National 4-H Curriculum
BU-07595

Embryology IN THE CLASSROOM

Hatching Classroom Projects

Helper's Guide

Beginner

Grades 2-5

REVIEWED & RECOMMENDED
National 4-H Curriculum

Dear Educator,

*Embryology: Hatching Classroom Project*s designed to provide you with background information and exciting experiential activities dealing with life science for use in your classroom. Each activity is designed to be grade-level appropriate and has been correlated to U.S. National Science Education Standards.

Children have a natural sense of curiosity about living things in the world around them. Building on this curiosity, students can develop an understanding of biology through direct experience with living things, their life cycles and their habitats. This curriculum was developed with your students in mind. Many believe students learn best by interacting with the world—by listening, observing, experimenting and applying their knowledge to real-world situations. Each activity within this curriculum follows these steps in the experiential learning model.

An additional goal of this curriculum is to help students develop life skills. Life skills help an individual live a productive and satisfying life. Within this curriculum your students will have the opportunity to develop life skills related to science processes, managing, thinking, working, relating and living a healthy lifestyle.

We hope that *Embryology: Hatching Classroom Projects* is an enjoyable experience for both you and your students as well as a beneficial unit in your life science curriculum. Here are a few quotes from kids who worked with our pilot:

The best part of learning about chickens and embryos was...

"Watching the eggs hatch and getting to play with the little chicks."

"Seeing the cute little chicks after they had hatched."

"Seeing how the embryos develop inside the shells. I also liked watching the chicks get their first white feathers and see them grow."

"It was fun the whole time."

"The best part was seeing how the chick hatched. It was cool how it pecked its way around the shell."

"The best thing was when they hatched. It was really exciting. I also liked learning about hatching eggs. I learned so much that I didn't know before."

Acknowledgements

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Hatching Classroom Projects

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Embryology and the National Science Standards

A classroom unit in embryology will help you meet the following National Science Standards:

Abilities necessary to conduct scientific inquiry

Ask questions about objects, organisms and events in the environment.

Plan and conduct a simple investigation.

Use simple equipment and tools to gather data.

Use data to construct a reasonable explanation.

Communicate investigations and explanations.

The characteristics of organisms

Organisms have basic needs. Organisms can survive only in environments in which their needs can be met.

Each animal has different structures that serve different functions in growth, survival and reproduction.

The behavior of individual organisms is influenced by internal cues and by external cues.

Life cycles of organisms

Animals have life cycles including birth, maturation, reproduction and death.

Animals closely resemble their parents.

Organisms and their environments

All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.

An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food, resources and the physical characteristics of the environment.

Abilities of technological design

Identify a simple problem.

Propose a solution.

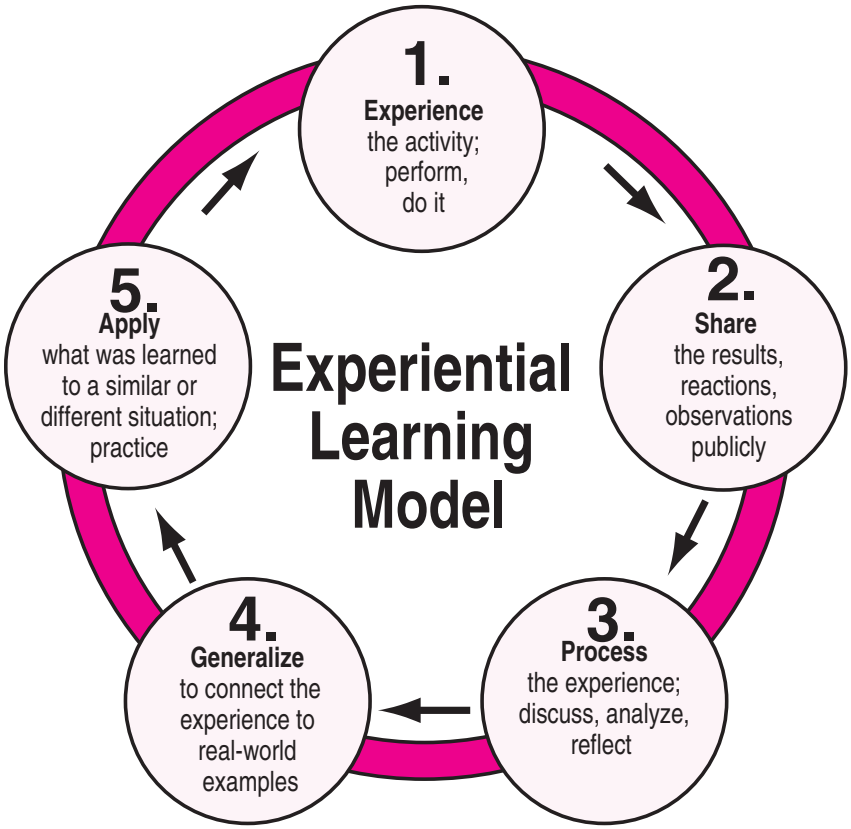
Implement proposed solutions.

Evaluate a product or design.

Communicate a problem, design and solution.

Experiential learning model

Experiential learning means having students do hands-on activities, reflect on the meaning and apply what they learned. This process helps ensure that the students learn actively and make knowledge a part of their world. It also helps students answer questions such as “Why should I learn this?” and “Now that I know this, what do I do next?”



Pfeiffer and Jones' Model

Providing an experience alone does not create “experiential learning.” The activity comes first. The learning comes from the thoughts and ideas created as a result of the experience. This is a “learn by doing” or experiential process. Addressing each step in the process assures a purposeful plan to obtain a specific goal.

Experience

The model begins with experience, action. This immediately focuses the attention on the learner rather than the teacher. This requires active co-operation from the learner, coupled with guidance from the teacher to help maintain the learner’s curiosity. Teaching becomes a cooperative enterprise.

Share

Sharing is simply asking the group or individuals, What did you do? What happened? What did it feel like to do (whatever)? This step should generate lots of information to lead to the process step.

Process

The questions and discussion now become more focused on what was most important about the experience. Common themes that emerge from the sharing session are explored further. Often the key teaching points related to the subject matter are discussed.

Generalize

In this step the experience is related to a real-world example. This step helps the student to answer the questions, Why should I learn this? What did the experience mean to me personally? To my everyday life? Subject matter and life skill development can be discussed in this step. For example, if you hope that the activity helps students develop teamwork skills, then questions about teamwork would be appropriate.

Apply

This step helps the student answer the question, Now that I know this, what do I do next? Can students express what they learned? Can they use what they learned? Can the student actually apply the learning to a new situation?

Life skill development

A skill is a learned ability to do something well. Life skills are abilities we can learn that will help us to be successful in living a productive and satisfying life. The following is a list of skills that students will develop through experiencing the activities within this curriculum. Also included is a set of criteria that can act as indicators to determine if the life skill is being developed.

Planning and organizing – A method for doing something that has been thought out ahead of time; how the parts can be put together.

Indicator:
Student can develop a part of a plan.

Keeping records – Recording selected useful information, usually focused for a specific purpose.

Indicator:
Student is able to categorize information and select useful information.

Teamwork – Work done by two or more people, each doing parts of the whole task. Teamwork involves communicating effectively, identifying and agreeing on a common task, dividing a task by identifying contributions by each person, accepting responsibility for one's part of the task, working together to complete the task and sharing accomplishment.

Indicator:
Understands roles as essential and enjoys working together with others of similar interests/abilities.

Science skill

These skills represent the scientific thinking and process skills that are essential to scientific inquiry. An inquiry based science classroom uses and encourages the use of these skills in science activities.

Observing – Generating reasonable questions about the world based on observation.

Examples:
Seeing, hearing, tasting, smelling and feeling.

Comparing and measuring – Using simple measurement tools to provide consistency in an investigation.

Examples:
Sensory observations, weight, quantity, quality, temperature and capacity.

Relating – Developing solutions to unfamiliar problems through reasoning, observation and experimentation.

Examples:
Asking questions, making a hypothesis, understanding relationships, designing and conducting simple investigations, identifying the control and variables in an investigation.

Poultry incubation

The Activities	Embryology Skill	Life Skill	Science Skill
Eggsploring the egg Page 14	Identifying parts of eggs	Learning to learn	Observing
Pick a chick Page 16	Selecting chicken breeds by characteristics	Communication and decision making	Categorizing
Warming up with eggs Page 18	Incubation of fertile eggs	Planning and organizing	Observing
Building an eggs-ray viewer Page 20	Preparing a candler	Relating to others, cooperation	Comparing and measuring
Playing peek-a-boo with embryos Page 22	Observation of embryos	Record keeping	Observing, communicating, relating
Building a home ‘tweet home Page 24	Preparing a brooder	Planning and organizing	Comparing and measuring
Counting the chicks Page 26	Connecting embryology and math	Record keeping	Comparing and measuring
Caring and handling Page 28	Handling chicks safely	Relating to others	Observing and communicating
Eggsploring careers Page 30	Exploring careers in the poultry industry	Developing teamwork	None

Planning and scheduling checklist

Planning is crucial to the success of an embryology project.
Use this section as a checklist to help you plan the project activities.
As you complete each part check it off so you know what has been finished.
Other important details to assist you with this project follow this checklist.

One to six months before you plan to start the project

- ☐ Plan the exact dates during which you wish to do this project.

  Dates of the embryology project:

  _____ to _____ .

- ☐ Before you order eggs, decide what you will do with the chicks that hatch. Contact a farmer, zoo or other animal caretakers who are equipped to properly care for the chicks.

  The chicks will be placed with

  _____.

- ☐ To insure egg availability, order the eggs at least one to three months in advance of the day you plan to set them.
- ☐ Secure an incubator at least a month before the start of the project and be sure it works properly.
- ☐ Read the lesson plan and secure any materials you will need at least a month before the project begins.

Starting the project

- ☐ Set up the incubator in a safe area and start running it 48 hours before eggs are to arrive.
- ☐ Prepare the students a few days before the project begins. Help them understand the principles of incubation and embryology. Discuss what the class wishes to accomplish and what role they will play in reaching the goals of the project. This includes preparing calendars and other project resources.
- ☐ If your class plans to incubate eggs, prepare the eggs for incubation.
- ☐ Turn the eggs three 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, candling, and other activities). These records are extremely helpful for trouble-shooting causes of poor hatches.
- ☐ Candle the eggs every three days to check progress.
- ☐ Stop turning eggs three days (after 18 days for chicken eggs) prior to expected hatch.
- ☐ Prepare brooder box at least two days prior to expected hatch.
- ☐ Remove the chicks from the incubator and place them in a warm brooder within two to six hours after they hatch.
- ☐ Remove and discard all remaining unhatched eggs 60 hours after the first chick hatches, then disconnect incubator power.
- ☐ Clean and disinfect the incubator as soon as the power is disconnected.
- ☐ Let the incubator dry. Then store it in a safe, cool and dry place.

Background for a successful project

Important procedures to consider

A. Plan the exact dates for your project. Many teachers use this material as a supplement to a specific curriculum like biology, human sexuality, human development or other related topics. It is extremely important that you understand that this is a continuous project for at least a 25-day period. Plan the project around holidays and testing periods. It is usually best to plan to set your eggs on a Tuesday. This allows you to prepare on Monday and insures that the chicks will not hatch on a weekend.

B. To prevent bacterial contamination, make sure that all students and teachers wash their hands after handling the eggs, raw egg products, incubated eggs, chicks and litter.

C. Before you order eggs, plan what you will do with the chicks that hatch. Contact a farmer, zoo or other animal caretakers who are equipped to care for the chicks properly. **NEVER** allow chicks to go home with students from your class. It is your responsibility to make sure that the chicks get a good home.

About the eggs

A. Obtaining fertile hatching eggs. Locating fertile eggs may present a problem, especially in an urban area. Most eggs sold in grocery stores are not fertile and cannot be used for incubation. Fertile eggs can usually be obtained from hatcheries or poultry breeding farms. Large hospitals may also be able to provide them. Contact your local Extension office for suggestions.

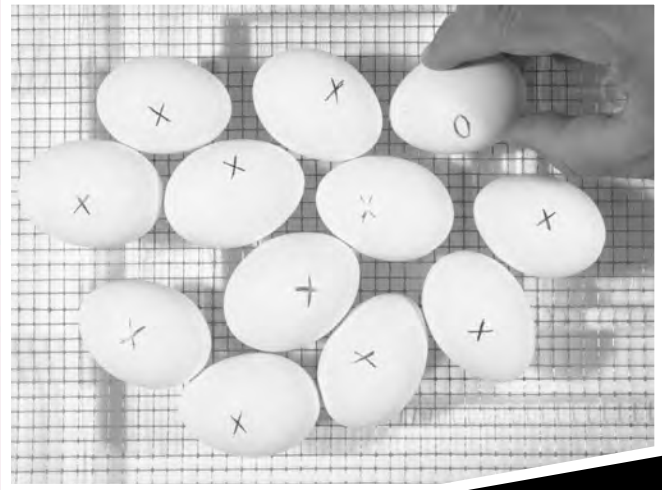
1. For a basic observation and hatching project, 12 eggs per incubator are adequate. If you are planning to do an experiment or activities, additional eggs may be required.
2. When you obtain fertile eggs from a source that does not routinely hatch its own eggs, you may want to test the eggs in an incubator to ensure that good fertility and hatchability can be obtained before you use the eggs as part of the class project. The presence of a male with a laying hen does not guarantee fertility or hatchability. You are also *strongly* encouraged to use chicken or coturnix quail eggs to hatch in the classroom. Duck, goose, pheasant and other species of fowl can be more difficult to hatch in classroom incubators. Duck and goose eggs often rot and may explode in the incubator.
3. When you have located a source of fertile eggs, pick them up yourself, if possible, rather than have them shipped or mailed. It is difficult for hatcheries, the postal service and transportation companies to properly handle small orders of eggs.

B. Caring for eggs prior to incubation. Timing, temperature and position are critical to safe storage.

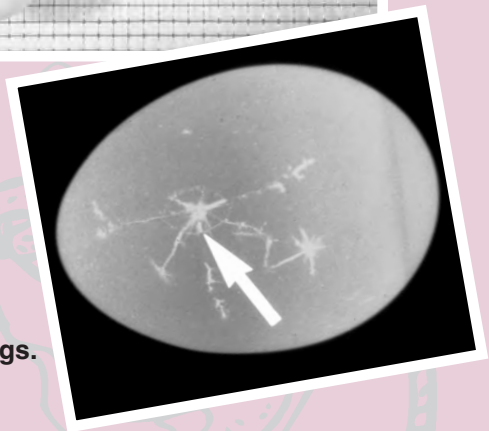
1. The eggs should be collected within four hours after they are laid.
2. If it is necessary to store fertile eggs before setting, store small end down at a temperature between 50 and 65°F and at 70 percent humidity.
3. Never store eggs more than 10 days after the eggs are laid. Hatchability drops quickly if they are stored for more than 10 days.
4. Transport fertile eggs in a protective carton, small end down. Do not leave eggs in the sun or a hot car. In winter, don't let the eggs get below 35°F.
5. It is always best to set the fertile eggs in a heated incubator within 24 hours of obtaining them.

C. **Preparing the eggs for incubating.** Fertile eggs from a commercial hatchery are usually already presorted. However, it is usually wise to check your eggs before setting them.

1. Candle eggs prior to setting to check for cracked eggs, thin-shelled eggs and double-yolked eggs. Do not incubate these eggs since they usually do not hatch.
2. Do not wash the eggs unless necessary. The eggs have a natural protective coating that is removed by washing. Only wash eggs that are visibly dirty. Then wipe the egg clean with a wet cloth warmer (at least 10 degrees warmer) than the temperature on the eggs. Do not set eggs that are excessively dirty.
3. Bring fresh eggs to be placed in the incubator to room temperature two hours prior to setting.
4. Mark the eggs with "X" and "O" on opposite sides to aid in daily turning. Also, number the eggs on the top of the large end to aid in identification and record keeping during the project. When marking eggs always use a pencil or wax crayon. Do not use permanent or toxic ink pens or markers.
5. Eggs that are warmed to room temperature should be immediately placed in the incubator.



Setting eggs that are marked with X's and O's.



Do not set cracked eggs.

About the incubator and incubation

A. Secure an incubator and make sure it is in good working order. You may choose a new or used incubator.

1. If buying a **new incubator**, order at least one month prior to the start of the project. Forced air incubators (with a fan to circulate the air) are best. Once the new incubator arrives, assemble if necessary and follow instructions for operation.
2. **Used incubators** should be checked one month prior to the start of the project. Make sure your equipment is clean and working correctly. This will allow you time to order parts or a new incubator if necessary.

B. Turn the incubator on a couple of weeks before the project starts and run it for 48 hours to insure that everything is working properly. Once you know it is in proper working order, unplug and set in a safe area until a few days before the start of the project.

C. Inform the administration and maintenance staff that you are doing this project and ask them to tell you if the electricity needs to be shut off for any reason.

D. Proper incubator placement in the classroom helps avoid problems.

1. Set up the incubator in a room that stays above 65°F.
2. Make sure the electrical outlet that you are using will be "on" 24 hours a day. Some schools turn off entire sections of the school at night and on weekends.
3. Place the incubator on a sturdy level surface.
4. Place the incubator at least six inches away from the edge of the surface to avoid accidental bumps.
5. Avoid high traffic areas, hot sunny windows, heating and cooling vents, drafty windows and doors.

E. Turn incubator on 36 to 48 hours prior to setting the eggs.

1. Adjust the incubator so it holds the desired temperature. Follow manufacturer guidelines for adjusting the temperature. In still-air units (without fans) adjust the temperature to 101°F. In forced-air units (with fans), adjust the temperature to 100°F. Always adjust the thermostat so the heat source goes off when the temperature reaches the desired temperature and comes on when the temperature drops below the desired temperature.
2. Use at least two thermometers to insure you are getting an accurate temperature reading.
3. Check the temperature often. Improper temperature can result in a poor hatch and weak chicks.

During incubation

A. Turn the eggs three times daily. Stop turning eggs three days (after 18 days for chicken eggs) prior to expected hatch. Remember to wash hands.

B. Keep water pans full at all times. Always add water that is warm to the touch. It is best to add the water when you open the incubator to turn the eggs.

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

D. Candle the eggs every three days to check progress.

E. Stop turning eggs three days (after 18 days for chicken eggs) prior to expected hatch.

F. Never help the chicks from the shell.

G. Remove the chicks from the incubator and place them in a warm brooder within two to six hours after they hatch. If your incubator has good levels of humidity the chicks may not dry in the incubator. They will dry once moved to the brooder.

H. Remove and discard all remaining unhatched eggs 60 hours after the first chick hatches, then disconnect incubator power.

I. Clean and disinfect the incubator as soon as the power is disconnected. Once the dirt has dried to the surface, it becomes difficult to remove.

J. Let the incubator dry. Then store it in a safe, cool and dry place.

Brooding the chicks

A. Make sure the brooder box is working 2 to 4 days prior to hatch.

B. Brooders should maintain a temperature of 92 to 95°F (taken at one inch above the floor level, the height of the chick's back) during the first week. If you keep the chick beyond the first week, decrease the temperature 5°F per week until room temperature is reached.

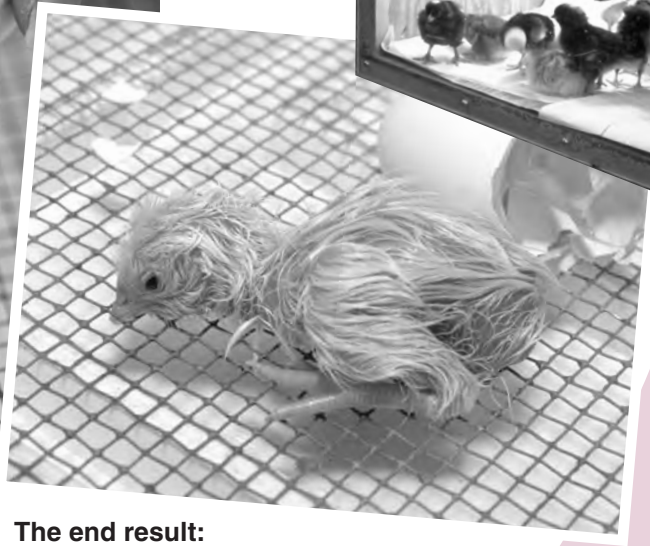
C. The brooder should have textured, absorbent litter on the floor. If the floor is slippery, the chicks can damage their legs. Pine or cedar shaving or textured paper towel work best in the classroom.

D. Feed 18 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-sized cans or a commercial chick feeder.

E. Water should be available at all times. Use watering equipment that will not allow the chick to get into the water and drown. Commercially made water fountains for use with a quart jar work best. If you need to use a watering device that is not proven, it is recommended that you place clean marbles or gravel in the water so the chicks can drink between them but not get into the water and drown.

F. 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.

Turn egg three times daily until the 18th day.



The end result:
A newly hatched chick.

The reproductive system and fertilization

The rooster

The male fowl has two testes along its back. These never descend into an external scrotum, as do those of other farm animals. A testis consists of a large number of very slender, convoluted ducts. The linings of these ducts give off sperm. The ducts eventually lead to the ductus deferens, a tube that conducts the sperm to a small papilla. Together, the two papilla serve as an intermittent organ. They are on the rear wall of the cloaca.

The rooster responds to light in the same way as the hen. Increasing day length causes the pituitary to release hormones. These, in turn, cause enlargement of the testes, androgen secretion and semen production, which stimulates mating behavior.

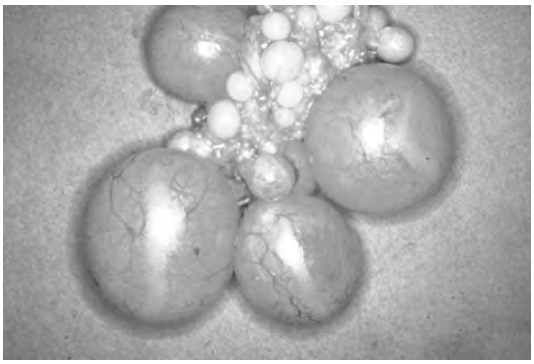


Figure 7 – Ovary

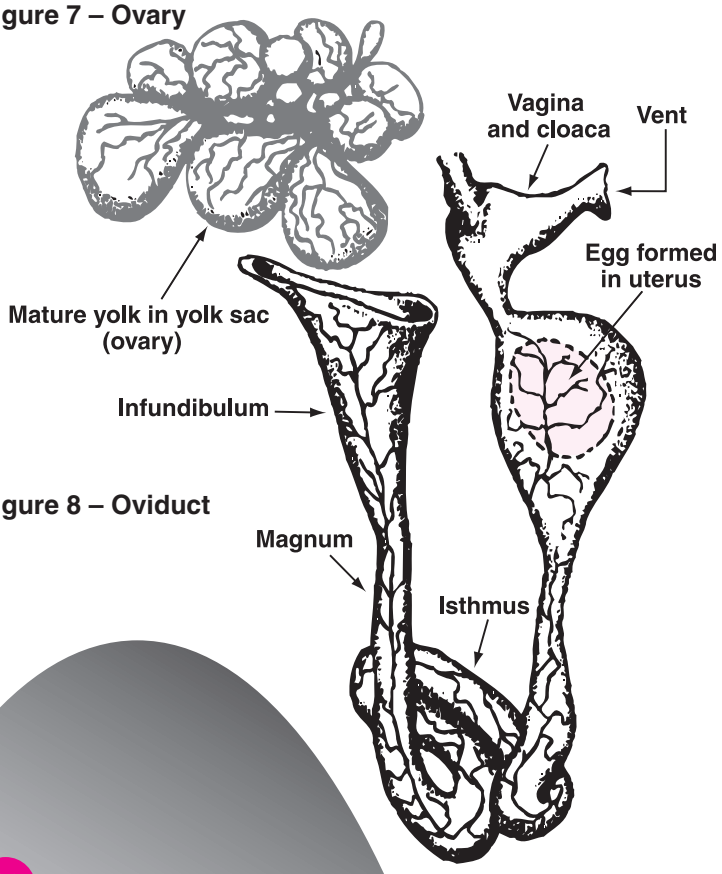


Figure 8 – Oviduct

The hen

The reproductive system of the female chicken is in two parts: the ovary and oviduct. Unlike most female animals, which have two 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 chick 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. **(Figure 7)**

The oviduct is a tube-like organ lying along the backbone between the ovary and the tail. In a mature hen, it is about 25 to 27 inches long. The yolk is completely formed in the ovary. When a yolk is fully developed, its follicle ruptures at the stigma line, releasing it from the ovary. It then enters the infundibulum, the entrance of the oviduct **(Figure 8)**.

The other parts of the egg are added to the yolk as it passes through the oviduct. The chalazae, albumen, shell membranes and shell then form around the yolk to make the complete egg, which is then laid. This complete cycle usually takes from 23 to 32 hours. About 20 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 there	Function of part
Infundibulum	2 in.	15 min.	Picks up yolk, egg fertilized
Magnum	13 in.	3 hr.	40–50% of white laid down, thick albumen
Isthmus	4 in.	1¼ hr.	10% albumen shell membrane laid down, shape of egg determined
Uterus	4.2 in.	20¾ hr.	40% of albumen, shell formed, pigment of cuticle laid down
Vagina and cloaca	4 in.	—	Egg passes through as it is laid

How eggs are fertilized

Each gender, the rooster and the hen, contributes something to the egg. The rooster provides sperm; the hen provides an ovum. When a rooster mates with a hen, it deposits sperm in the end of the oviduct. These sperm, containing male germ cells, travel the length of the oviduct and are stored in the infundibulum. On the surface of every egg yolk there can be seen a tiny, whitish spot called the blastodisc. This contains a single female cell. If sperm is present when a yolk enters the infundibulum, a single sperm penetrates the blastodisc, fertilizing it and causing it to become a blastoderm. Technically, the blastoderm is the true egg. Shortly after fertilization, the blastoderm begins to divide into two, four, eight and more cells. The first stages of embryonic development have begun and continue until the egg is laid. Development then subsides until the egg is incubated. The joining of sperm and ovum is called fertilization. After fertilization, the egg can develop and become a chick.

The rooster must be present for an egg to be fertilized. Supermarket eggs are from hens that are raised without a rooster. Roosters are not necessary at farms where eggs are produced for people to consume. Eggs for incubation are grown at special farms called breeder farms where roosters are with the hens.

Development during incubation

As soon as the egg is heated and begins incubation, the cluster of cells in the blastoderm begins to multiply by successive divisions. The first cells formed are 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 grouping or layer. These cell groupings are called the ectoderm, mesoderm and endoderm. These three layers of cells constitute the materials out of which the various organs and systems of the body develop.

From the **ectoderm**, the skin, feathers, beak, claws, nervous system, lens and retina of the eye, linings of the mouth and vent develop. The **mesoderm** develops into the bone, muscle, blood, 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 physiological processes take place during the transformation of the embryo from egg to chick. These processes are respiration, excretion, nutrition and protection.

For the embryo to develop without being connected 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.

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 food for the embryo. As embryonic development continues, the yolk sac is engulfed within the embryo and completely reabsorbed at hatching. At this time, enough nutritive material remains to feed the chick for up to three days.

The **amnion** is a transparent sac filled with colorless fluid that serves as a protective cushion during embryonic development. This amniotic fluid also permits the developing embryo to exercise. Specialized muscles developed in the amnion gently agitate the amniotic fluid. The movement keeps the growing parts free from one another, preventing adhesions and malformations.

The **chorion** contains the amnion and yolk sac. Initially, the chorion has no apparent function, but later the allantois fuses with it to form the choric-allantoic membrane. This enables the capillaries of the allantois to touch the shell membrane, allowing calcium reabsorption from the shell.

The **allantois** membrane has many functions. It:

- serves as an embryonic respiratory organ
- receives the excretions of the embryonic kidneys
- absorbs albumen, which serves as nutriment (protein) for the embryo
- 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 closest portion remains within the embryo throughout the development.

Daily embryonic development

Before egg laying

- Fertilization.
- Division and growth of living cells.
- Segregation of cells into groups with special functions.

Between laying and incubation

- Very little growth; inactive stage of embryonic life.

During incubation

Day 1

Major developments visible under microscope:

18 hours — Appearance of alimentary tract.

19 hours — Beginning of brain crease.

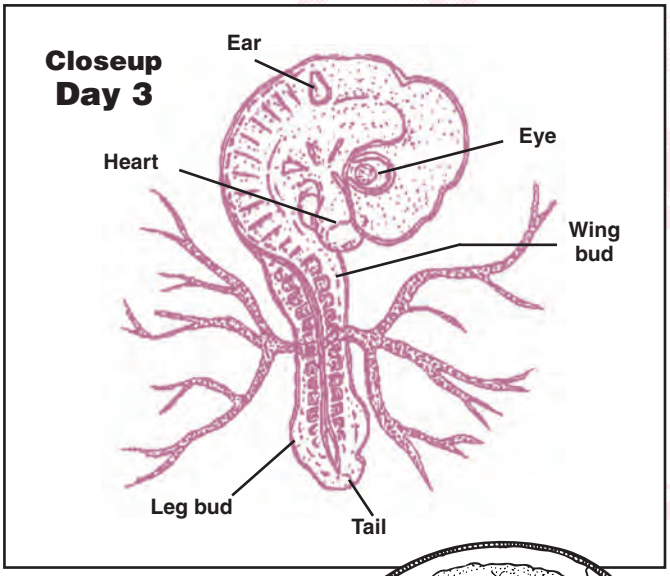
20 hours — Appearance of vertebral column.

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 2

24 hours — Embryo begins to turn on left side.

24 hours — Blood vessels appear in the yolk sac.

24 hours — 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 the heart, which starts to beat.

35 hours — Beginning of formation of ear pits.

36 hours — First sign of amnion.

46 hours — Formation of throat.

Day 3 (see figure)

Beginning of formation of beak, wings, legs and allantois.

Amnion completely surrounds embryo.

Day 4 (see figure)

Beginning of formation of tongue.

Embryo completely separates from yolk sac and turns on left side.

Allantois breaks through amnion.

Day 5

Proventriculus and gizzard formed.

Formulation of reproductive organs — sex division.

Day 6 (see figure)

Beak and egg tooth begin to form.

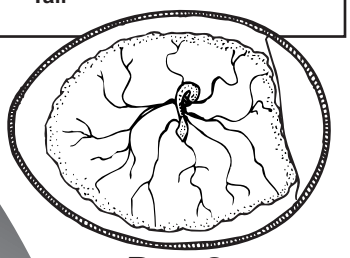
Main division of legs and wings.

Voluntary movement begins.

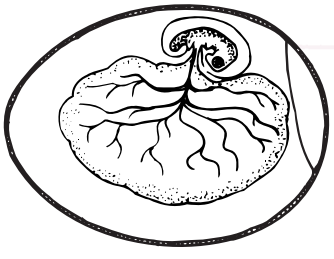
Day 7

Digits on legs and wings become visible.

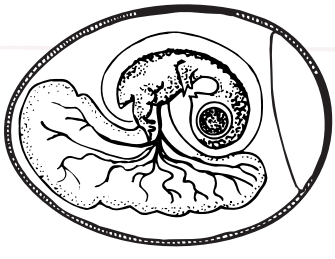
Abdomen becomes more prominent due to development of viscera.



Day 3



Day 6



Day 9

Day 8

Feathers begin to form.

Day 9 (see figure)

Embryo begins to look bird-like.

Mouth opening appears.

Day 10

Beak starts to harden.

Skin pores visible to naked eye.

Digits completely separated.

Day 11

Days 10 to 12 tend to run together. No different changes visible on these days.

Day 12 (see figure)

Toes fully formed.

Down feathers visible.

Day 13

Scales and claws become visible.

Body fairly well covered with feathers.

Day 14

Embryo turns its head toward blunt end of egg.

Day 15

Small intestines taken into body.

Day 16

Scales, claws and beak becoming firm and horny.

Embryo fully covered with feathers.

Albumen nearly gone and yolk increasingly important as nutrient.

Day 17

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

Day 18 (see figure)

Growth of embryo nearly complete.

Day 19

Yolk sac draws into body cavity through umbilicus.

Embryo occupies most of space within egg except air cell.

Day 20 (see figure)

Yolk sac completely draws into body cavity

Embryo becomes chick, breaks amnion and starts breathing air in air cell.

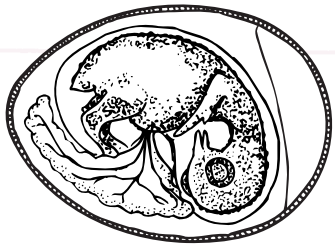
Allantois ceases to function and starts to dry up.

Day 21

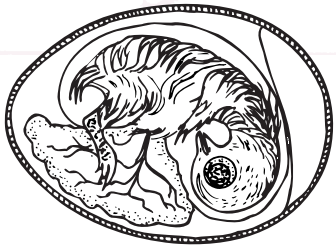
Chick hatches.

Although used only to break through the shell, the egg tooth serves its critical purpose well.

Coturnix (Japanese) quail	16–18 days
Chicken	21 days
Pheasants	24–26 days
Ducks	28 days
Geese	28 days
Guinea	28 days
Turkey	28 days
Swan	35 days
Muscovy duck	35 days
Ostrich	42 days



Day 12



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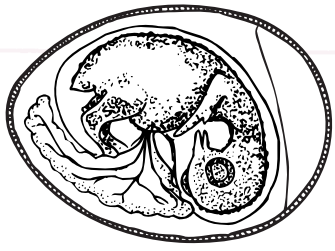
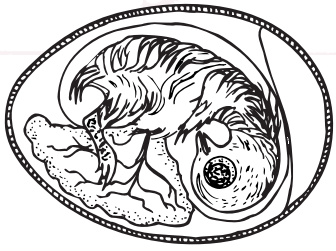


Day 12



Day 15

Day 18

Day 20

Eggsploring the egg

Embryology skill:
Identifying parts of eggs

Life skill:
Learning to learn

Science skill:
Observing

School subjects supported:
Biology

Preparation time:
20 minutes

Activity time:
20 minutes

What you need:
- ☐ Eggs
- ☐ Copies of Student Activity Sheet "Eggsploring Parts" (page 36)
- ☐ Plates
- ☐ Two glasses or bowls
- ☐ Vinegar
- ☐ Water
- ☐ Receptacle for eggs after the activity

Introduction

Have you ever wondered how the parts of an egg stay separate until you are ready to scramble them for breakfast? Or why there is that stringy thing in the white of an egg?

In this activity, you will learn the parts of the egg and what each part does. Listen carefully, and by the time you are finished, you will be an "eggspert."

Get ready

When buying eggs, allow extra eggs for each group; students may damage eggs they are using before completing all of the activities. If you don't mind a little extra clean-up, let the students break their own eggs. If you want to avoid the mess, break them a few minutes beforehand and put them into plates. (If you break eggs too early, they dry up.)

For the last part of the activity, prepare eggs in vinegar a few days before the class by putting them in bowls or glasses and completely immerse them in vinegar. Allow the eggs to soak in the vinegar solution for up to two days. The shells should dissolve completely. Once the shells dissolve, carefully remove the eggs from the vinegar and place them in a bowl of water.

Do it

1. Allow the class to break up into small groups of three to five students. Each group should have a plate and an egg.
2. Make sure that after handling the raw eggs all students wash their hands to prevent bacterial contamination.
3. In this activity, students are asked to identify parts of an egg using the definitions. Allow time for the students to experiment with finding the structures and complete the "Eggsploring the Parts" sheet *(see activity on page 36)* on their own. Should they need help in locating specific structures, try to ask questions like:
   - *Where would you expect to find the inner thick albumen?*
   - *What might its relationship to the yolk be?*
   - *How might you be able to separate the inner and outer albumen?*
   - *Where would you find the air cell in the eggshell?*
   - *How does each part aid the developing embryo?*
4. Show each group the egg that has been in vinegar so that the students can see the shell membranes.

Break Out

From a local farm, obtain eggs of different shapes, colors, sizes, with calcium deposits, and with meat and blood spots. Ask the class to examine the eggs, find the differences, learn why the variations occur, and why they normally don't see them in the store.

Talk it over

Share

- What new parts did you learn?
- Why is it necessary to wash your hands after working with raw eggs?

Process

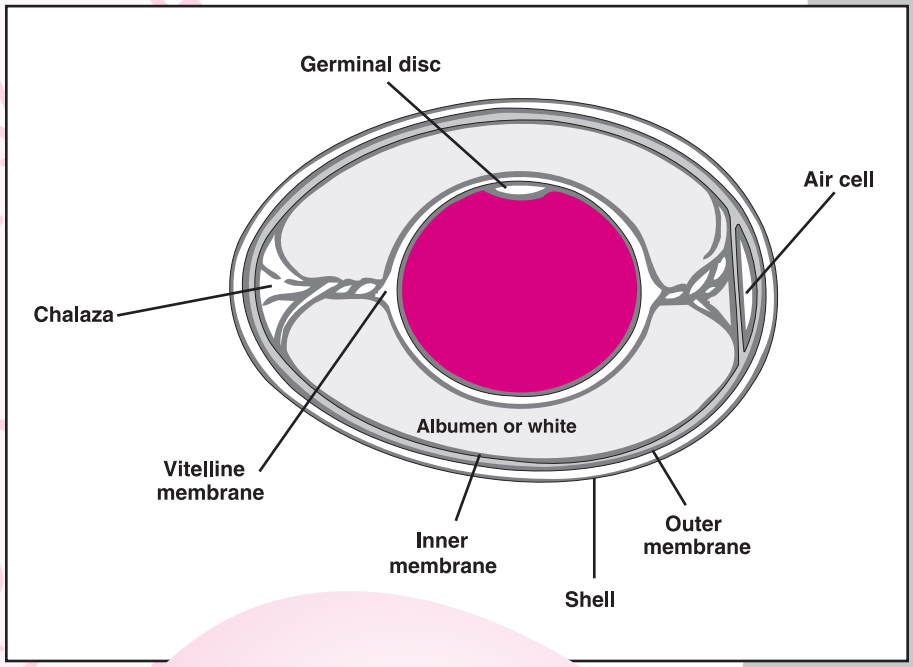
- How is each part of the egg important to the development of the embryo?
- What will you do differently the next time you identify egg parts? Why?
- How did the real egg help or hinder learning the parts?

Generalize

- What other ways do you like to learn parts of items? Why?

Apply

- How will your understanding of egg parts affect your use of eggs in the future?



CONSIDER this

- The 1999 estimate for eggs produced were 192.5 million cases.
- The top 10 egg-producing states are:
  1. Ohio
  2. Iowa
  3. California
  4. Indiana
  5. Pennsylvania
  6. Texas
  7. Minnesota
  8. Georgia
  9. Nebraska
  10. Florida

- *Can your students find the states listed above?*

Other questions you may ask.

- *How might you learn this information in a different way?*
- *What senses did you use? When have you used your senses to learn before?*

Evaluate it

- ☐ *Can students identify the parts of the egg?*
- ☐ *Can students tell how the parts contribute to embryo development?*

ON THE W.W.W.

Visit the AEB Web site at: www.aeb.org

Obtain the record for egg production in one year and the number of eggs that the average consumer uses each year.

Pick a chick

Embryology skill:
Selecting chicken breeds by characteristics

Life skill:
Communicating and decision-making

Science skill:
Categorizing

Preparation time:
One hour

Obtain pictures of chicken breeds and place them in an egg carton. Pictures may be obtained by purchasing the UW-Madison Extension Service's *Chicken Breeds & Varieties*, searching for hatcheries or breeds on the Web or asking hatcheries for old catalogs.

Activity time:
One class period

What you need:
- ☐ Paper
- ☐ Scissors
- ☐ Egg cartons
- ☐ Poultry hatchery catalogs
- ☐ Publication: *Chicken Breeds & Varieties*
- ☐ Copies of Student Activity Sheet "Chick Breed Maker Notebook" (page 37)

Introduction

If you've seen one chicken, you've seen them all, right? Wrong. Actually, chickens, like many domesticated (tame) animals, are grouped by certain breeds and characteristics. Just as a Dalmatian is different from a Saint Bernard, a Rhode Island Red chicken is different from a Buff Cochin. In this unit, your students will learn how chickens are classified and how to identify the group in which they belong.

Get ready

Divide the class into five groups. Give each group a set of poultry catalogs or the *Chicken Breeds & Varieties* publication. Breed and variety photos are also available on the suggested www site. Place the name of the chicken classes in an egg carton. Have someone from each group pick one of the five classes: American, Asiatic, Mediterranean, English and Games.

Do it

1. Have the students talk about the characteristics that set apart the different breeds.
2. Ask the students to pick a specific breed of chicken they want to learn more about. Or place the names for that class in the egg carton and have the students pull one out at random.
3. After the students have chosen the breed they want to work with, ask them to select the key features that describe this bird and play the game "I Spy."
4. For example, with a chicken that is in the American Class, like a Rhode Island Red breed, single comb variety, the game might go like this:

   Student: I spy.

   Class: Who do you spy?

   Student: Someone with a "single comb."

   Class: The class guesses.

   Student: The student can respond with more clues about origin, color, or a special feature of a Single Comb Rhode Island Red chicken.
5. Continue with the rest of the breeds the students have picked.

Breed	Cornish	Houdon	Orpington	Langshan	Wyandotte	Dorking	Brahma	Rhode Island
Class	English	Continental	English	Asiatic	American	English	Asiatic	American

Talk it over

Share
- What makes each breed of chicken different?
- Why did you choose your breed?
- What made selecting a breed difficult?

Process
- What were the most common characteristics used to determine chicken breeds?
- Why is it important to categorize chickens into breeds?
- How did you determine the order of characteristics to help students guess?

Generalize
- Describe something that you planned or a choice that you made by looking at more than one possibility.
- Why is communication or decision making important at school? At home?
- Where could decision making help you with other tasks?

Apply
- How do you plan for new arrivals at your home, such as a dog or cat or new brother or sister?
- How does your family plan for special activities?
- For what things can you not plan?
- Why is it important to put plans in writing?

Evaluate it

☐ Do students know the components that make up the classification system for chickens?

☐ Do students know why there is a classification system for chickens? Or for other living things?

☐ How many breeds were the students able to identify by the chicken's characteristics?

☐ Were students able to see the benefit of planning in other situations?

Break Out

Make a "chicken collage"

(See activity on page 37.)

1. Find pictures of different chicken breeds.
2. Cut out your favorite parts from each breed, for example, feathered shanks, rose comb and buff-colored body.
3. Put these different parts together.
4. Give this new breed of chicken a name that would reflect the changes that you have made, for example "Booted Buff Rose Comb Plymouth Rock."
5. Using this collage of your new chicken breed and the new breeds from other class or club members, have a chicken show. Have your principal judge the show.

CONSIDER this

The American Poultry Association offers a book called the Standard of Perfection, which contains a complete description and pictures of more than 300 recognized breeds of chickens. There are more than 350 combinations of physical features in chickens with different colors, sizes and shapes.

American Poultry Association
Lorna Rhodes, Secretary/Treasurer
133 Millville Street
Mendon MA 01756
Phone: (508) 473-8769

There are also two sizes of chickens: standard and bantam. Bantams are one-third to one-fifth the size of standard chickens. There is an American Bantam Association, which offers a standard for bantams.

American Bantam Association
Eleanor Vinhage, Secretary
P. O. Box 127
Augusta NJ 07822
Phone: (973) 383-6944
Fax: (973) 383-8633

The system of classification for chickens is separated into three components: class, breed and variety. See glossary for definitions.

Warming up with eggs

Embryology skill:
Incubation of fertile eggs

Life skill:
Planning and organizing

Science skill:
Observing

School subjects supported:
Science

Preparation time:
10 minutes

Activity time:
20 minutes (egg preparation),

10 minutes daily (turning eggs, filling water canals or water pan), and

4 to 12 hours (hatching process)

What you need:
- ☐ Incubator
- ☐ Fertile eggs
- ☐ No. 2 pencil
- ☐ Embryology record sheet (page 42)
- ☐ Dish sponge (½ inch by 4 inches)
- ☐ Brooder box
- ☐ Copies of Student Activity Sheet "Warming up with eggs" (page 38)

Introduction

We're all used to seeing things grow and develop—watching changes that take place over months and years. But watching chicken embryos is different. Huge changes happen in days or weeks. It's like putting the growth process on fast forward.

In this lesson you will study chicken embryos as they grow. The science of studying the unborn—and in the chicken's case, the unhatched—is embryology. The unhatched chick is called the embryo, and the development of the embryo is called embryogenesis.

We use a thermometer to measure temperature. Temperature regulation is very important during the incubation process. The range of temperatures inside the incubator should be from 98°F to 101°F with 99.5°F being the best. We should not let the temperature rise above 101°F because higher temperatures can harm or kill the embryo. Temperatures below 98°F can delay the hatch time.

The chicks inside the eggs need humidity to keep them from drying out. At Day 18, increase the humidity by adding small, wet dish sponges next to the water canals or pan. When they begin to hatch, increase the humidity to soften the eggshell membranes.

The eggs need to be turned at least three times a day. This will keep the developing embryo from sticking to one side of the eggshell.

It takes about 21 days for the chicks to hatch. When a chick hatches, it has a special structure at the end of its beak called an egg tooth. The egg tooth helps the chick to break out of its shell. A few days after hatch, the egg tooth will fall off.

Get ready

You may wish to discuss the information in the introduction with the class. Ask your students how they keep track of turning the eggs, checking the temperature and ensuring that the canals are full of water.

Do it

1. Divide the students into teams of three to five. Have each team answer the following questions:

   How will you mark the eggs?

   How will you turn the eggs?

   How will you fill the water canals or water pan?

   How will you monitor the temperature?

   (See activity on page 38.)

2. Have the teams share their plans with the class. Discuss the plans and determine which plan provides for the best care of the eggs and the incubator by reviewing the preceding questions.
3. A suggested plan follows:

   With a No. 2 pencil, mark an "X" on one side of each egg and an "O" on the other side. Do not use ink because it may poison the embryos. Set the eggs in the incubator with all "X" sides up. This arrangement will help you monitor egg turning.

   Fill the water canals or water pan with tap water. Adjust the incubator temperature to 100°F or as close as possible. Turn the eggs three times per day from Day 2 in the incubator to Day 18.

Share

- Why was marking the eggs important?
- Describe your team's plan for incubating the eggs.
- How did your marks on the eggs differ from others?
- What is your team's plan for the best way to mark the eggs?
- What is your team's average incubator temperature?
- What is your team's plan for the best way to fill the water canals or pan?

Process

- What things might we use to identify the eggs?
- Why should we use a pencil instead of a pen to mark the eggs?
- What ways can you think of to keep the humidity at the required levels?
- How could you determine that turning the eggs three times a day is necessary?
- How might you maintain the proper temperature if electricity were no longer available?
- Why should the incubator temperature be properly regulated?
- What will you do differently the next time you hatch chicks? Why?

Generalize

- How does the thermostat that controls the heating and air conditioning at home compare to the incubator?
- What other thermometers have you read?
- How are those thermometers different from the one inside the incubator?

Apply

- What did you learn about working as a group that you can use in the future?

Using the Embryology record on page 42, have the students record the temperature inside the incubator each time the eggs are turned. Take a daily average and an overall average at the end of the project.

Using human thermometers to measure body temperature, have the students measure their own body temperature every hour during the school day and take an average of each individual.

If the incubator does not have to be returned right away, consider incubating other things to observe bacterial growth. Try a table egg broken out in a dish, a piece of a potato or a piece of an apple. After a few days, note any changes in these substances.

Evaluate it

Did the students learn…

- ☐ the importance of turning the eggs?
- ☐ the importance of keeping the water canals filled?
- ☐ the importance of proper regulation of the incubator temperature?
- ☐ about the egg tooth and its function?
- ☐ how long it takes a chick to hatch?
- ☐ how to average numbers?

Building an eggs-ray viewer

Embryology skill:
Preparing a candler

Life skill:
Relating to others, cooperation

Science skills:
Comparing and measuring

School subjects supported:
Math

Preparation time:
An hour to secure the needed materials. This can be shortened if you ask the students to bring the cardboard and small boxes from home.

Activity time:
30 to 40 minutes

What you need:
- ☐ Heavy cardboard boxes at least 1 foot by 1 foot in size
- ☐ Small box, such as a pencil box (at least 3 inches by 4 inches, and 1 inch deep)
- ☐ Scissors
- ☐ Electrical or duct tape
- ☐ Overhead projector (with light source from below the glass surface)
- ☐ Copies of Student Activity Sheet "Building an Eggs-ray Viewer" (page 39)

Introduction

If you like sneak previews, then candling is for you. Candling fertile eggs plays an important role in the embryology project. A candler is used to examine fertile eggs by shining a bright light through the egg. Candling serves three important functions.

1. Candling eggs before they are set identifies cracked eggs that might burst.
2. Candling helps detect which eggs are developing into an embryo.
3. Candling the eggs every few days allows you to watch the embryo grow and develop without damaging the egg.

In the poultry industry, eggs are candled for two reasons.

1. At the hatchery, eggs are candled to help remove cracked eggs before setting and infertile eggs that are not developing after a week of incubation.
2. At the consumer egg grading plants, eggs are candled to help remove cracked eggs and those that have defects making them undesirable for human markets.

Get ready

Involve the students in building a candler by dividing the class into teams. Supply each team with the same supplies and ask each group to design and build their own candler. Plans for an overhead candler are also included so that you (the teacher) can build a candler for class use if you would like. However, you are encouraged to use a candler designed and built by one of the teams.

Do it

1. Divide the class into teams of three to five students. Each team should use the Building an Eggs-ray Viewer sheet *(see activity on page 39)* to help them design and build a candler. Explain that they have 30 minutes to design and build an egg candler with the supplies you give them. Also, show them the overhead projector and explain that it will be the source of light for their candler. Basic questions to answer include:

   Does the candler provide enough light to see cracks in an eggshell or the embryo inside the egg?

   Can you candle eggs without damaging them?

   Does the candler limit the amount of light that escapes so the room can be darkened properly to allow seeing inside the egg?

   Does the way the egg sets on the candler allow optimal viewing of the different parts of the egg and embryo?

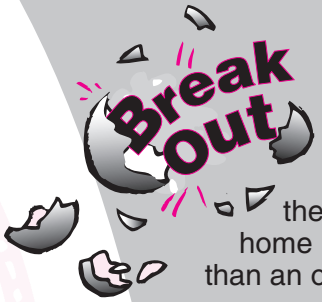
2. Have the teams share their candler with the class. Ask them to explain:

   How the team decided on the plan before they began to build.

   What was unique about their plan.

   How their plan met the basic needs of a candler mentioned in step 1 above.

3. Try each candler in a darkened room and discuss which candler best allows the students to see inside the egg. If you already have a candler, compare it with the class designs.



Have students design and make their own egg candler at home (with a flashlight rather than an overhead projector).

Candle some eggs at home and show your family how to look at eggs. Why does the store-bought egg look different from the ones at school?

Share

- How did your candler differ from the others that were built?
- What do you like about your team's plan compared to the others? Why?

Process

- Why do we candle eggs?
- What things make a good candler?
- How would you improve your candler?
- What plans did you have to make before starting this project?

Generalize

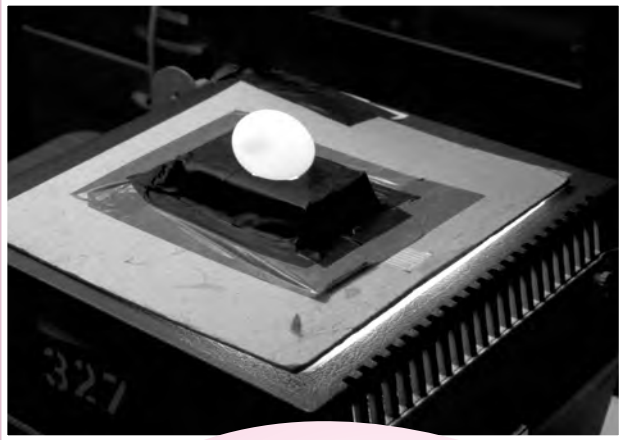
- What other items have you built? How was this building process like or different from those?
- How can planning and organizing help you in other parts of your life?
- How did not having instructions and specifications affect the building process?

Apply

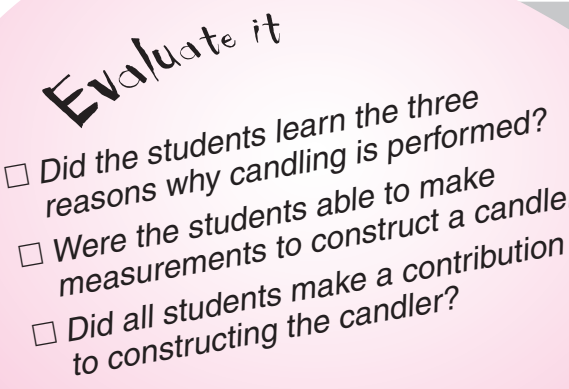
- What did you learn about working as a group that you can use in the future?
- What will you do differently the next time you plan to build something?

The following instructions provide information for development of a typical candler. You may want to build one of these for use in class or to compare it to the candlers developed by the class.

1. Cut out a flat 1 by 1 foot piece of cardboard.
2. Remove one of the large sides of the small box.
3. Cut an egg-shaped hole 1.5 inches by 1 inch in the topside of the small box (opposite from the side you just removed). This hole holds the egg so you can see the embryo while handling the egg as little as possible.
4. Place the small box on the center of the piece of cardboard and trace the box outline. Cut a hole in the center of the piece of cardboard the same size as the small box.
5. With duct tape, fasten the small box to the piece of cardboard (with the egg-shaped hole up).



6. Place the cardboard on top of the glass base of the overhead projector, and you are ready to candle.



Playing peek-a-boo with embryos

Embryology skill:
Observation of embryos

Life skill:
Record keeping

Science skill:
Observing, communicating, relating

School subjects supported:
Biology

Preparation time:
5 minutes, unless you need to build a candler (see "Building an eggs-ray viewer")

Activity time:
10 minutes to allow students to record their observations

5 minutes on Day 3, 4, 6, 9, 13, 18 and 20 of development to observe the embryo

What you need:

- ☐ Soap and water (for washing hands before and after handling eggs)
- ☐ Overhead candler (see page 20, "Building an eggs-ray viewer")
- ☐ Box-style overhead projector (light comes from under platform) with an extension cord, if necessary
- ☐ Fresh eggs of assorted colors
- ☐ Fertile eggs developing in the incubator (white-shelled eggs work best for viewing)
- ☐ Darkened room (for best view)
- ☐ Copies of Student Activity Sheet "Playing peek-a-boo with embryos" (page 40)

Introduction

The overhead candling method allows the students to observe the development of a chicken embryo without damaging it.

Get ready

Review the suggested activities for this lesson and the science of the developing embryo. Determine which of the suggestions would be most appropriate for your students.

Ask the class to list the safety measures they should use to be sure that the embryos and class members aren't put at risk. Conduct this activity in a way that ensures hygiene and safe handling of the eggs.

Do it

1. Before candling any eggs, ask the students to record what they think a three-day-old chicken embryo will look like. (Have them write, draw or both; *see activity on page 40).* Encourage them to use their imagination and draw or write from their background and experience.
2. With the candler, compare a fresh refrigerated egg to an egg that has been kept at room temperature for three to five days. Identify the air cell and yolk. Look for cracks. Gently crack an egg to see what the crack looks like.
3. Candle each developing egg and select an egg that has an embryo in a good viewing position.
4. To candle the egg, set the candler on an overhead projector. Place the overhead projector on the floor or on a low tabletop so students can see. Darken the room. (The darker the room the better the 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.
5. Ask the students to observe a three-day-old chicken embryo, then ask them to discuss what they saw. How might the embryo change between observations? Is anything moving?
6. Observe an embryo at Day 3, 4, 6, 9, 13, 18 and 20. If possible allow the students to candle the eggs after the first day or two.
7. After they have finished observing the developing embryo, ask them to record (orally, written, drawn or combination) how the embryo was different than what they expected.

Talk it over

Share

- What happened as the class observed the embryo for the first time?
- What differences did you see between the eggs? Any movement?
- Are all embryos developing? If not, why not?
- How has the embryo changed since you last saw it?
- Which embryo parts were most easily seen?

Process

- Why should you not allow the eggs to cool too much while candling?
- Why is it helpful to candle the eggs and see what is happening at different stages?
- Why is the heart and eye developing so fast?

Generalize

- Why is it important to wash your hands before and after handling eggs?
- What did you learn about the importance of keeping records or graphs?
- Why would it be helpful for a doctor to be able to view an unborn baby?
- How do we view the developing fetus in human or animal pregnancies?

Apply

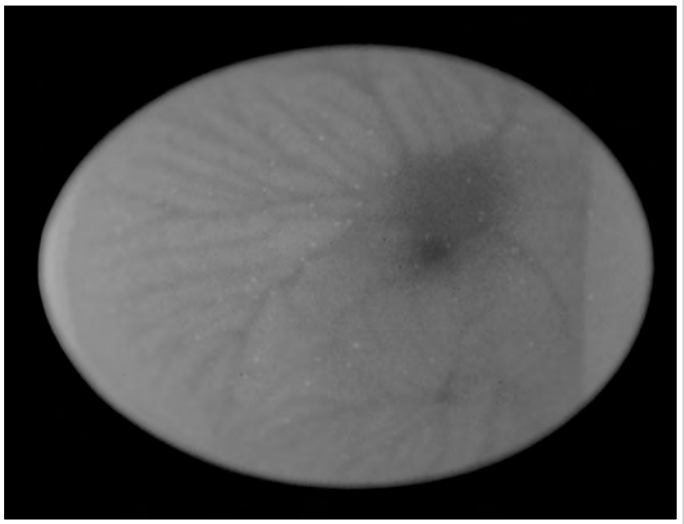
- Why is it important to chart the growth of a developing fetus?
- How will what you learned in this lesson be useful in the future?
- What other times might it be important to keep records?

Evaluate it

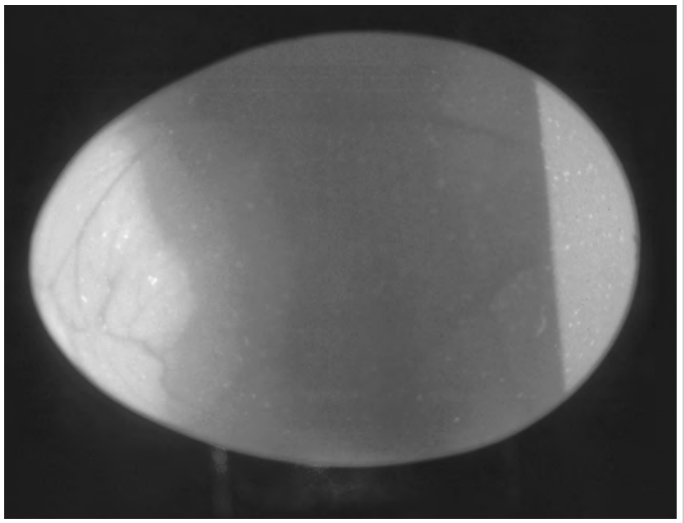
- ☐ Did students candle the eggs and explain what they saw?
- ☐ Did the students identify differences between the eggs in the incubator?
- ☐ Did the students observe critical stages of embryonic development?
- ☐ Were the students fascinated or surprised by what they saw?

Break Out

Did you know that egg producers use candlers to help them grade and sort eggs that are sent to market?



6-Day embryo under candling light.
Notice distinct blood system and eye (black spot).



12-Day embryo
The egg becomes darker and the air cell gets larger as the embryo grows.

Building a home 'tweet home

Embryology skill:
Preparing a brooder

Life skill:
Planning and organizing

Science skill:
Comparing and measuring

School subjects supported:
Math

Preparation time:
45 minutes

Activity time:
60 minutes (will vary)

What you need:

- ☐ Cardboard box 24 to 36 inches square
- ☐ Cardboard box about 12 inches by 18 inches, and at least 12 inches tall
- ☐ Goose necked lamp
- ☐ 40-watt light bulb
- ☐ Waterer
- ☐ Newspapers, magazines, or pine shavings
- ☐ Roll of paper towels
- ☐ Thermometer
- ☐ Student Activity Sheet "Building a home 'tweet home"(page 40)

Introduction:

Ever wanted to be a mother hen? Now is your chance. When you raise chicks in a brooder, you are taking the place of the chicks' female parent. Through the brooder, you provide warmth, shelter and food. And you learn a lot about how to take care of a baby—even though that baby is mostly fuzz and just a few inches tall.

Get ready

Because there is little time when the chicks hatch, build the brooder or set up at least two days before hatching. The brooder should maintain a temperature of 95°F (temperature taken at chick level) during the first week. If you keep chicks beyond one week, decrease the temperature 5°F per week until you reach room temperature. Use pine shavings or paper towels on top of several layers of newspaper for litter. Do not use news or magazine paper without paper towels because the surface may become slick, which can cause the chicks to develop "spraddle legs."

Do it

1. Involve the students in planning a brooder for their chicks. Divide the students into teams of three to five. Each team should use the student sheet *(see activity on page 41)* to help them develop a plan for the brooder. Have the teams share their brooder plan with the class. Basic questions to consider are:

   Does the brooder provide shelter for the chicks?

   Does the brooder provide heat for the chicks?

   Does the brooder provide food for the chicks?

2. Discuss the plans and determine which plan provides for the best brooder.
3. Build one brooder box as a total class project. The instructions on the next page provide information for development of a typical brooder. You may wish to build one of these and compare it to the one built by the class.

Teacher note:

You may choose which brooder you would like your class to build.

The courtyard brooder will be used for an example in this lesson since it is easily made with supplies in an everyday classroom. However, teachers who plan to do this project again and would like to construct something more permanent may wish to build a wooden observation brooder.

Courtyard brooder

1. The 24- to 36-inch-square cardboard box serves as the chick courtyard. Cover the bottom with about two inches of pine shavings. If shavings are not available, place newspapers (about five layers) on the bottom and cover with paper towels to provide traction.
2. Place the feeder and waterer in the box.
3. If you are using a goose neck lamp, bend it over the side of the box. Never place the light closer than 18 inches from the brooder floor or walls.
4. Test the brooder temperature for several days before the chicks hatch. To test, place a thermometer on the bottom surface. The temperature should be 95°F for the first week. After that, lower by 5 degrees each succeeding week. Raise or lower the light bulb or change the light bulb size to change the temperature. After the chicks hatch, if the chicks appear cold (shivering), move the light closer. If the chicks appear too hot (panting), move the light farther away.
5. If you would like to make a brooder window on the side of the box, cut a hole large enough to see through, and cover the hole with clear plastic wrap.
6. Place the box at your students' eye level for best viewing.

Ready for the chicks

A warm new home

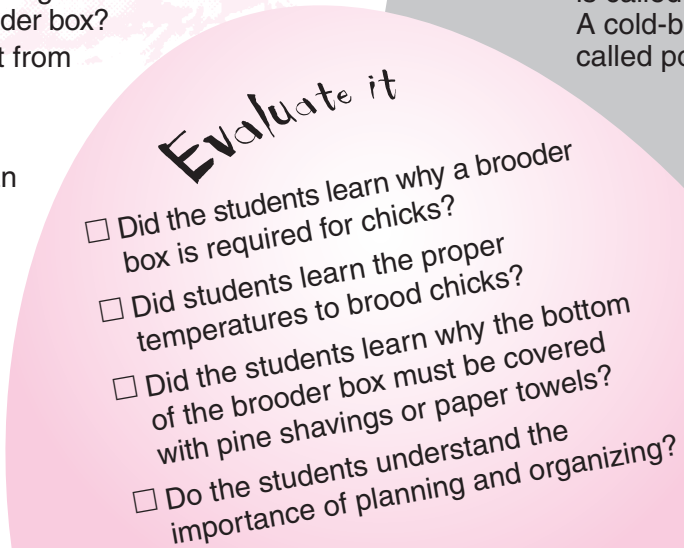
Share
- What materials did you use to make the brooder? Why?
- What is your team's plan for the best brooder?

Process
- What does the chick need to stay alive?
- How could you help the chick if it is shivering or panting?
- Why was it necessary to have pine shavings or paper towels in the bottom of the brooder box?
- How was the planning process different from other items you have planned?

Generalize
- Why is it important to organize your plan before doing it?
- How was the final brooder plan alike or different from the ideas generated at the beginning of class?

Apply
- How can you use what you learned about planning and organizing in other assignments?

At home, read about animals that are cold-blooded. Make a list and share it with your class at school. A warm-blooded animal is called homeothermic. A cold-blooded animal is called poikilothermic.



Counting the chicks

Embryology skill:
Connecting embryology and math

Life skill:
Keeping records

Science skill:
Comparing and measuring

School subjects supported:
Math

Preparation time:
Variable

Activity time:
Variable

What you need:
Varies by the activity

- ☐ Scale
- ☐ Rulers
- ☐ Thermometers
- ☐ Measuring tape
- ☐ Calculator
- ☐ Graph paper

Introduction

Children need to see how mathematical ideas are related. Math concepts need to be connected to everyday experiences both in and out of school, so kids become aware of the usefulness of mathematics. Learning and using math across all curriculum areas is important to develop broad-based skills in mathematical connections.

Get ready

Review the following suggestions for math enhancements to the embryology curriculum. Check the suggestions that would be most appropriate for your students.

Do it

1. Grouping

- ☐ Have the students compare and contrast the eggs or chicks and then organize them into categories, like color, texture, behavior, etc.

2. Ordering

- ☐ Arrange the stages of development in the egg in the correct order.

3. Measuring

- ☐ Eggs
  Measure weight, length and diameter.
- ☐ Chicks
  Measure weight, height.
- ☐ Caring for chicks
  Measure daily temperature and humidity, and amounts of feed and water.
- ☐ Making an apparatus
  Use measurements in building the brooder and candler.

4. Estimation

- ☐ Conversion of Celsius and Fahrenheit temperatures—
  For a quick estimate of Celsius, subtract 30 from the Fahrenheit temperature and divide by 2. For a quick estimate of Fahrenheit, multiply the Celsius temperature by 2 and then add 30.
- ☐ Estimate amounts of bedding and feed that will be needed for the project.

5. Percent

- ☐ Calculate percentage of hatch.
- ☐ Chicks should be given food that is 18 to 22 percent protein. Discuss with students what that means.

6. Graphing

- ☐ Plot timeline of incubation period of 21 days.
- ☐ Graph incubator temperature and humidity.
- ☐ Graph number of eggs at beginning of project, number used for experimentation and number that hatch or do not hatch.
- ☐ Graph weights of eggs and chicks over the length of the incubation and after hatched.

7. Problem-solving

- ☐ Have students develop a method to assign responsibility and keep track of egg-turning.
- ☐ Calculate intervals in which eggs should be turned.
- ☐ Develop a budget for the class embryology unit.
- ☐ Develop word problems related to embryology.

  For example, if you spend 50 cents a day on food and it takes ___ days before a chick starts laying eggs, how much money should you charge for a dozen eggs in order to make a profit?

8. Number computation

- ☐ Calculate differences between human's and chicks' body temperatures, length of development for embryos and size.
- ☐ Calculate average daily temperature in incubator or brooder, average weight of chicks and average weight of growth of chicks over one week.
- ☐ Convert temperatures from Celsius to Fahrenheit.

  To convert Fahrenheit temperatures to Celsius, subtract 32 from the Fahrenheit temperature and multiply by 5/9.

  To convert Celsius temperature to Fahrenheit, multiply the Celsius temperature by 5/9 and add 32.

Share

- What did you do?
- What happened?
- What was most difficult? Easiest?

Process

- What did you learn about _____?
- What else would you like to know about _____?
- What was the most important thing you learned?
- What would you do differently next time?

Generalize

- What else might you try?
- What did you learn about the importance of keeping records like graphs?

Apply

- How will what you learned be useful in the future?
- What could you do to become even better at math or keeping records?
- How will you help others learn about _____?

The egg tooth

The egg tooth is only present to help the chick break from the egg. Within 12 to 24 hours after the chick hatches, the egg tooth will dry and fall off.

Evaluate it

- ☐ Can students apply math skills to real-world experiences?
- ☐ Can students collect and organize data?
- ☐ Can students explain the process of how they determined the answer to a math problem?

Caring and handling

Embryology skill:
Handling chicks safely

Life skill:
Relating to others

Science skill:
Observing and communicating

School subjects supported:
Health and safety

Preparation time:
One hour

Activity time:
One class period

What you need:
- ☐ Ultraviolet light
- ☐ Antibacterial hand soap
- ☐ Paper towels
- ☐ Water

Introduction

Did you know you could be dangerous even though you don't want to be? When you handle something as small and delicate as a chick, you should be extra careful not to hurt it. Give it lots of time to rest after you pick it up. Here's an even bigger surprise. That cute, warm and fuzzy ball of fur could be dangerous to *you*. No, it won't bite or punch you, but it might carry **germs** that could make you sick. That's why it is important to wash your hands after you have picked up a chick. Then both you and the chick will be healthy and strong.

Get ready

Once the chicks have hatched, students naturally want to hold them. But newly hatched chicks should not be handled much, if at all. Some children may not have the coordination needed to handle chicks appropriately. Proper **handling** is important to keep an animal as fragile as a baby chick from being stressed or harmed.

Most students understand the importance of washing their hands after they go to the bathroom. It is also important to wash after handling a chick. This exercise was designed to ensure proper handling of the chick, proper hand washing for the safety of the child and the prevention of disease in the child or the chick.

Your students should work in pairs or groups of three or four, with one chick per group. Students will have to sit on the floor, so have a blanket or sheet available for them to sit on. Also, set up a hand-washing station in the classroom. This station could be a sink or just a bowl of warm soapy water. Include some paper towels.

Do it

The students should sit down on their sheet with their feet touching each other. Pass around a wind-up chick, Beanie Baby or stuffed animal the size of a chick until each child has held it. An adult should supervise this activity, so the students learn to handle the object correctly.

After this initial activity, place a real chick in the center of the circle and allow the chick to run around. When the chick goes to someone in the group, he or she may pick it up (under adult supervision) for one minute. Then the student should put the chick down in the circle and let it go to someone else, who may hold it for a minute. This continues until each child has held the chick for a minute. After all the students have held the chick, put it back into the brooder.

After holding the chick, rub "Glitter Bug Potion" on the hands of each student.

> *Ask them to hold their hands under a black light and look for signs of germs. Ask them to describe what the germs look like.*
>
> *Then ask your students to wash their hands with antibacterial soap and dry them thoroughly. They should again hold them under the black light to see whether the germs are gone.*

Talk it over

Share
- How did it feel to hold a baby chick?

Process
- Why did you handle the Beanie Baby chicken before you handled the real chicken?
- How could improper handling of a chick hurt it?
- Why is it important to wash your hands after handling a chick?

Generalize
- When you were holding the chick, how did the chick tell you that it was comfortable or uncomfortable?
- How do other baby animals let you know when they are comfortable or uncomfortable?

Apply
- What do you do when you are uncomfortable? Too hot? Too cold?
- Why is washing your hands important?
- What will you do differently the next time you handle chicks?

For 2nd and 3rd Grade

Kids Only

Trace your hands and color in the spots where you found the most germs.

Ticklers

How many of your students know how to play "Ring around the Rosie?" Ask the students in their groups to join hands, circle around their blanket or sheet and then sit down on the sheet.

Break Out

Take it home
List all the different activities after which you wash your hands.

Share it
Teach a younger brother, sister or friend to wash their hands properly.

CONSIDER this

How would you make a germ-free environment?

FYI

After the chicks hatch out of their shell, they must stay in the incubator until their down is completely dry. Birds should be moved to an environment (such as a brooder) that provides the following: supplemental heat, food (such as a chick starter diet), and good clean water. Students should not handle chicks a lot because too much handling can stress them and allow them to get sick.

To pick up a chick, always move slowly and gently. Cup your left hand with the fingers pointing upward. Place your right hand around the chick (fingers pointing downward) until you can pick it up. Place the chick in your left hand. Hold your right hand cupped around the top of the chick (fingers still pointing downward) so the chick will not escape.

Some of your students' motor skills may not be fully developed, depending on their ages. For example, a child might hold the chick too tightly, suffocating it. Or a child might hold the chick loosely, allowing it to fall.

Children and adults who handle chicks also need to know the importance of hand washing. All warm-blooded animals, (like dogs, humans and birds) carry salmonella, a bacterium that can cause severe diarrhea and dehydration. You and your students should thoroughly wash with antibacterial soap to prevent contamination. To ensure that students wash properly, place a harmless dye on the students' hands and look at them with a black light.

Eggsploring careers

Embryology skill:
Exploring careers in the poultry industry

Life skill:
Developing teamwork

School subjects supported:
Social studies

Preparation time:
15 minutes

Activity time:
20 minutes

What you need:

☐ Slips of paper that are labeled:

- Producer
- Plant manager
- Poultry scientist
- Food scientist
- Marketer
- Veterinarian
- USDA inspector
- Truck driver

☐ Create a few "wild card" slips that can be filled in later as the students identify other careers in the poultry industry.

Introduction

How does an egg get from the chicken on a farm to the grocery store and into our homes? Many people with different jobs help to provide safe and high-quality poultry products. You may not realize how many careers are available in the poultry industry. This activity will help you to better understand the poultry industry and its career possibilities.

Get ready

Before doing this activity, ask the students to list as many poultry careers as they can. Write these on slips of paper. Make sure you have at least one **career** for each student. You also may want to write the careers on a chalkboard or flip chart and talk about them to get everyone involved. Doing this will help the youth describe the careers in this activity.

Do it

1. Split the class into groups of eight.
2. Tape one slip of paper with the name of a career onto each student's back without letting him or her see what the paper says.
3. Have the team members sit in circles. Take turns having one person in the middle while everyone in the circle describes that career.
4. When the person in the middle has guessed what his or her career is, another person moves to the middle.
5. Repeat until everyone has been in the middle.

Talk it over

Share
- What did you like about this activity?
- What poultry careers did you learn about?

Process
- Why is it important to learn how to describe jobs to people?
- Why is it important for the people in these jobs to work together?

Generalize
- How did you work as a team to help the person in the middle guess the career?
- How would you describe a job that you would like when you get older?
- How can you learn more about jobs in the poultry industry?

Apply
- How will this activity help you think about possible career choices?
- How can you learn more about jobs in the poultry industry?

Evaluate it

☐ Did the students discuss their ideas about careers?

☐ Did students learn about careers in the poultry industry?

☐ Did students work together in these career exploration activities?

Break Out

Have students expand this experience by talking with adults about careers and writing what they learned in a journal.

Ask someone in the poultry industry to visit the class and talk about what they do.

FYI

The poultry industry involves many companies from around the world. There is a career for almost any interest connected to poultry. Poultry producers are responsible for providing housing and care for birds, while grain farmers provide the soybean, corn and cottonseed that goes into feed. Poultry scientists work to improve genetic characteristics, feed and disease prevention. Food scientists create new poultry food products and improve the quality of food already on the market.

Marketers find new ways to promote poultry. Processing plant managers make sure the right number of birds are ready for processing on a given day, and that the plant can handle those birds. Professors do research to improve the industry and teach future industry leaders. USDA inspectors examine poultry products and make sure they are safe and of a high quality. Truck drivers transport birds to farms, processing plants, stores and restaurants. All of these people and jobs are essential to the poultry industry, which offers an array of opportunities for up-and-comers.

Glossary

Air cell – The air pocket that forms between the inner and outer shell membranes to replace moisture the egg loses as it cools and is stored.

Albumen – A combination of the four layers of a whitish watery substance (88 percent water, 11 percent protein) that surrounds and contains the yolk within the center of the egg shell. Inner and outer thick albumen is the major source of egg riboflavin and protein. In high-grade eggs, it stands higher and spreads less than the thin albumen. In lower grade eggs, it thins and looks like the thin albumen.

Allantois – An organ in the embryo of birds which develops into part of the umbilical cord and unites with the chorion, forming the placenta. Responsible for respiration, absorption of minerals from the shell and handling waste.

Amnion – A membranous, fluid-filled sac surrounding the embryo. Important for protection, it allows the embryo to exercise during development.

Avian – Of, or pertaining to, Aves or birds.

Bacteria – Microscopic, single-celled organisms.

Bantam – A miniature fowl, some distinctive breeds, others being miniatures of a large breed or variety, approximately one-fourth (1/4) to one-fifth (1/5) normal weight.

Blastoderm or germinal spot – The collective mass of cells produced by the splitting of a fertilized ovum from which the embryo develops.

Blastodisc or germinal disc – The germinal spot on the ovum from which the blastoderm develops after the ovum is fertilized by the sperm.

Bloom – The coating or covering on the eggshell that seals its pores.

Breed – A group of birds that have the same physical features, such as body shape or body type, skin color, number of toes, feathered or non-feathered shanks (legs) and carriage or station.

Brood – Baby chicks hatched from one nest (setting) of eggs.

Brooding – Caring for the young of animals.

Candling – Shining a bright light through an egg in order to observe its interior.

Carbohydrate – Compounds containing carbon, hydrogen, and oxygen, a sugar or starch.

Career – Profession that is undertaken as a long-term commitment.

Chalazae – Prolongations of the thick inner-white, or albumen, that are twisted like ropes at each end of the yolk. Their function is to anchor the yolk in the center of the eggshell cavity.

Chick – A newly hatched baby chicken.

Chorion – A membrane enveloping the embryo, external to and enclosing the amnion.

Chromosomes – A series of paired bodies in the nucleus, constant in number in any one kind of plant or animal.

Class – A group of chicken breeds from the same geographical origin (large fowl) or showing similar characteristics (bantams).

Dorsal – Of, on or near the back.

Dry-bulb thermometer – Expresses a temperature reading in number of degrees Fahrenheit or centigrade/Celsius.

Ectoderm – A cell layer grouping responsible for the development of the skin, feathers, beak, claws, nervous system, lens and retina of the eye, linings of the mouth and vent.

Egg (avian) – The female reproductive cell (ovum) surrounded by a protective calcium shell and, if fertilized by the male reproductive cell (sperm) and properly incubated, capable of reproduction.

Egg tooth – Also called "chicken tooth." The temporary horny cap on the chick's upper beak which serves for pipping (breaking through) the shell. Usually dries and falls off within 18 hours after chick hatches.

Embryo – A fertilized egg at any stage of development prior to hatching. In its later stages, it clearly resembles the fully developed chick.

Embryology – The study of the formation and development of plant and animal embryos.

Endoderm – A cell layer grouping responsible for the development of the linings of the digestive tract and the secretory and respiratory organs.

Evaporation – Changing of moisture (liquid) into vapor (gas).

Experiment – A test made to demonstrate a known truth, to examine the validity of a hypothesis, or to determine the efficacy of something previously untried.

Fahrenheit – A temperature scale that registers freezing point of water as 32°F and boiling point as 212°F under standard atmospheric pressure. Named after Gabriel D. Fahrenheit (1686–1736).

Fertile egg – An egg that has been fertilized by sperm or is capable of developing an embryo.

Gene – An element in the chromosome of the germ cell that transmits hereditary characteristics.

Germs – Microorganisms that can cause sickness or disease.

Hatchery – A facility where eggs are incubated commercially.

Hatching egg – A fertilized egg with the potential of developing an embryo.

Humidity – See "relative humidity."

Incubate – To maintain favorable conditions for developing and hatching fertile eggs.

Incubator – A container with the proper humidity and temperature to allow fertile eggs to hatch.

Infundibulum – The entrance to the oviduct.

Membrane – Soft, pliable sheet or layer of tissue covering an organ.

Mesoderm – A cell layer grouping responsible for the development of the bones, muscle, blood and the reproductive and excretory organs.

Nutritious – (Food or feed) contains substances necessary to sustain life and growth.

Ovary – The female reproductive gland in which eggs are formed.

Oviduct – The tube through which eggs pass after leaving the ovary.

Ovum – The female reproductive cell.

Pecking order – The basic pattern of social organization within a flock of poultry in which each bird can peck the birds lower in the order without fear of retaliation. Social hierarchy.

Pipping – A baby chick breaking from its shell.

Pores – Miniature openings in the shell of an egg through which gases are exchanged.

Protein – One of a group of nitrogenous compounds commonly known as amino acids.

Relative humidity – The amount of moisture in the air compared with the amount that the air could contain at specific temperatures. Expressed as a percentage.

Shell – The egg's outer covering consisting mainly of calcium carbonate. The shell is the egg's first line of defense against bacterial contamination.

Shell membrane – The membranes between the shell and the liquid portion of the egg. The outer shell membrane is fused to the shell, and the inner shell membrane surrounds the liquid portion of the egg. The air cell forms between the two membranes, usually at the large end of the egg.

Still-air incubator – A container for hatching chicks that does not have mechanical ventilation.

Strain – Families or breeding populations of chickens that possess common traits.

System – A functioning unit of the anatomy, such as the skeletal, muscular, glandular, respiratory and digestive systems.

Testes – The male genital glands (plural) **testicle, testis** (singular).

Variety – A subdivision of a breed. Different characteristics include feather color, comb type and the presence of a beard and muffs.

Vitamin – A fat- or water-soluble substance necessary, in very small amounts, to allow for normal growth and maintenance of life.

Vitelline membrane – The clear seal that holds the yolk.

Wet-bulb thermometer – A device used to measure the amount of moisture or water vapor in the air.

Yolk – A globular mass of yellow, nutritious semi-liquid contained in a transparent membrane (the vitelline membrane) and located in the center of an egg. The yolk is the chick's food during its pre-hatching life and its first food after it emerges from the shell.

Yolk sac – A membrane sac that surrounds the yolk of the egg.

Embryology

Beginner Student Assessment Rubric

Science as inquiry

☐ 5 points
Student demonstrates above average ability to ask questions, plan and conduct simple experiments, use data, and communicate results.

☐ 3 points
Student demonstrates satisfactory ability to ask questions, plan and conduct simple experiments, use data, and communicate results.

☐ 1 point
Student demonstrates unsatisfactory ability to ask questions, plan and conduct simple experiments, use data, and communicate results.

Characteristics of living things

☐ 5 points
Student demonstrates above average understanding of the basic needs of developing embryo and chick.

☐ 3 points
Student demonstrates satisfactory understanding of the basic needs of developing embryo and chick.

☐ 1 point
Student does not demonstrate understanding of the basic needs of developing embryo and chick.

☐ 5 points
Student demonstrates above average understanding of egg and chicken parts and their functions.

☐ 3 points
Student demonstrates satisfactory understanding of egg and chicken parts and their functions.

☐ 1 point
Student demonstrates unsatisfactory understanding of egg and chicken parts and their functions.

Life cycle

☐ 5 points
Student demonstrates above average understanding of chicken's life cycle.

☐ 3 points
Student demonstrates satisfactory understanding of chicken's life cycle.

☐ 1 point
Student demonstrates unsatisfactory understanding of chicken's life cycle.

☐ 5 points
Student demonstrates above average understanding that chicks closely resemble their parents.

☐ 3 points
Student demonstrates satisfactory understanding that chicks closely resemble their parents.

☐ 1 point
Student demonstrates no understanding that chicks closely resemble their parents.

Organisms and environment

☐ 5 points
Student demonstrates above average understanding that chicks' behavior relates to environment, i.e., warmth, shelter, food.

☐ 3 points
Student demonstrates satisfactory understanding that chicks' behavior relates to environment, i.e., warmth, shelter, food.

☐ 1 point
Student demonstrates no understanding that chicks' behavior relates to environment, i.e., warmth, shelter, food.

Abilities of technological design

☐ 5 points
Student demonstrates above average understanding of steps in the design process, i.e., identify the problem, propose solution, try out solution, evaluate and improve, communicate the solution.

☐ 3 points
Student demonstrates satisfactory understanding of steps in the design process, i.e., identify the problem, propose solution, try out solution, evaluate and improve, communicate the solution.

☐ 1 point
Student demonstrates no understanding of the steps in design process, i.e., identify the problem, propose solution, try out solution, evaluate and improve, communicate the solution.

Planning and organizing skills

☐ 5 points
Student is capable of considering the situation and coming up with an above-average plan.

☐ 3 points
Student is capable of considering the situation and coming up with a satisfactory plan.

☐ 1 point
Student developed an unsatisfactory plan for the situation.

Record keeping skills

☐ 5 points
Student demonstrates above-average ability to categorize and select useful information.

☐ 3 points
Student shows satisfactory ability to categorize and select useful information.

☐ 1 point
Student shows unsatisfactory ability to categorize and select useful information.

Teamwork skills

☐ 5 points
Student understands role in the team and enjoys working with others.

☐ 3 points
Student shows some understanding of role in the team and likes to work with others.

☐ 1 point
Student does not understand role as part of a team and does not like to work with others.

Science skill of observation

☐ 5 points
Student generates reasonable questions about the world based on observation. Student uses all senses when observing.

☐ 3 points
Student generates some reasonable questions about the world based on observation. Student uses most senses when observing.

☐ 1 point
Student does not generate reasonable questions about the world based on observation. Student uses only one sense when observing.

Science skill of comparing and measuring

☐ 5 points
Student demonstrates above-average ability to use simple measurement tools to provide consistency in an experiment.

☐ 3 points
Student demonstrates satisfactory ability to use simple measurement tools to provide consistency in an experiment.

☐ 1 point
Student is not able to use simple measurement tools to provide consistency in an experiment.

Science skill of relating

☐ 5 points
Student demonstrates above-average ability to develop solutions to unfamiliar problems through observation and experimentation.

☐ 3 points
Student demonstrates satisfactory ability to develop solutions to unfamiliar problems through observation and experimentation.

☐ 1 point
Student demonstrates inability to develop solutions to unfamiliar problems through observation and experimentation.

Adding up

Science as inquiry . . . . . _____
Characteristics of living things . . . . . _____
Life cycle . . . . . _____
Organisms and environment . . . . . _____
Abilities of technological design . . . . . _____
Planning and organizing skills . . . . . _____
Record-keeping skills . . . . . _____
Teamwork skills . . . . . _____
Science skill of observation . . . . . _____
Science skill of comparing and measuring _____
Science skill of relating . . . . . _____

Student name _____

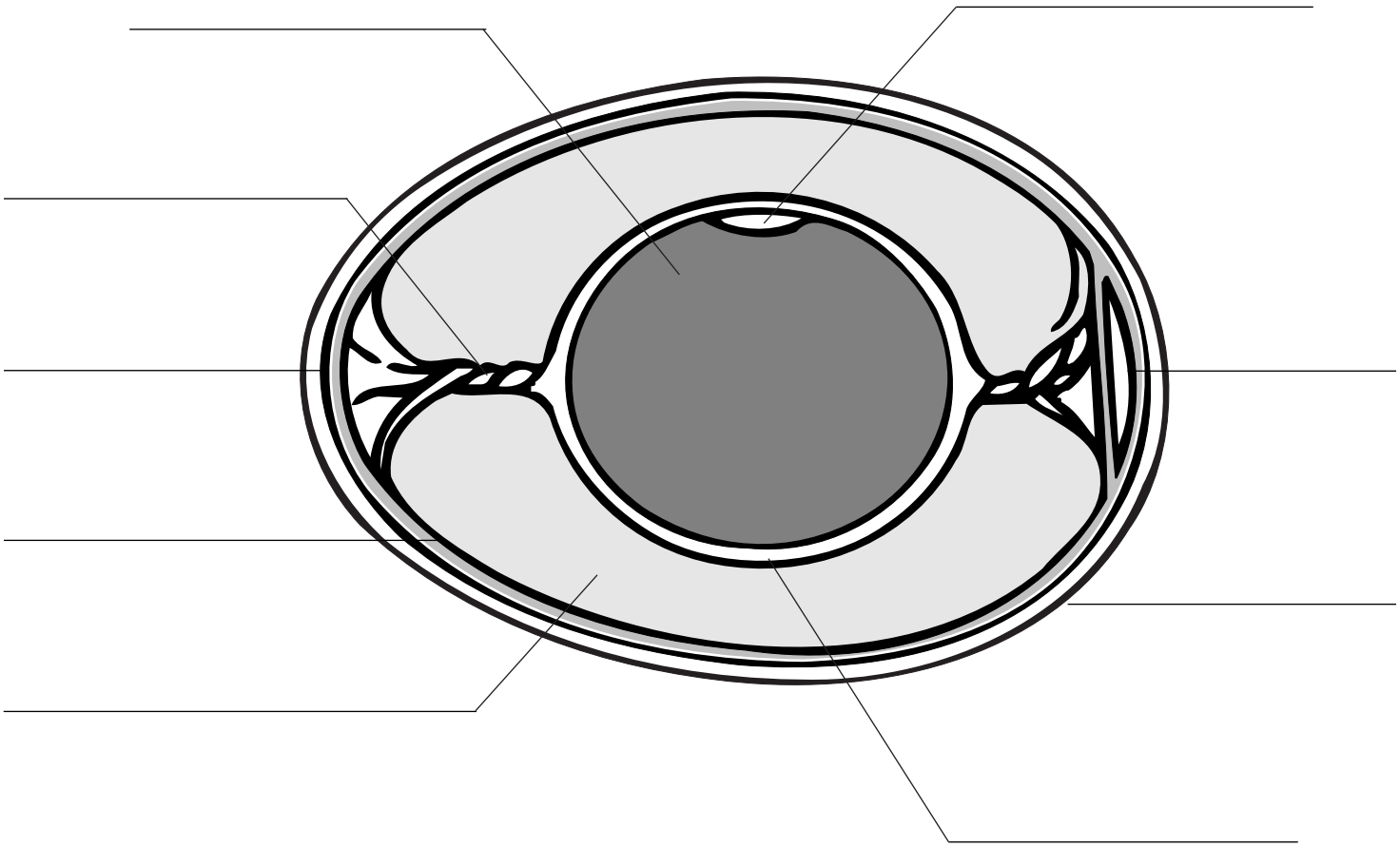
Total points ◯

Name

Eggsploring the parts

Match the name with the egg part and write it on diagram.

air cell	germinal disc	shell
albumen	inner membrane	yolk
chalaza	outer membrane	vitelline membrane



Student Activity Sheet

Name

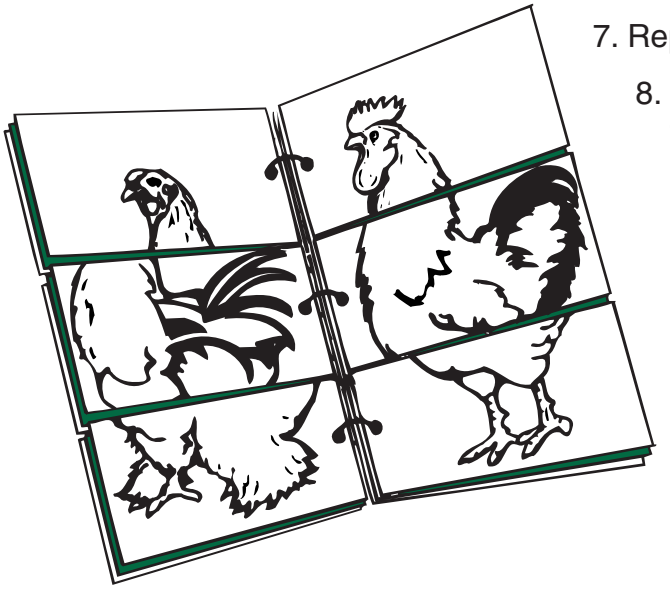
Chick breed-maker notebook

What you need

- ☐ 10 sheets of blank paper
- ☐ Scissors
- ☐ Glue
- ☐ Three-hole punch
- ☐ Three-ring binder

Do it

1. Three-hole punch your plain paper.
2. Cut the paper into three equal sections (about 3⅔ inches by 8½ inches each).
3. Place the paper into a three-ring binder. Have the top third of the paper in the top ring, the middle third of the plain paper in the middle ring and the bottom third of the paper in the bottom ring.
4. Cut out pictures of chickens from poultry catalogs.
5. Divide the pictures of the chickens into three parts: the top third showing the neck and head, the middle third showing the body and the bottom third showing the legs.
6. Glue the pictures of the top third of the chicken to the top third of the paper. Glue the pictures of middle third of the chicken to the middle third of the paper. Glue the pictures of bottom third of the chicken to the bottom third of the paper.



7. Repeat for 10 different breeds.
8. Mix and match them to come up with the different combinations. How many different breeds can you come up with?
9. Display your favorite new breed you created and give it a name.

Name _____

Warming up with eggs

What's the problem?
Write about why we need to turn the eggs, fill the water canals and monitor the incubator temperature.

_____

_____

_____

_____

_____

How could you solve the problem?
Write about your ideas for turning the eggs, filling the water canals, and monitoring the incubator temperature.

_____

_____

_____

_____

How could you test your plan?
Share the plan. Listen as each team shares its plans. Write down the ideas that you think are best.

_____

_____

_____

_____

_____

1

What could you do to improve your ideas?

With your teacher's help, work as a class to turn the eggs, fill the water canals, and monitor the incubator temperature. Consider setting up a schedule that would allow teams to rotate responsibilities.

2

Test your measurements.

Using the embryology record sheet, record the temperature each time you turn the eggs and take an average.

Student Activity Sheet

Name _____

Try it yourself

Building an eggs-ray viewer

Have you thought about what the chick might look like as it is developing inside the egg? With the candler, you will be able to see different parts of the egg and portions of the chick as it develops. Use your planning skills to design a candler. Answer the following questions to make your plan.

1 What's the problem?

Write about why we need to candle fertile chicken eggs.

_____

_____

_____

2 How could you solve the problem?

Write about your ideas for the candler.

_____

_____

_____

Draw a picture of what the candler will look like.

3 How could you test your plan?

_____

_____

_____

4 Share the plan.

Listen as each team shares their plans. Write down the ideas that you think are best.

_____

_____

_____

5 How could you improve the candler?

Draw a new picture.

- ☐ Help your team design and make a candler.
- ☐ Test your candler. Candle an egg. Can you see what is inside?

Write down the egg parts that you can identify with the aid of your candler.

_____

_____

Name _____

Playing peek-a-boo with embryos

Did you know a chicken embryo looks a lot like you did during your first three months of life inside your mother? Don't feel bad. Many embryos look alike during their early development.

What makes chickens special is that the embryo develops outside the mother's body. This arrangement lets us get a closer look at how the embryo develops without harming the mother or other embryos.

1. **Use the back of this paper to write or draw what you think a chicken embryo looks like.**
2. **After you have observed a developing embryo, draw what you saw in the space below. Then answer the questions.**
3. **Compare what you expected to see and what you actually saw. Write a paragraph explaining the difference between your expectations and what you actually experienced.**

What did you learn?

- ☐ What shape did the embryo have for the first five days of incubation? Draw the shape and label the head, heart and tail.
- ☐ Circle the first part of the embryo you noticed.

Where does the embryo get its food to help it grow?

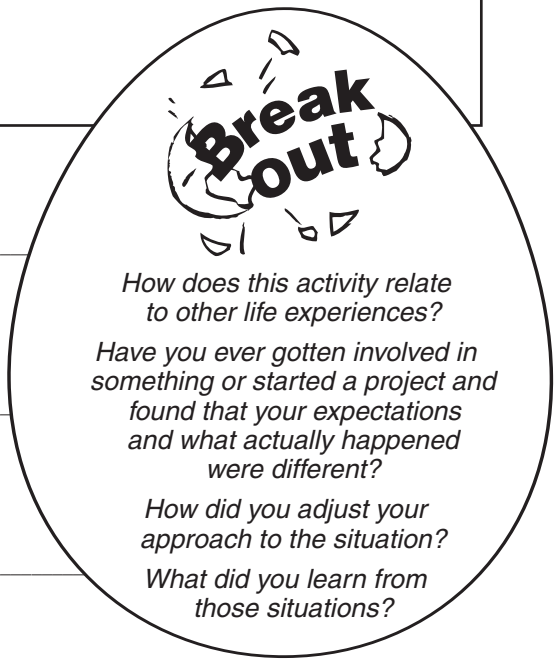
_____

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

_____

What does the amnion (the sac of clear fluid that surrounds the embryo) do for the embryo?

_____



Student Activity Sheet

Name _____

Building a home 'tweet home

Ever wanted to be a mother hen? Now is your chance. When you raise chicks in a brooder, you are taking the place of the chicks' mother hen. Through the brooder, you provide warmth, shelter and food. And you learn a lot about how to take care of a baby—even though that baby is mostly fuzz and just a few inches tall.

Use your planning skills to design a brooder, or new home, for your chicks once they hatch. Answer the following questions to make your plan.

1 What's the problem?

Describe what your chick needs in a new home.

_____

_____

_____

_____

2 How could you solve the problem?

On a separate piece of paper, write or draw about your ideas for the brooder and what the brooder will look like.

3 How could you test your plan?

_____

_____

_____

_____

4 Share the plan.

Listen as each team shares their plans. Write down the ideas that you think are best.

_____

_____

_____

_____

5 What could you do to make the brooder better?

Draw a new picture of how the brooder will look.

6 With your teacher's help, work as a class to make a brooder for your chicks. Place a thermometer in the brooder. Record the temperature three times a day for two days.

Day One	Day Two
Test one _____	Test one _____
Test two _____	Test two _____
Test three _____	Test three _____

7 What changes could you make to your brooder to keep the temperature at 95°F?

_____

_____

Beginner

Name _____

Embryology Record Sheet

Day Set: _____ Number Eggs Set: _____

Day Stop Turning: _____ Number Eggs Fertile: _____

Day Expected to Hatch: _____ Number Eggs Hatched: _____

Where did you get the eggs?

_____

What kind of eggs did you set in the incubator?

_____

What temperature is the incubator? _____

When do you add water?

_____

How often do the eggs need to be turned?

_____

How will you check fertility? _____

_____

_____

Addition and Subtraction

A. If you collect two eggs from one nest, four eggs from another nest and three from the final nest, how many eggs will you have to set in the incubator?

B. Mary had two dozen eggs in her basket. She dropped the basket and broke seven eggs. How many eggs are still unbroken?

C. If you set 18 eggs in the incubator and 11 hatched, how many eggs did not hatch?

D. If a hen laid one egg on 19 different days during the month of March, how many days did the hen not lay an egg?

Percentages

E. If a hen laid one egg on 20 different days during the month of April, what percent of April did the hen not lay an egg?

F. If you tested ten eggs for fertility and found that six were fertile, how many eggs out of 1,000 eggs from the flock would you expect to be fertile?

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	13	14	15	16	17	18
Not Fertile																		
Fertile did not pip																		
Fertile and pipped																		
Hatched																		
Died																		

Egg-stra notes

Poultry resources

Breed reference

American Bantam Standard
American Bantam Association
P. O. Box 127
Augusta NJ 07822
e-mail: fancybntms@aol.com

American Standard of Perfection
American Poultry Association
133 Millville St.
Mendon MA 01756-1210
(508) 473-8769
e-mail: apanetcontact@home.com

Extension publications

The following publications are available from:

Extension Publications
630 W. Mifflin St.
Madison WI 53706
(608) 262-3346

- *Bantams* NCR 209
- *Chicken Breeds and Varieties* A2880 (1989)
- *Home Slaughter of Poultry* A1478 (1989)
- *Poultry for Fun and Food* 4H281 (1993)
- *Pigeons* 4H135 (1985)
- *Raising a Small Turkey Flock* NCR060 (1981)
- *Raising Waterfowl* A3311

4-H "Skills for Life" Poultry Science Series

- NCR 507 Poultry 1 – *Scratching the Surface*
- NCR 508 Poultry 2 – *Testing Your Wings*
- NCR 509 Poultry 3 – *Flocking Together*
- NCR Poultry 4 – *Group Activity Guide*

Minnesota Chicken Pattern BU–2350
Distribution Center
20 Coffey Hall
Minnesota Extension Service
University of Minnesota
St. Paul MN 55108
(612) 625-8173

Poultry Judging 408-050
Cooperative Extension Bulletin Distribution
P. O. Box 68583
University of Nebraska
Lincoln NE 68583
(402) 472-9712
(402) 472-0542 fax
e-mail: gnickels@unl.edu

National poultry archives

National 4-H Poultry and Egg Conference
Contact: Ken Koelkebeck
282 Animal Sciences Lab
1207 West Gregory Dr.
University of Illinois
Urbana IL 61801
(217) 244-0195
http://www.ext.vt.edu/national4hpoultry/index.html

Organizations

American Egg Board
1460 Renaissance Dr.
Park Ridge IL 60608
http://www.aeb.org/

American Bantam Association
P. O. Box 127
Augusta NJ 07822

American Poultry Association
133 Millville St.
Mendon MA 01756-1210
(508) 473-8769
e-mail: apanetcontact@home.com
http://www.ampltya.com/

Poultry Science Association
111 N. Dunlap Ave.
Savoy IL 01874
(217) 356-3182
http://www.psa.uiuc.edu/

National Chicken Council
1155 15th St. NW
Washington DC 20005
(202) 296-2622
http://www.eatchicken.com/

The National Turkey Federation
1225 New York Ave. NW, Suite 400
Washington D.C. 20005
(202) 898-0100
(202) 898-0203 fax
http://www.turkeyfed.org/

U.S. Poultry & Egg Association
1530 Cooledge Road
Tucker GA 30084
Telephone: (770) 493-9401
Fax: (770) 493-9257
http://www.poultryegg.org/

Periodicals

Game Breeders Gazette
1155 E. 4780 South SS
Lake City UT 84117

Hen House Herald
(exhibition poultry)
Box 1647
Easley SC 29641

Poultry Digest
(egg and meat chickens)
Watt Publishing Co.
122 S. Wesley Ave.
Mount Morris IL 61054

Poultry Press (monthly)
P. O. Box 542
Connersville NY 47331
http://www.poultrypress.com/pp

Turkey World
Watt Publishing Co.
122 S. Wesley Ave.
Mount Morris IL 61054

Supply catalogs

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
(800) 962-2660

"Development of the Chicken Embryo" (color poster)
Jamesway Incubator Company
1712 Williams Rd.
P. O. Box 629
Monroe NC 28111
(704) 291-9113

REVIEWED & RECOMMENDED
National 4-H Curriculum

Discover over 180 National 4-H Curriculum titles in mission areas of Science, Engineering and Technology; Healthy Living; and Citizenship. Youth activity guides are filled with fun, engaging experiences that cultivate abilities youth need for everyday living as they progressively gain knowledge about subjects that interest them.

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Agricultural Science
- Afterschool Agriculture

Animal Science
- Beef
- Cat
- Dairy Cattle
- Dairy Goat
- Dog
- Embryology
- Entomology
- Exploring Farm Animals
- Meat Goat
- Pets
- Poultry
- Rabbit
- Sheep
- Swine
- Veterinary Science
- Horse

Engineering and Technology
- Aerospace Adventures
- Electric Excitement
- Computer
- Exploring 4-H Robotics
- Geospatial
- Sewing Expressions
- Small Engines
- Woodworking Wonders

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- Exploring Your Environment
- Forestry—Forests of Fun
- Fishing for Adventure
- Outdoor Adventures

Plant Science
- Down-to-Earth—Gardening in the Classroom
- Gardening

Science Discovery
- Science Discovery Series

Healthy Living

Health and Fitness
- Bicycle Adventures
- Child Development—Kids on the Grow
- Keeping Fit and Healthy

Nutrition
- Foods
- Microwave Magic

Citizenship

Communication and Expressive Arts
- A Palette of Fun
- Communications—Express Yourself!
- Photography
- ¡Qué Rico! Latino Cultural Arts
- Theatre Arts
- Visual Arts

Community Action
- Citizenship—Public Adventures
- Service Learning

Leadership
- Exploring 4-H
- Step Up To Leadership

Personal Development
- Consumer Savvy
- Financial Champions

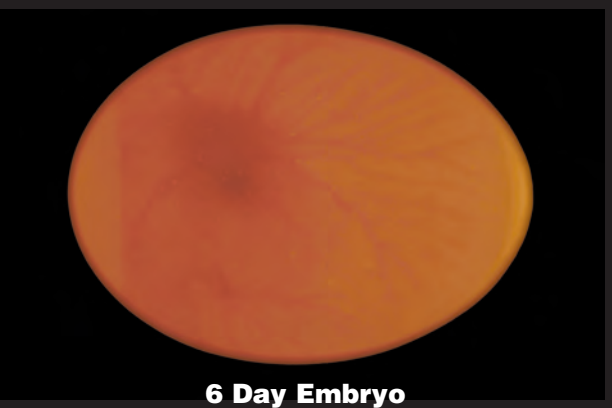
Workforce Preparation
- Be the E—Entrepreneurship
- Get in the Act!

Resources

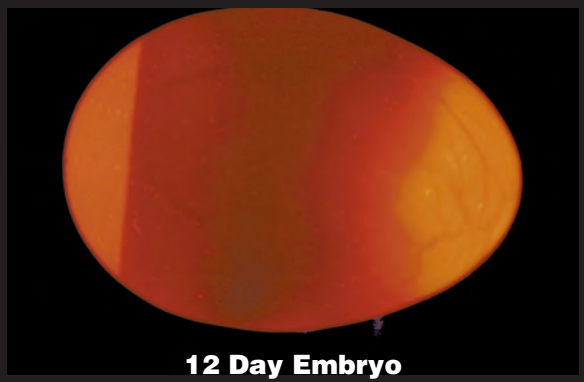
- Experiential Learning Video

Find more about **Embryology** and other projects online at:

www.4-hcurriculum.org



6 Day Embryo
Under Candling Light



12 Day Embryo
Under Candling Light

The 4-H Pledge

I pledge
my Head to clearer thinking,
my Heart to greater loyalty,
my Hands to larger service, and
my Health to better living,
for my club, my community,
my country, and my world.

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www.4-hcurriculum.org