg from the incubator and place it on the hole of the candler. With the egg on its side, gently rotate the egg until you get the best view of the embryo.

Some Recommended Activities Include:

1. Candle a fresh refrigerated egg and another egg that has been kept at room temperature for 3 to 5 days. Identify the air cell and yolk. Look for cracks. Gently crack an egg to see what the crack looks like.
2. Observe a 48-hour embryo, 3-day embryo, 6-day embryo, 9-day embryo, 12-day embryo, 18-day embryo, and a 19-day-old embryo.

The Shell-Window Method

Removing part of the shell of an egg provides another way to study embryo development. In embryos more than 2 days old, most of the development can be seen if the shell is removed from the air-cell end of the egg.

Materials needed:

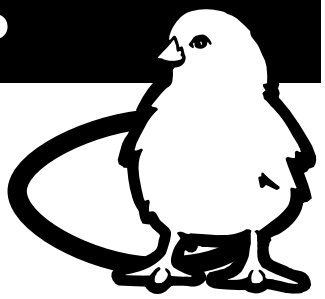
- Fertile eggs
- Egg carton
- Water pan and water
- Scissors
- Tweezers or forceps
- Eyedropper

Math SOL 4.11

Science SOL 4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4

English SOL 4.1, 4.5, 5.1, 5.7, 5.8

Lesson III — The Embryo



The major obstacle after assembling the necessary equipment is to open the shell without damaging the embryo and its membrane. This is not as difficult as it appears. Here is a step-by-step explanation of how to open fertile, incubated eggs for embryo observation:

Step One:

Carefully crack the shell at the air-cell (broad) end of the egg. Do not puncture the inner shell membrane.

Step Two:

Cut or peel off the shell covering the air cell. Do not puncture the inner shell membrane (see Figure 20).

Step Three:

Using forceps, tweezers, or scissors, remove the inner shell membrane covering the air cell. In eggs beyond the second day of incubation, embryonic membranes adhere to the shell membranes. Moisten the membranes with warm water dispensed from an eyedropper while removing the thin transparent shell membrane. The water will prevent the shell membrane from sticking to the embryonic membrane.

Step Four:

Set the egg in an egg carton, window up and observe the embryo with the aid of a magnifying glass.

In young embryos (3 to 8 days), a rich network of blood vessels spread out from the embryo and surround the yolk. This network is the vitelline or yolk sac circulatory system. In embryos 2 to 4 days of age, observe the tiny red heart beating rapidly and pumping the blood throughout the intra- and extra- circulatory systems.

One characteristic of birds is the remarkable growth and development of the eye after the embryo is 24 hours old.

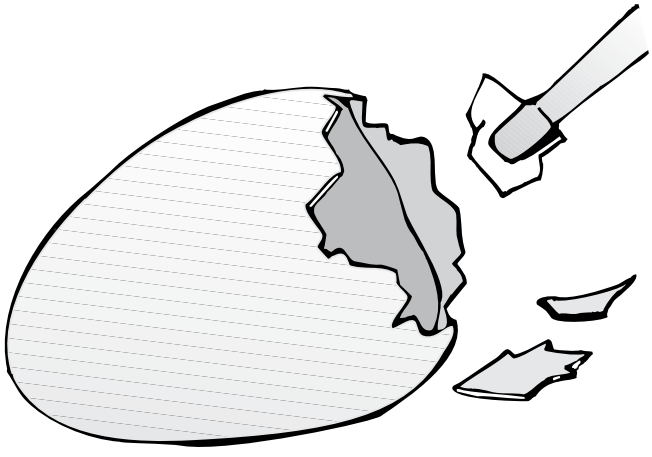
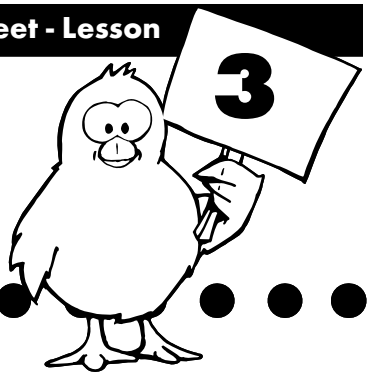


Figure 20. Shell window

Math SOL
4.11
Science SOL
4.1, 4.4, 4.8, 5.5, 6.1, 6.2, 6.8, 6.9, LS.2, LS.3, LS.4
English SOL
4.1, 4.5, 5.1, 5.7, 5.8

"Beginning of Life"



Name:_____

1. What shape does the embryo have for the first 5 days of incubation? Draw the shape and label the head, heart, tail.

2. What was the first part of the embryo you noticed? _____

   a. What did it look like? _____

3. What day of incubation did you first see the following?

   _____ blood vessels

   _____ heart beating

   _____ eye

   _____ beak

   _____ leg

   _____ fluff

   _____ egg tooth

4. What day of incubation did you hear the embryos peep? _____

5. What does the yolk sac supply for the embryo? _____

6. What supplied food for you when you were developing in your mother?

   _____

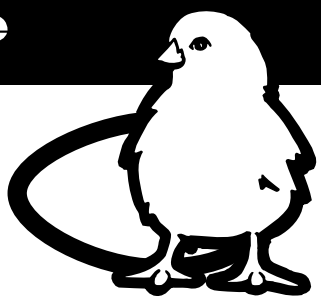
7. What does the amnion (clear fluid sac surrounding the embryo) do for the embryo?

   _____

8. What does the egg tooth help the chick do?

   _____

Lesson IV — Home Sweet Home



Objectives

- Teach students what a chick needs to live
- Teach responsibility for a living thing

Life Skills

Learning to learn	Communication	Managing feelings
Decision making	Concern for others	Social skills
Critical thinking	Self responsibility	Cooperation
Teamwork	Contributions to group effort	

Tie to SOLs

Math	Science
4.11, 5.10, 5.11, 6.9, 6.10	LS.4, LS.8

Time Required: 1 hour (continued over 2 to 3 days)

Supply List

- Cardboard box
- Feed
- Feeder
- Heat source
- Newspaper
- Paper towels
- Water container

Background Information and Procedure:

A. Build a brooder (preferably with the class) at least 3 days prior to hatching day. Discuss what the walls and covered areas are for. Why use towels to provide traction for the chicks? What do the chicks need after they hatch? How does the mother hen supply these things in nature?

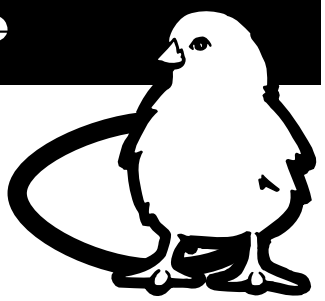
B. After the chicks hatch, place them in the prepared brooder area.

   1. Observe the egg teeth at the tips of the chicks' bills.
   2. Observe the parts of the chicken.

Math SOL 4.11, 5.10, 5.11, 6.9, 6.10

Science SOL LS.4, LS.8

Lesson IV — Home Sweet Home



3. Observe and discuss the chicks and how they function. Do they socialize with other chicks, students in class? How can comparisons be made between the chicks and the students? What is the same, what is different in their daily functioning? Chickens and other birds develop a very specific pecking order. Can you identify which chick is on top? Which chick is on bottom?

C. Observe and discuss how the chicks eat and drink. What types of ingredients are in chick food? Corn, soybeans, vitamin, minerals? Why are they important for the chicks to grow?

D. Discuss the type of care a baby chick needs versus that of a baby kitten, robin, etc. Which need to be fed by a parent? Can they move, see, etc.? How are they different?

E. Explain to the students where the chicks will live once they leave your classroom.

Content Background

Evaluation:

Turn in student activity sheets to demonstrate learning progress.

- Beginning of Life Record Book (Brooder sheet)
- Home Sweet Home sheet

Once the Chicks Hatch

Brooding

Whether there is 1 chick or 1,000 chicks in the brooding unit, the principles are the same. The chicks must be kept warm, well fed, watered, protected from predators and dampness, and provided with plenty of fresh air without being exposed to drafts. Unless you are properly equipped, it is not advisable to raise the chicks in the classroom for more than a week.

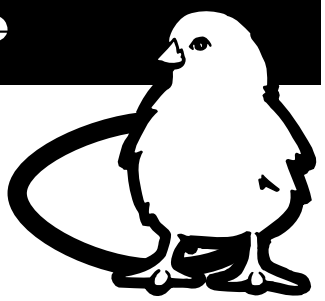
Newly hatched chicks can live on the unabsorbed yolk in their bodies for about 72 hours if necessary. However, chicks with access to feed and water will begin to eat and drink when less than 1 day of age.

Since you have little time when the chicks hatch, it is extremely important that you build and/or set-up all necessary equipment at least 2 days prior to the chicks hatching.

Math SOL
4.11, 5.10,
5.11, 6.9,
6.10

Science SOL
LS.4, LS.8

Lesson IV — Home Sweet Home



Brooders should maintain a temperature of 95°F (taken at 1 inch above the floor level, the height of the chick's back) during the first week. If you keep the chicks beyond the first week, decrease the temperature 5°F per week until room temperature is reached.

The brooder should have a textured, absorbent litter on the floor. If the floor is slippery, the chicks can damage their legs.

Feed 18 percent to 22 percent protein chicken starter food. This completely balanced ration can be obtained from any feed-and-garden store. The feed can be placed in jar lids, egg cartons, small tuna type cans or a commercial chick feeder, any item that can hold enough feed to keep feed available at all times and is easy for the chicks to eat from.

Water should be available at all times. Use watering equipment that prevents the chick from getting into it and drowning. Commercially made water fountains can be bought and added to a quart jar. These are inexpensive and work very well for the first 4 weeks of age when brooding chicks.

Clean the waterer and brooder daily. This will prevent odors and keep the brooder dry. Dampness provides favorable conditions for the development of molds and bacteria. Providing at least 1 square foot for every 5 chicks will also help keep the conditions more desirable.

How to Build a Brooder and Brood Chicks for the First Week

This information tells you how to build 3 brooding units: 2 temporary, disposable brooders and 1 strong, reusable brooder.

A. Courtyard-type Temporary Brooder for 1 or 2 Weeks of Brooding (see Figure 21 on P-39)

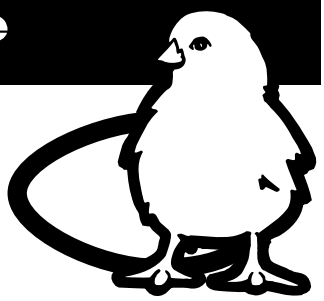
Materials needed:

- 1 cardboard box approximately 24 inches square
- Another cardboard box approximately 12 inches by 18 inches and at least 12 inches high.
- 1 light socket on an electric cord
- 1 40- to 60-watt light bulb
- 1 water fountain
- Old newspaper
- 1 roll of paper toweling
- 1 roll of clear wrapping paper

Math SOL 4.11, 5.10, 5.11, 6.9, 6.10

Science SOL LS.4, LS.8

Lesson IV — Home Sweet Home



Procedure:

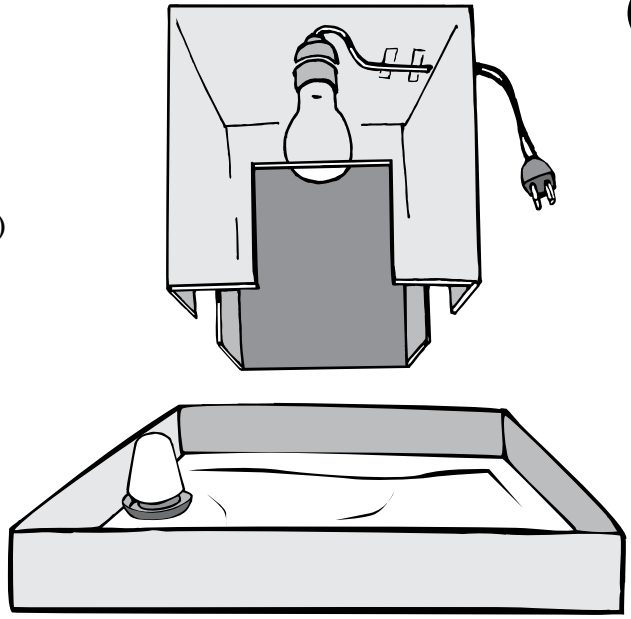


Figure 21. Courtyard brooder

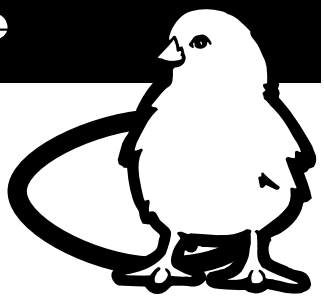
1. Remove the top of each cardboard box.
2. Cut the sides of the largest box (24 inches by 36 inches) down to 6 inches high. This is the chick courtyard where the feed and water will be placed.
3. Now, cut 1 hole 4 inches high by 6 to 10 inches across (depending on size of box) in 3 of the 4 sides of the small box. These are to serve as doorways to the heat source. Cut these holes close to the open-end edge of the 3 sides (remember, the chicks have to get in and out).
4. Turn this small box over so the covered side is up. Cut a round hole one-half the size of your light socket in the center of the covered end of the box. Then cut 3 slits from the inside of the round hole approximately 1 inch out into the box top. Cut these 3 slits at different angles. Now, punch the light socket down into the hole about three-fourths of the length of the socket. Tape the electrical cord to the box top. This will help keep the light bulb from falling to the floor and causing a fire. Never use a light bulb larger than 60 watts, and never place the light closer than 6 inches to the brooder floor.
5. Cover the bottom of the largest box (courtyard) with newspaper and then a layer of paper towels. The paper towels give the chicks traction and prevent leg damage.
6. Put the other box (the open end down) in the center of the box with the paper towel surface.

Add a waterer and a feeder, and your brooder is ready for the chicks.

Some instructors cut out part of a side or part of the top of the brooding box (the box with the light bulb) and cover the area with clear plastic wrap so everyone can see the chicks. By covering the open area with plastic wrap, the heat from the bulb is still trapped inside the box and keeps the chicks warm.

Math SOL
4.11, 5.10,
5.11, 6.9,
6.10

Science SOL
LS.4, LS.8



B. Gooseneck Brooder (see Figure 22)

Materials needed:

- 1 cardboard box at least 18 inches long by 18 inches wide and 12 inches high
- 1 gooseneck lamp with a 60- to 75-watt light bulb
- Waterer and feeder
- Newspaper and paper towels for litter
- Clear plastic wrapping paper (see previous page)

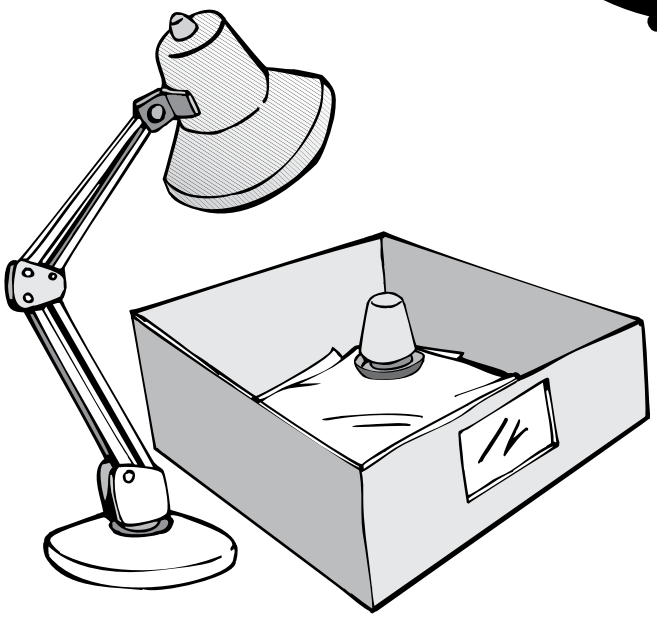


Figure 22. Gooseneck-lamp brooder

Procedure:

The cardboard box serves as the chick brooder. The size and shape is not important as long as it is large enough to house the chicks and equipment. Put the newspaper in the box bottom, cover with paper towels, and place the feeders and waterers in the box. The neck of the lamp can be bent over the side of the box. The lamp can be bent closer to the chicks if they seem cold or moved upward if they seem too warm.

Many instructors cut a large window in the side of the box and cover it with plastic wrap, then place the box at the observer's eye level for best viewing.

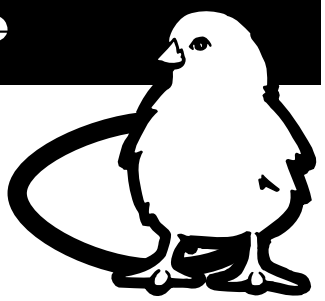
C. Wooden Brooder, a Strong and Reusable Brooder that is Easy to Build (see Figure 23 on P-41)

Math SOL 4.11, 5.10, 5.11, 6.9, 6.10

Science SOL LS.4, LS.8

This plywood brooder is easy and inexpensive to build. The proportions can be changed if necessary. The brooder is designed to trap heat in half of the unit to keep the chicks warm. The other half allows you to observe the chicks eating and moving about. The top above the light bulbs should be hinged to allow you to open the top to clean the brooder and catch the chicks.

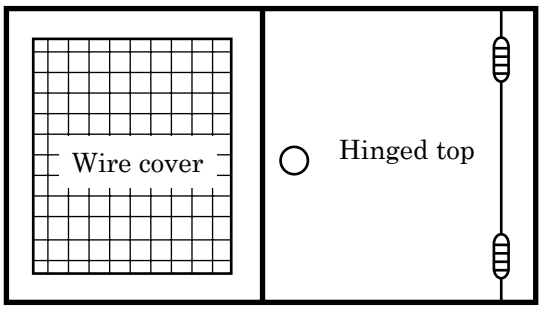
Use 2 light bulbs on the heated end of the brooder. If one burns out, the other will help maintain heat in the brooder. In a classroom, 2 25-watt bulbs will usually produce enough heat. However, adjust the size of the light bulbs to regulate the temperature. It should be 95°F in the heated

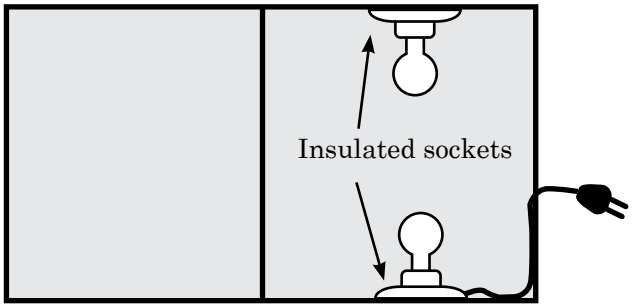


side for the first week, then decrease the temperature by 5°F per week by decreasing the light bulb size.

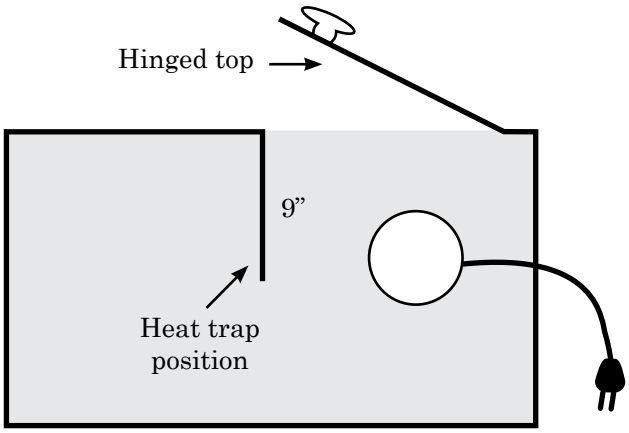
Place a layer of newspaper about 5 pages thick in the bottom of the brooder and cover with 2 layers of paper towel. This will keep the chicks from slipping and hurting themselves.

Top View





Inside view from top



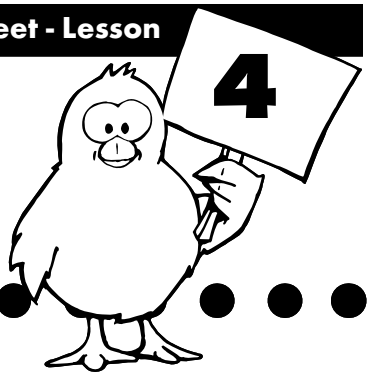
Inside view from side

Figure 23. Wooden chick brooder

Math SOL 4.11, 5.10, 5.11, 6.9, 6.10

Science SOL LS.4, LS.8

Beginning of Life Record Book



V. IMPORTANT STAGES OF DEVELOPMENT:

Keep and attach a record of the changes that occur in the embryo each day. If you can candle the eggs, how does the appearance inside the egg change each day?

Doug's 4-H EMBRYOLOGY Calendar

				Thursday 1	Friday 2	Saturday 3
Sunday 4	Monday 5	Tuesday 6	Wednesday 7	Thursday 8	Friday 9	Saturday 10
Sunday 11	Monday 12	Tuesday 13	Wednesday 14	Thursday 15	Friday 16	Saturday 17
Sunday 18	Monday 19	Tuesday 20	Wednesday 21			

VI. BROODING CHICKS:

1. Three principles to follow in brooding chicks are that the chicks must be kept:

   a._____

   b._____

   c. _____

2. What is to be your heat source for the brooder? _____
3. When you put the chicks in the brooder, what should the temperature be? _____
4. How do you know if the chicks are too hot?_____
5. How do you know if the chicks are too cold? _____
6. What are you feeding your chicks? _____
7. Describe what changes you observe in the chicks each day. _____

   _____

VII. PROJECT REPORT:

Write and attach a report on what you have done in your chick incubation project. You may want to include pictures or drawing to illustrate what you observed. Some of the things you may want to write about in your report are:

- The kinds of eggs you set (chicken, quail) and where you got your eggs.
- Whether any embryos died during incubation and what you think caused them to die.
- Anything unusual that happened during the course of the project.

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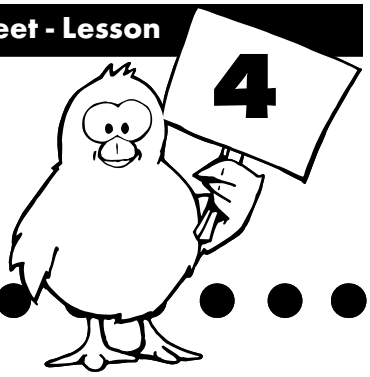
Home Sweet Home



Name:_____

Circle the word that does NOT belong below:

1. These things are needed to raise a chick:

   Heat Food Water Toys Bedding Shelter Light

2. A chick has:

   Down Beak Comb Eyes Ears Egg tooth Feathers Feet

3. Chick food contains:

   Corn Minerals Vitamins Soybeans Sugar Protein

4. The chick can do these things as soon as it hatches:

   Eat Drink Walk Crow See Sleep

5. These are some names used for baby animals.

   Chick Kid Lamb Horse Calf Foal Kitten Pup

Complete the sentences below by circling the CORRECT answer.

6. Textured material is put on the floor of a brooder so the chicks can't _____.

   Cry Jump Slip

7. Chicks _____ their heads when they drink.

   Lift Shake Scratch

8. When the chicks first hatch and are placed in the brooder they _____ a lot.

   Run around Eat and drink Sleep

9. The _____ is only used to help the chick get out of the egg and falls off a day after the chick hatches.

   Fluffy down Egg tooth Hammertoe

10. Baby chicks must be fed _____after hatching.

    Crop milk Complete starter mash Whole grain

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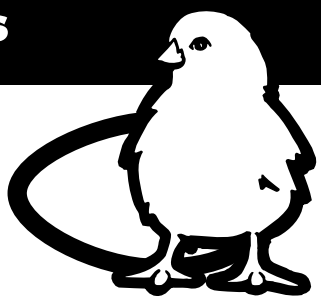
Lesson V — Vital Records



Objectives

- Teach students the importance of record keeping
- How to use records to understand principles and make decisions.

Life Skills

Learning to learn	Critical thinking
Problem Solving	Record keeping
Decision making	Planning/organizing

Tie to SOLs

Math	Science	English
4.8, 4.10, 4.12, 4.19, 5.3, 5.7, 5.9, 5.10, 5.11, 5.12, 5.17, 5.18	4.1, 6.1, 6.2	4.1, 5.1, 5.8, 6.8, 6.9

Time Required: 5 to 20 minutes a day, total of up to 3 hours over entire project

Supply List

- Ruler
- Thermometer
- Scale
- Paper or computer software to develop spreadsheets and post information

Background Information and Procedure:

Record keeping can be used for 2 important aspects of the Beginning of Life project.

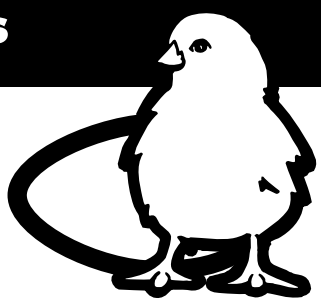
1. Teach students the importance of keeping records and how to keep records

Math SOL 4.8, 4.10, 4.12, 4.19, 5.3, 5.7, 5.9, 5.10, 5.11, 5.12, 5.17, 5.18

Science SOL 4.1, 6.1, 6.2

English SOL 4.1, 5.1, 5.8, 6.8, 6.9

Lesson V — Vital Records



2. Help you and other resource person troubleshoot incubation and hatching problems.

There are a number of records everyone should keep as part of the overall project. Develop a working chart/checklist on the table or wall by the incubator. Showing the students how to develop a personal log or journal for this project can also be valuable.

Before incubating them, number all eggs on the large end and record how many were set.

During incubation, have the students record the temperature (before or as soon as incubator is opened), when eggs are turned, and how much water is added daily (best to add once a day at about the same time).

Every 3 days candle the eggs. Record which are not fertile, which seem to have stopped developing.

At the end of the project student should make the following calculations

$$\%\ \text{Fertile} = \frac{\#\ \text{Fertile}}{\#\ \text{eggs set}}$$

$$\%\ \text{Hatch} = \frac{\#\ \text{Hatch}}{\#\ \text{eggs set}}$$

$$\%\ \text{Hatchability} = \frac{\#\ \text{Hatch}}{\#\ \text{fertile eggs}}$$

Other simple records and calculations you can consider:

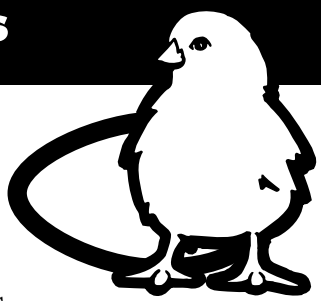
1. Calculate the percentage of even-numbered eggs versus the percentage of odd-numbered eggs.
2. Ask the students to develop graphs to display statistics/records.
3. Weigh a group of eggs daily to determine the percentage weight lost from dehydration.
4. Measure air cell size changes as egg dehydrates.
5. Measure humidity by making or using wet bulb thermometer.
6. Measure the volume of water added during incubation.
7. Make chart of all temperature readings; look at average/mean/range.

Math SOL
4.8, 4.10, 4.12, 4.19, 5.3, 5.7, 5.9, 5.10, 5.11, 5.12, 5.17, 5.18

Science SOL
4.1, 6.1, 6.2

English SOL
4.1, 5.1, 5.8, 6.8, 6.9

Lesson V — Vital Records



From these records, compare with results from each egg. Did it hatch or not? Were the eggs that did not hatch dehydrating faster?

Keep records over numerous years to share among schools to see if results are tied to any of the records kept. These records can also be used with Lesson II's suggested experiments.

Evaluation

Turn in student activity sheets to demonstrate learning progress.

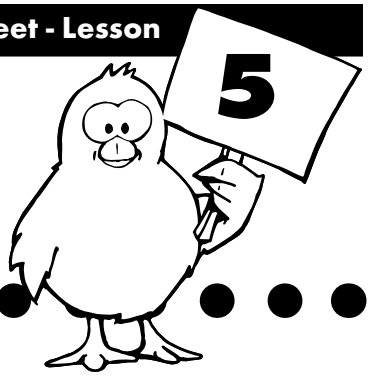
- Beginning of Life Record Book (complete Lesson II Record Book)

Math SOL
4.8, 4.10, 4.12, 4.19, 5.3, 5.7, 5.9, 5.10, 5.11, 5.12, 5.17, 5.18

Science SOL
4.1, 6.1, 6.2

English SOL
4.1, 5.1, 5.8, 6.8, 6.9

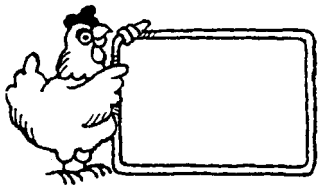
Math Studies



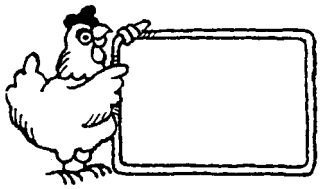
Word Problems

The Answer Chicken Says:

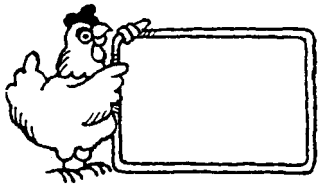
John collected 2 eggs from 1 nest, 4 eggs from another nest, and 3 eggs from the final nest. How many eggs did John collect?



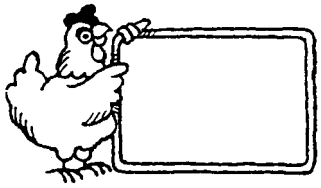
The incubator was opened and the temperature dropped to 95˚F. It takes 5 minutes for the incubator temperature to rise 1˚F. How many minutes will it take for the incubator to reach 100˚F?



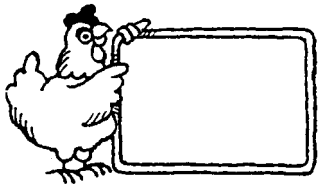
Mary had 2 dozen eggs in a basket. She dropped the basket and 7 broke. How many eggs were still unbroken?



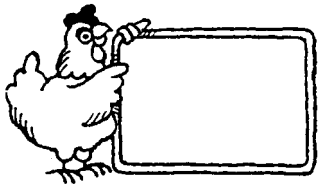
There were 18 eggs in the incubator. Nine (9) chicks hatched on Monday and 3 chicks hatched on Tuesday. How many chicks will need to be removed from the incubator and put in the brooder?



There were 10 eggs in the refrigerator. Mom used 4 eggs to bake a cake. Dad ate 2 eggs for breakfast and dropped 1 egg and broke it. How many eggs are left?



A hen laid 1 egg per day for 19 days in March. How many days did she not lay an egg?



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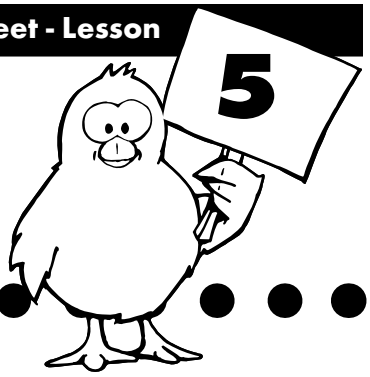

Math Studies

Match the egg that holds the correct answer to the math problem.

10 + 17	121 - 18	11 x 6	97 + 63	429 - 104
72 - 13	19 + 18	$6\sqrt{84}$	14 x 7	253 + 132

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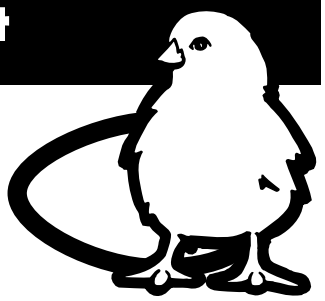
Lesson VI — The Big Event



Objectives

- Learn how to plan/schedule appointments
- Learn how to plan, develop, and send announcements and invitations
- Allow students to present what they have done and learned
- Predict outcomes, discuss results, and share feelings about outcomes

Life Skills

Learning to learn	Record keeping	Decision making
Cooperation	Problem solving	Communication
Planning/organizing	Teamwork	Self responsibility
Social skills	Managing feelings	

Tie to SOLs

Math	Science	English
5.12	4.1, 5.1, 5.2, 5.3, 5.7	6.1

Time Required: 1 to 3 hours

Supply List

- Paper
- Computer (optional)
- Art supplies
- Calendar (can create your own)

Background Information and Procedure:

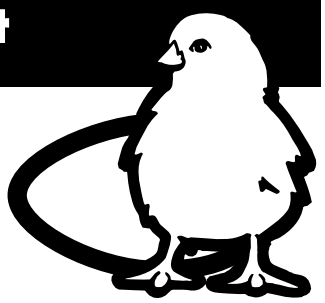
One of the most exciting times during this project is hatch time. Why not share this excitement with others (other classes, parents, etc.)? This project offers a number of social and personal development opportunities throughout the 25 days the project is actively running. Consider doing one or more of these activities during the project.

Math SOL 5.12

Science SOL 4.1, 5.1, 5.2, 5.3, 5.7

English SOL 6.1

Lesson VI — The Big Event



At the beginning

1. Discuss the class's "responsibility" for this project and assign students to keep records (temperature, turning, adding water), turn the eggs, and protect the project.
2. Ask each students to prepare an information flyer to take home or send to other classes to explain what the class and students will be doing and learning over the 3-plus-week period of the project.
3. Discuss expected outcomes. Will all the eggs hatch? Are all human pregnancies successful? Ask all the students to write a paragraph of expected outcomes and place them in file till the end of the project. Compare the expected to the actual outcomes. May incorporate with oral presentation at end of project.

During the project:

Best after the 9th day of incubation since the first 9 days of incubation are a busy time. Also, by the 9th day you will have idea of how successfully the embryo development is progressing.

1. Show each student how to prepare invitations for parents and the other classes to visit your class on the 21st day to see the results of the class project. Discuss how to set up a schedule. How much time should be blocked for each class? What would be a good time for parents to come to see the results? How will the class decide scheduling conflicts? What needs to be included in the invitation (time, place, why, RSVP)? Let the students use art supplies, computer, etc., to lay out and decorate their invitations. Hand deliver or mail the invitations at least 7 to 10 days before hatch. Consider sending a reminder or follow-up notice.
2. Between day 9 and day 14 of incubation, discuss the expected outcomes and events that may have affected the outcome over the first part of the project. Ask all of the students to submit a written paragraph about their revised expected outcome. Again, file them till end of project.

At the end of the incubation period

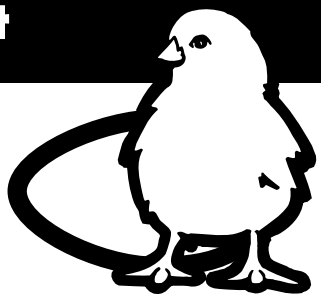
1. Have each student write a "birth announcement" to send to other classes and a parent. Discuss what to include.
2. Discuss the results of the hatch. Did all the eggs hatch? Why not? Any handicapped chicks? Relate to human births. Some die, some are handicapped. Discuss how the students feel about the results of the project.

Math SOL
5.12

Science SOL
4.1, 5.1, 5.2, 5.3, 5.7

English SOL
6.1

Lesson VI — The Big Event



3. Ask 1 student or team of students to give a short oral presentation about the project to each group that visits the classroom. Or ask each student to compare expected outcomes to what actually happened and give a brief oral presentation to the class, or write a paper exploring why or how they were different.
4. Ask the students to write a thank you note to everyone who helped make this project successful.

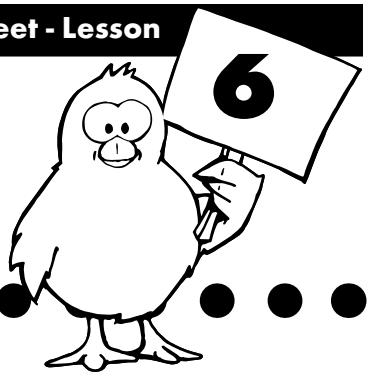
Evaluation

Turn in student activity sheets and prepost them for the overall project to demonstrate learning progress. Complete certificates for "Egg-cellent Work."

Math SOL
5.12

Science SOL
4.1, 5.1, 5.2, 5.3, 5.7

English SOL
6.1



Overall Program

Name:_____

Beginning of Life Pretest/Posttest

1. Identify the parts of the broken-out egg.

2. How long does it take a chicken egg to develop and hatch? _____
3. In which end of the egg is the air cell located?_____
4. All eggs develop into a bird when placed in an incubator. _____True ____False
5. What is the ideal temperature for incubating chicken eggs?_____
6. How many times a day should you turn chicken eggs in the incubator?
7. When does the chick start to use its lungs to breath?
   a. At the 6th day of incubation
   b. After it pips through the air cell
   c. After it pips a hole though the shell
   d. After it hatches from the shell
8. What 3 things must you provide day-old chicks for them to live?
   a. _____
   b. _____
   c. _____
9. What is it called when you hold an egg up to a bright light to observe what is inside the egg without breaking it open?

   _____
10. What do the 4 H's stand for in 4-H?_____

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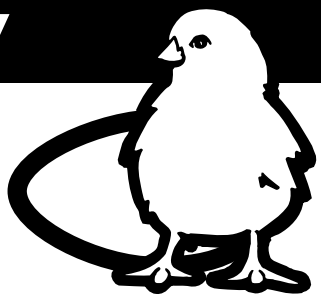


Bibliography

Abbot, U.K. and Craig, R.M. Avian Embryology Projects. Department of Poultry Husbandry, University of California, Davis, Calif. 15 pages with reference.

Adams, A.W., and Smith, L.T. Poultry Science Phase. Cooperative Extension Service, Kansas State University, Manhattan, Kans. 32 pages, five units: introduction, the egg, incubator, incubation, and embryos.

Caldwell, M. Jane. Embryology Members' Manuals I and II, North Carolina Agricultural Extension Service, Raleigh, N.C. 18 pages each volume.

Card, L.E., and Nesheim, M.C. Poultry Production. Philadelphia, Pa. Lea & Febiger, 1973.

Committee on Youth Science Projects. "List on Youth Poultry Science Projects Which Are Available for General Distribution." Poultry Science (1964) 43:1616.

Committee on Youth Science Projects "Suggested Format for Youth Science Projects in Poultry." Poultry Science (1964) 43:1615.

Committee on Youth Science Projects. "Science Studies in Poultry Biology." Poultry Science (1974) 53:455.

Davis. 4-H Embryology: North Carolina 4-H Agent Planning Guide. North Carolina State University, Raleigh, N.C.

Flanagan, G.L. Window Into An Egg. New York, N.Y. Young Scott Books, 1969.

Georgiou, Constantine. Wait and See. Irvington on the Hudson, N.Y. Harvey House, Inc., 1962. For primary grades 1, 2, 3.

Gerry R.W. The Use of Eggs and Chicks in Classroom Projects. College of Agriculture, University of Maine, Orono, Me. 04473. Five sections.

Hughes, B.L. Incubation Eggs of Domestic Birds. Circular 530, 1972. Clemson University, Clemson, S.C. 15 pages, illustrated.

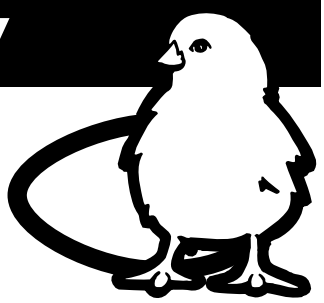
Hyre, H.M., and Voitle, R.A. Incubating Chicken Eggs and Preparing Chick Embryos for Display. Appalachian Center, West Virginia University, Morgantown, W.V.

Japp, G.R. Genetics and Breeding of Chickens. Cooperative Extension Service, Ohio State University, Columbus, Ohio. 19 pages, illustrated, data on feather and color sexing.

Kingsburg, F.W. From Egg To Chick – Incubators and Their Operation. 4-H 45, 1967. Cooperative Extension Service, Cook College, Rutgers University, New Brunswick, N.J. 18 pages, plans for several incubators, and comments on embryology of the chick.

Johnson, H.S. 4-H Poultry Science, A 4-H Poultry Incubation Experiment for Older Youth. Cooperative Extension Service. Michigan State University, East Lansing Mich.

Bibliography



Malinovsky. 4-H Chick Embryology Project. Cooperative Extension Service, Ohio State University, Columbus, Ohio. 20 pages.

Marquard, J.W. Lesson Plans For Teaching The Avian Embryo. Cooperative Extension Service, Ohio State University, Columbus, Ohio. 20 pages

Moreng, R.E., and Enos, H.L. Embryo Science, A Study Outline For Youth. Cooperative Extension Service, Colorado State University, Fort Collins, Colo.

Muller, H.D. The Chick in Science Projects. Department of Avian Science, Colorado State University, Fort Collins, Colo. Beginning, conducting, and analyzing a science investigation.

Patten, B.M. Early Embryology of the Chick. 4th ed. New York, N.Y. The Blakiston Company, 1952. covers the embryology of the chick in detail.

Quigley, G.D. A Chick Incubation. College of Agriculture, University of Maryland, College Park, Md.

Quigly, G.D. "Wanted: More Science Fair Project in Poultry." Poultry Science. 40:1445.

Ridlen, S.F., and Johnson, H.S. From Egg to Chick. Cooperative Extension Service, University of Illinois, Urbana, Ill. 16 pages, a guide to the study of incubation and embryonic development.

Romanoff, A.J. The Avian Embryo. New York, N.Y. Macmillan Company, 1960.

Romanoff, A.J., and Romanoff, A.L. The Avian Egg. New York, N.Y. John Wiley and Sons, 1949.

Schano, E.A. 4-H Poultry Incubation and Embryology Teaching Material. Poultry Science Department, Rice Hall, Cornell University, Ithaca, N.Y. About 20 lessons, clearly written and illustrated.

Swiney, K.L. 4-H Poultry Science Studies. Cooperative Extension Service, Clemson University, Clemson, S.C.

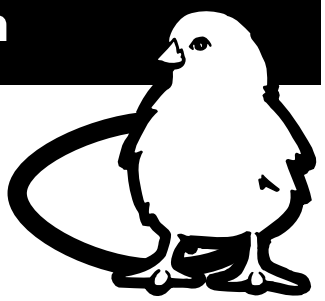
Talmadge, D.W. "An Embryology and Incubation Institute for High School Science Teachers and Students." Poultry Science 40:1464.

Talmadge, D.W., and Aho, W.A. Incubation and Embryology of the Chick. 1973. Animal Industry Department, University of Connecticut, Storrs, Conn. 20 pages, illustrated.

Taylor, L.W., ed. Fertility and Hatchability of Chicken and Turkey Eggs. New York, N.Y. John Wiley and Sons, 1949.

Winter, A.R., and Funk, E.M. Poultry Science and Practice, New York, N.Y. J.B. Lippincott Company, 1960. A general poultry text with information on fertility, hatchability, and principles of incubation.

Teachers Evaluation Form



The following questions have been designed to determine the effectiveness of the 4-H Embryology program. This information will be utilized by the county and state Extension personnel to:

- Evaluate this year's program.
- Design new and/or improved resources for this program in the future.

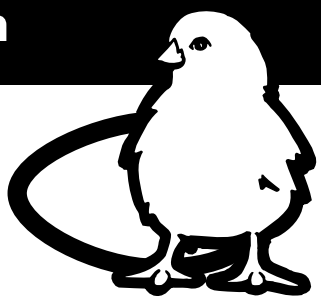
All individual responses are confidential and will be reviewed only by your Extension 4-H agent who is the local Beginning of Life program leader. A unit program summary of results should be sent to state program specialists each year.

General Impressions of Embryology

Please indicate your personal response to the following statements by placing an "x" at the appropriate location on the scale provided.

Strongly Agree	Agree	Disagree	Strongly Disagree	
☐	☐	☐	☐	1. 4-H Embryology was a useful addition to my regular teaching unit.
☐	☐	☐	☐	2. The information presented in embryology is accurate and up-to-date.
☐	☐	☐	☐	3. The embryology information is of instructional value to me in preparing classroom lesson plans.
☐	☐	☐	☐	4. The sheets contributed to the embryology classroom learning experience.
☐	☐	☐	☐	5. The "Beginning of Life" embryology leader's guide assisted me in classroom preparation for embryology.
☐	☐	☐	☐	6. The 4-H embryology material is applicable to instruction in nonscience curriculum areas.
☐	☐	☐	☐	7. I felt I received adequate training to help me use embryology in my classroom
☐	☐	☐	☐	8. Students' positive perceptions of science were enhanced by utilizing 4-H embryology.

Teachers Evaluation Form



Strongly Agree	Agree	Disagree	Strongly Disagree	
☐	☐	☐	☐	9. Students' positive perceptions of nonscience curricula were enhanced by 4-H embryology.
☐	☐	☐	☐	10. Students' knowledge and skills in vocabulary were enhanced though the use of the 4-H Beginning of Life project.
☐	☐	☐	☐	11. Students' knowledge and skills in living processes were enhanced through the use of the 4-H Beginning of Life project.
☐	☐	☐	☐	12. Students' knowledge and skills in _____ were enhanced through the use of the 4-H Beginning of Life project. (Fill in the blank)

Specific Suggestion for Future Embryology Programs

Please respond briefly to the following questions.

1. Did you integrate 4-H embryology into nonscience curricula?

   Yes No If so, how?

2. Do you plan to utilize 4-H embryology in your classroom again next year?

   Yes No

3. What modifications would you suggest to facilitate a more positive learning experience with the 4-H embryology program?

Basic Statistical Data

_____ 1. How many eggs did you set?

_____ 2. How many hatched

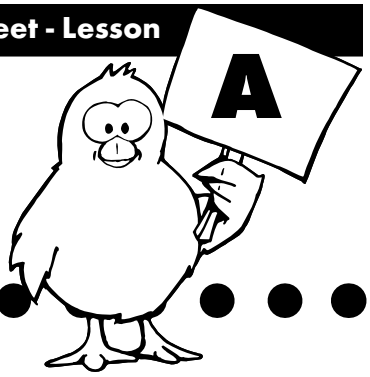
Yes No 3. Did you candle eggs on a regular basis?

Yes No 4. Did you use an additional water pan?

_____ 5. Did you hand turn or automatic turn eggs?

_____ 6. Egg source: (1) a commercial breeder farm, (2) a local producer, or (3) Virginia Tech

"Eggs-periment"



A Natural Wonder

Name _____

Shell

- Outer covering of the egg is composed of calcium carbonate.
- Color does not affect its quality, cooking characteristics, or nutritional value.

Shell membranes

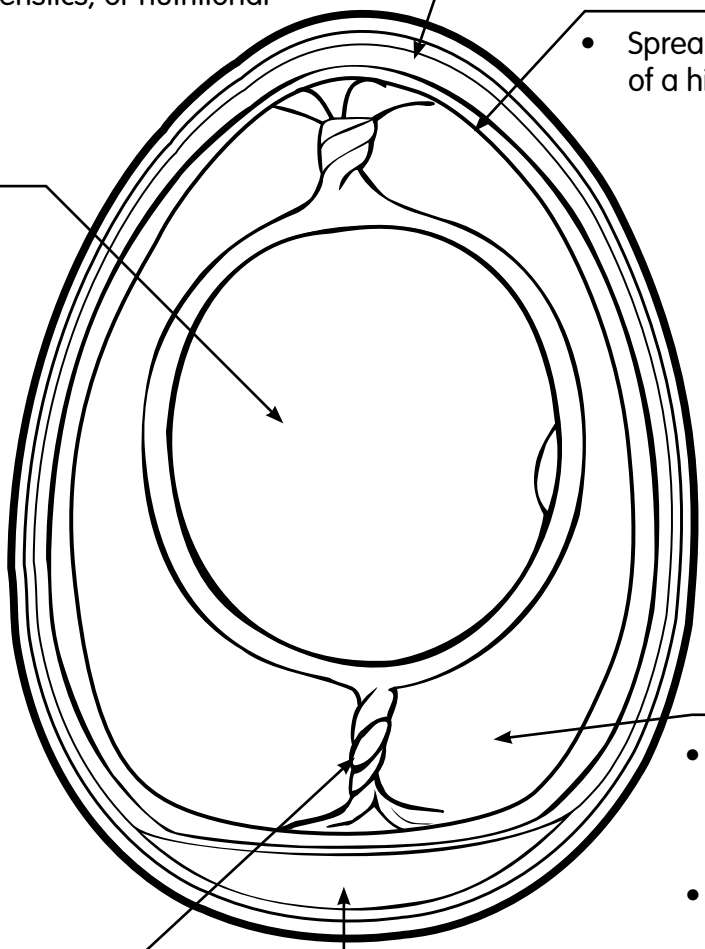
- Provide protective barrier against bacteria.

Thin albumen (white)

- Spreads around thick white of a high-quality egg.

Yolk

- Color varies with the hen's feed, but doesn't indicate nutritional content.
- Major source of vitamins, minerals, and fat.



Thick albumen (white)

- Excellent source of riboflavin and protein.
- Stands higher and spreads less than thin white in high-quality eggs.
- Thins and becomes indistinguishable from thin white in low-quality eggs.

Chalazae

- Indicator of quality.

Air cell

- Increases in size with age.

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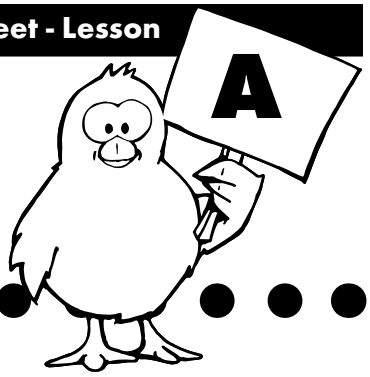


Answer Sheet

Answers for Lesson 1:

"Eggs-periment"

Observe a fresh, unbroken chicken egg

Can you tell if the egg is fertile or nonfertile? If so, how? Cannot tell in shell

Observe a broken-out chicken egg

2. Fat – Yolk Protein – Albumen Calcium – Shell

Answers for Lesson 2:

Incubation Quiz

1. incubator	4. humidity	7. warm	10. beak
2. thermostat	5. three	8. gently	
3. thermometer	6. 100˚F to 101˚F	9. sticking to the shell	

Pre-test/Post-test

1. False

2. Container with temperature control used to incubate eggs

3. 1) temperature 2) humidity 3) Turning (rotation) of the egg

4. 100˚F -101˚F

5. 3 times

6. Keeps the eggs from dehydration

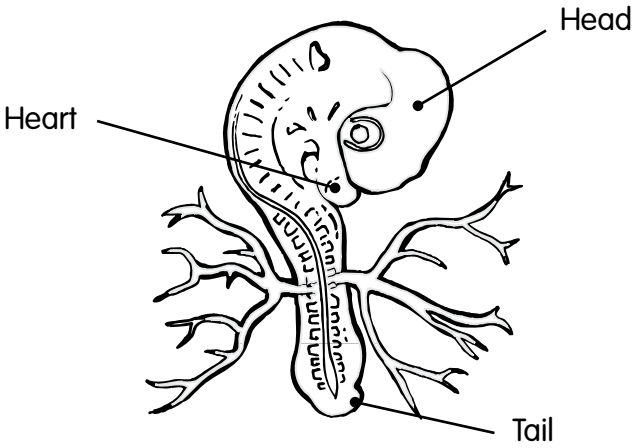
7. True

8. On their sides

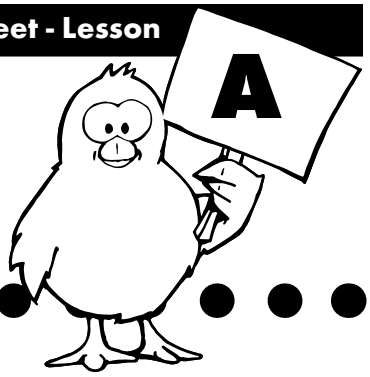
Answers for Lesson 3:

Beginning of Life

1. See illustration



Answer Sheet



3.	2	Blood vessels	6 or older	Leg
	2	Heart beating	13 or older	Fluff
	4 or older	Eye	9 or older	Egg tooth
	6 or older	beak		

4. 19 or older

5. Food

6. Mother's blood (placenta)

7. Provides protection plus an area to exercise

8. Break out of the shell

Answers for Lesson 4:

Home Sweet Home

1. toys	4. crow	7. lift	10. complete starter mash
2. feathers	5. hen	8. sleep	
3. sugar	6. slip	9. egg tooth	

Answers for Lesson 6:

Overall Program

Beginning of Life Pre-test/Post test

1. Yolk, Albumen, Germinal spot, Chalazae, Shell

2. 21 days

3. Large

4. False

5. 100˚F - 101˚F

6. 3-5 times

7. b. after it pips through the air cell

8. a. warmth/protection b. food c. water

9. Candling

10. head, heart, hands, and health

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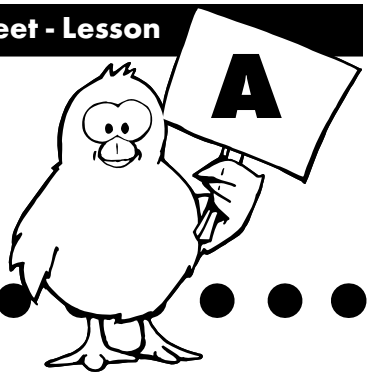
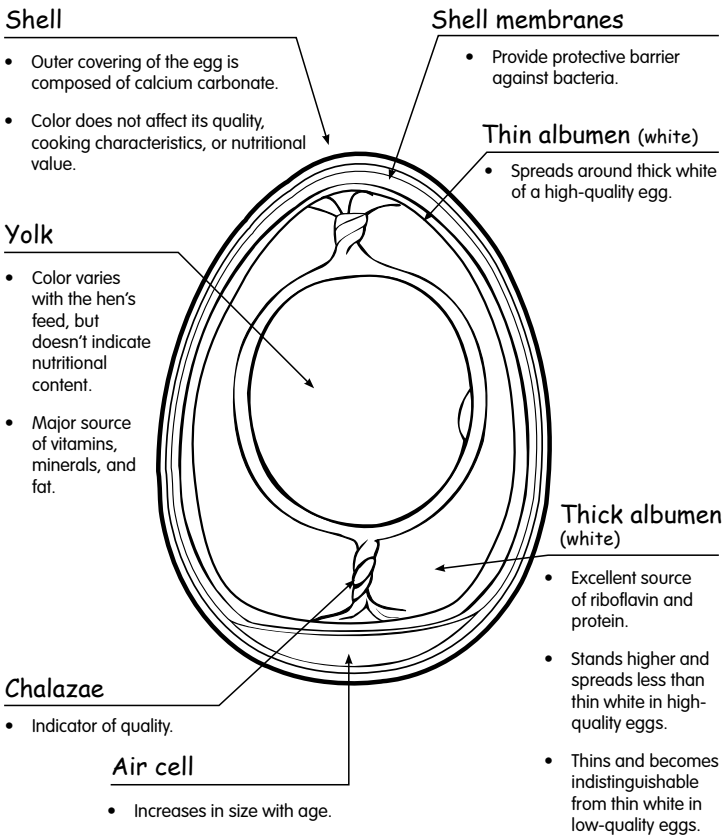


Answers to Beginning of Life Record Book Worksheet

I. Parts of the egg



2. An egg is an oval body from the ovary of the female that contains the germ cell for development of a new individual along with the food source for its development.

3. **Shell:** provides for protection, exchange of gases, supplies calcium for bones

   Germinal disc: is where fertilization occurs on yolk and where development of chick really begins.

   Yolk: the source of food during development.

   Albumen: is mainly water and provides moisture and a protein source for the egg.

4. **Shell:** provides pores for the exchange of oxygen and CO_2 as well as calcium for bone development.

   Yolk: provides fats, vitamins, and minerals for growth and development.

   White: provides the protein necessary for growth and development as well as liquid medium for development.

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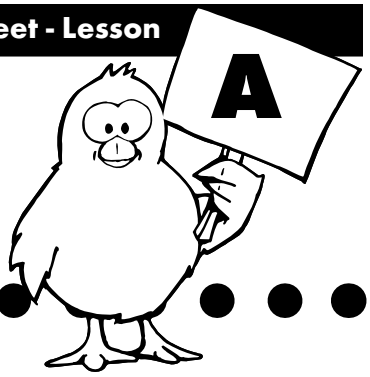
Answers to Beginning of Life Record Book Worksheet



II. Incubator and its operation

1. An incubator is a container that provides the controlled temperature and humidity that are necessary for the development of the chick. In nature the mother hen's body temperature and skin moisture provide the warmth and humidity. The mother hen also turns the egg when she is sitting on the nest.
2. 101˚F (for still air) 100˚F for forced air
3. Either extreme in temperature may cause the developing chicks to die or it may affect stages of development resulting in deformed and/or weak chicks
4. The water in the incubator is the source of the humidity (moisture in the air). Without proper humidity (water) the developing chick will adhere to the membranes and/or shell and die.
5. It is necessary to turn the eggs 3 times a day to keep the embryos from adhering to membranes. From day 18 on, it is no longer necessary to turn the eggs as the chicks are now turning inside the shells on their own.

III. Daily thermometer reading: self-explanatory

IV. Individual egg progress: self-explanatory

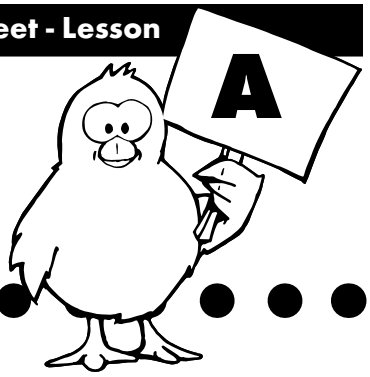
V. Important stages of development: self-explanatory

VI. Brooding of chicks

1. a (warm) b (fed) c (watered)
2. Self-explanatory
3. 95˚F
4. Too hot: they move away from the heat source, may pant, etc.
5. Too cold: huddle together in a pile, chirp loudly
6. Self-explanatory
7. Self-explanatory (look especially for changes in feathers)

VII. Project report: self-explanatory

Worksheet: Vocabulary Studies



Unscramble eggs!

1. egg
2. hen
3. yolk
4. hatch
5. shell
6. embryo
7. beak
8. chicken
9. incubator
10. wings
11. fertilized
12. temperature

Egg Crossword

Across

2. embryo
3. germinal disc
7. incubator
8. shell
9. brooder
13. rooster
14. allantois
15. calcium
16. chick

Down

1. fertilization
4. albumen
5. air cell
6. chalaza
10. egg
11.yolk
12. protein
17. hen

Word Sleuth

F	G	N	0	I	N	M	A	K	J	R	0	T	A	B	U	C	N	I
E	E	K	S	R	K	C	D	R	E	T	E	M	0	M	R	E	H	T
R	T	P	W	L	D	K	T	K	A	R	H	I	A	H	J	T	B	Z
T	C	M	0	L	E	L	N	A	L	B	U	M	E	N	Q	G	N	0
I	S	Y	L	N	0	S	B	N	S	I	H	U	J	D	K	R	Y	Y
L	I	S	W	Y	S	K	S	P	I	N	L	V	G	C	E	R	P	M
I	D	K	R	0	I	P	B	E	H	E	N	0	L	T	B	U	F	W
Z	L	P	A	L	0	A	K	I	V	H	T	F	S	M	S	R	C	A
A	A	N	Q	K	T	D	C	U	E	D	C	0	E	N	L	0	A	Z
T	N	B	V	S	N	C	I	M	B	Q	0	G	R	U	D	T	L	A
I	I	A	K	A	A	P	H	J	L	R	K	0	S	P	T	M	C	L
0	M	U	I	C	L	A	C	Q	L	M	P	E	L	L	E	S	I	A
N	R	R	0	F	L	B	A	R	E	D	0	0	R	B	I	P	U	H
C	E	Z	H	B	A	M	A	K	H	V	L	Q	D	T	R	0	M	C
A	G	C	H	0	R	I	0	N	S	0	A	I	R	C	E	L	L	K

Make it up!

Beak
Blood vessels
Brooder
Chick
Chicken
Comb
Crack
Development
Egg
Egg tooth
Embryo
feathers
Fertilizer
Fluff
Hatch
Hear
Hen
Incubator
Membrane
Peeps
Rooster
Sac
Shell
Temperature
Toes
Whites
Wings
Yolk

External anatomy of the rooster

S	E	L	K	C	I	S	T	A	I	L	C	0	V	E	R	T	S	A
A	A	G	R	K	U	D	A	C	G	I	J	N	D	S	H	0	F	D
D	P	D	E	P	P	0	I	N	T	S	0	F	C	0	M	B	L	E
W	S	K	D	E	J	G	L	F	U	M	P	U	I	T	J	A	U	C
I	F	T	L	L	0	T	H	I	G	H	0	W	R	R	L	C	F	U
N	G	H	U	P	E	G	K	D	A	A	I	F	K	H	G	I	F	H
G	E	R	0	I	A	H	Q	S	L	N	U	T	H	A	C	K	L	E
B	J	0	H	P	R	D	0	M	G	P	E	0	M	Q	L	N	C	W
0	I	A	S	T	L	T	R	C	I	V	D	0	P	K	E	A	P	K
W	D	T	F	S	0	K	0	M	K	A	E	B	T	F	L	H	M	B
K	C	E	N	A	B	V	T	I	P	N	0	M	R	U	P	S	P	0
W	H	I	J	E	E	K	C	E	N	N	K	B	H	W	F	T	R	L
0	C	B	A	R	I	N	A	M	0	B	S	E	L	T	T	A	W	N
L	S	R	T	B	M	H	P	D	T	F	H	C	0	J	Q	G	U	K
B	M	0	C	C	D	A	E	Y	E	A	R	B	S	K	D	A	E	H

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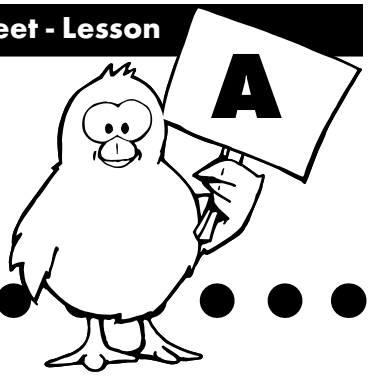
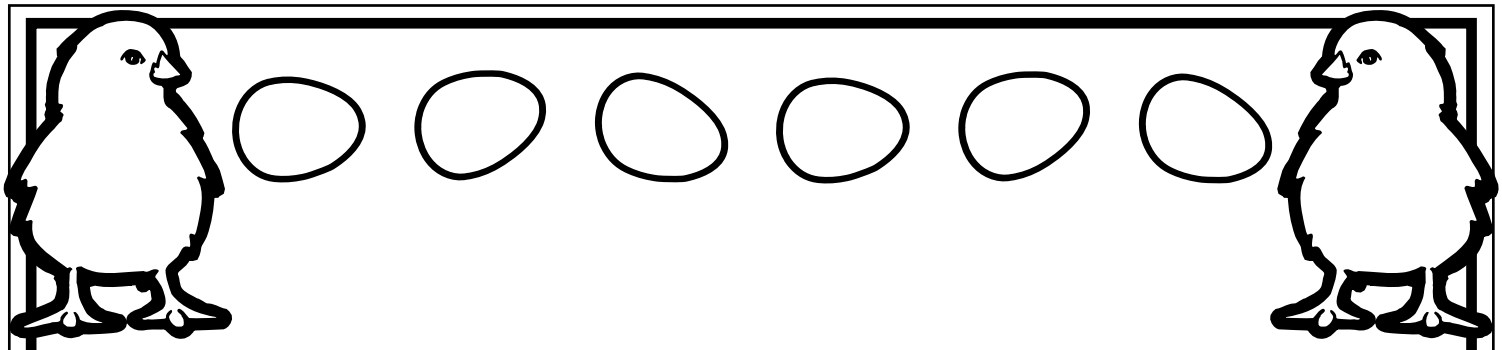
Worksheet: Vocabulary Studies



Worksheet: Math Studies

10	121	11	97	429
+ 17	- 18	x 6	+ 63	- 104
27	103	66	160	325
72	19		14	253
- 13	+ 18	14	x 7	+ 132
59	37	$6\overline{)184}$	98	385

Word problems: 1. (9) 2. (25) 3. (17) 4. (12) 5.(3) 6. (12)



Awarded To

_____

For

"Egg-cellent" Work

on

_____

by

_____