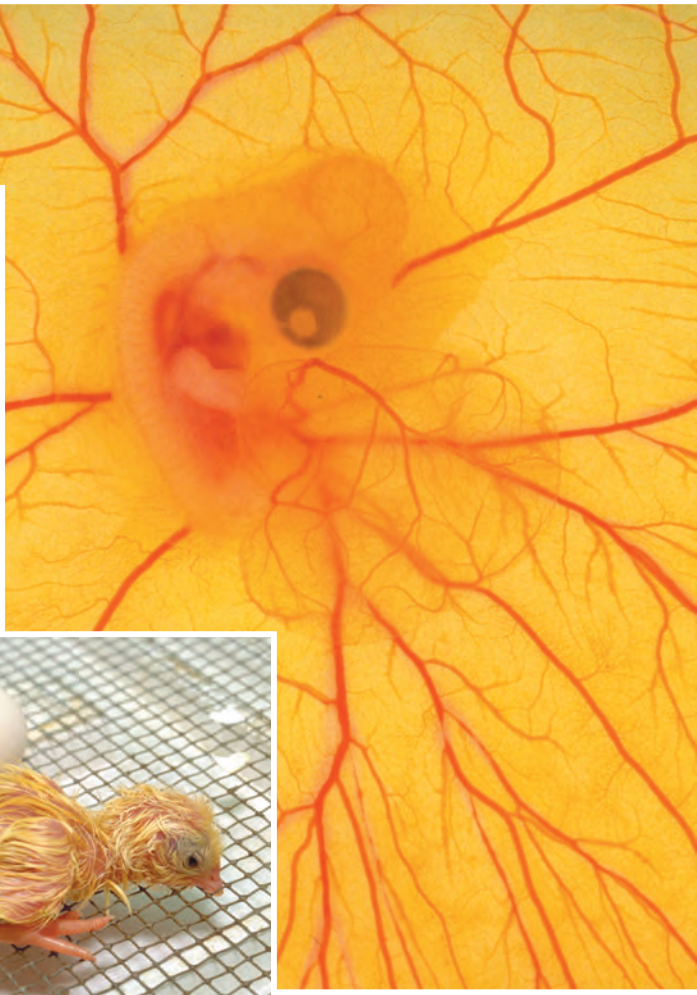
National 4-H Curriculum
BU-07595

Embryology IN THE CLASSROOM

Hatching Classroom Projects



Helper's Guide
Beginner
Grades 2-5

REVIEWED & RECOMMENDED
National 4-H Curriculum

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.

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

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.

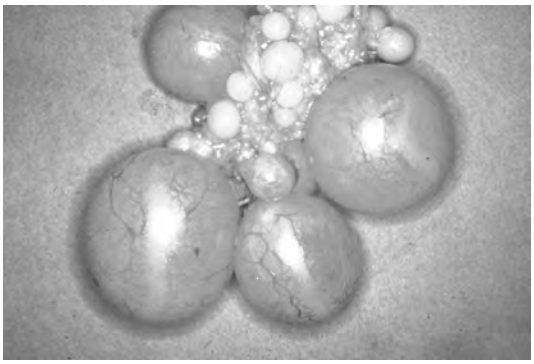


Figure 7 – Ovary

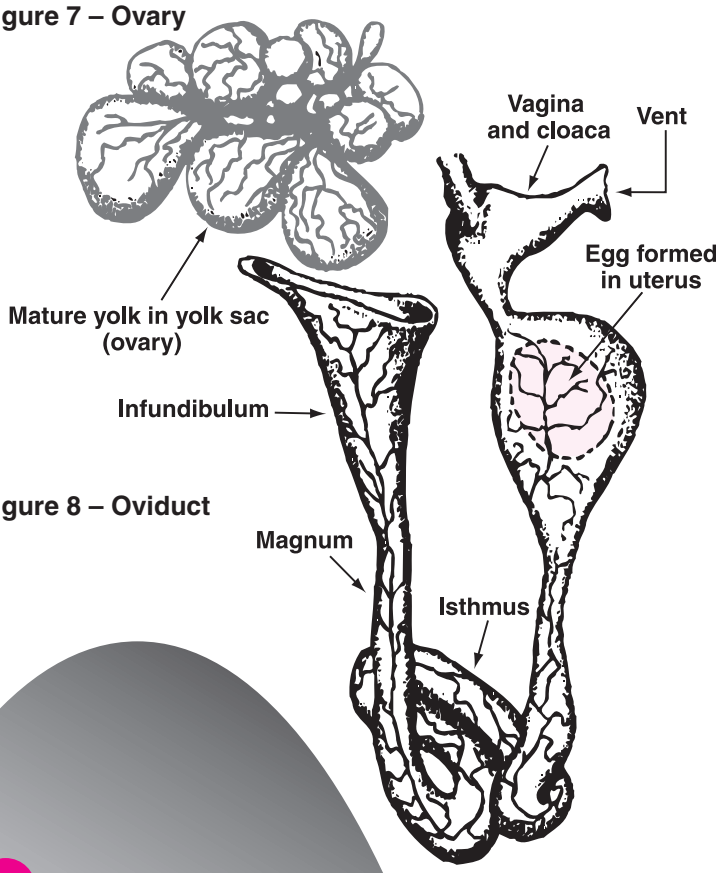


Figure 8 – Oviduct

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.

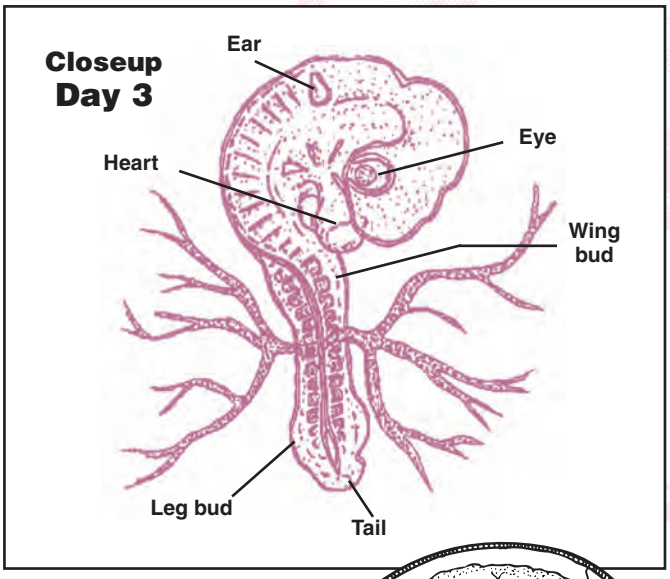
20 hours — Appearance of vertebral column.

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.

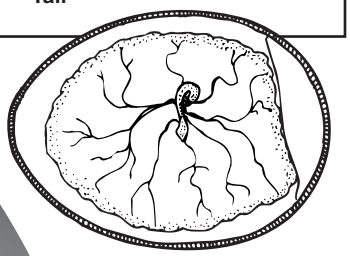
Main division of legs and wings.

Voluntary movement begins.

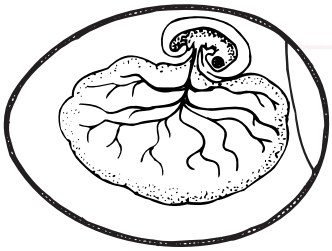
Day 7

Digits on legs and wings become visible.

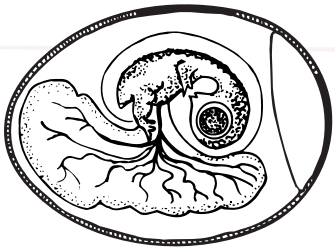
Abdomen becomes more prominent due to development of viscera.



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.

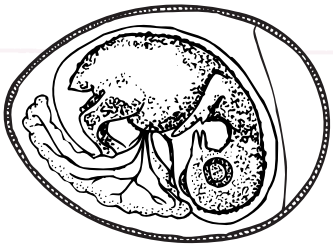
Allantois ceases to function and starts to dry up.

Day 21

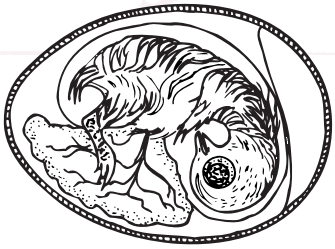
Chick hatches.

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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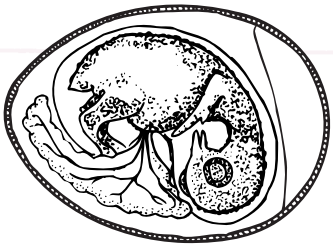
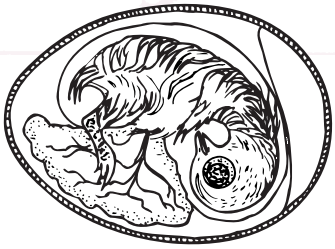


Day 12



Day 15

Day 18

Day 20

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.

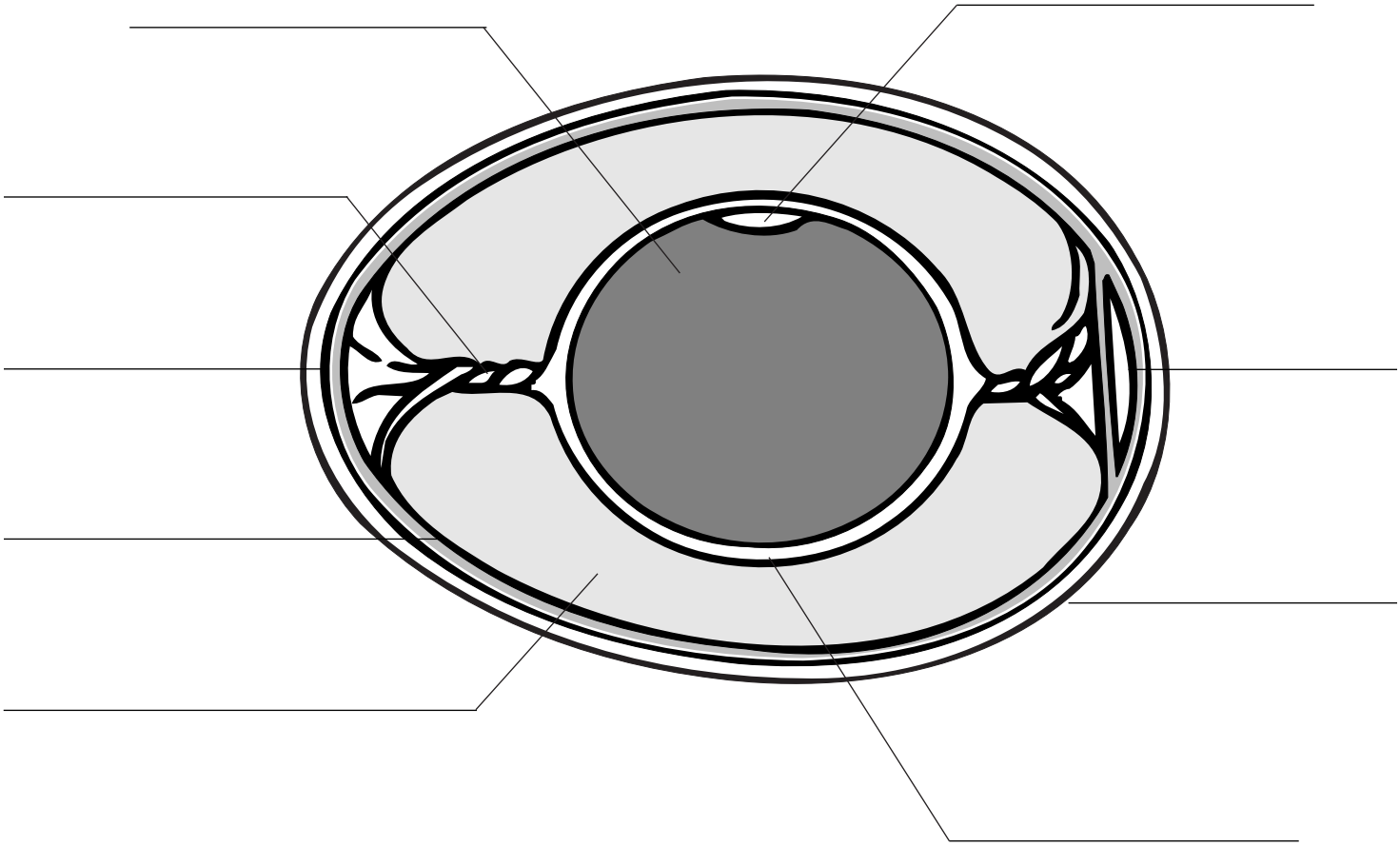
Yolk sac – A membrane sac that surrounds the yolk of the egg.

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



Name _____

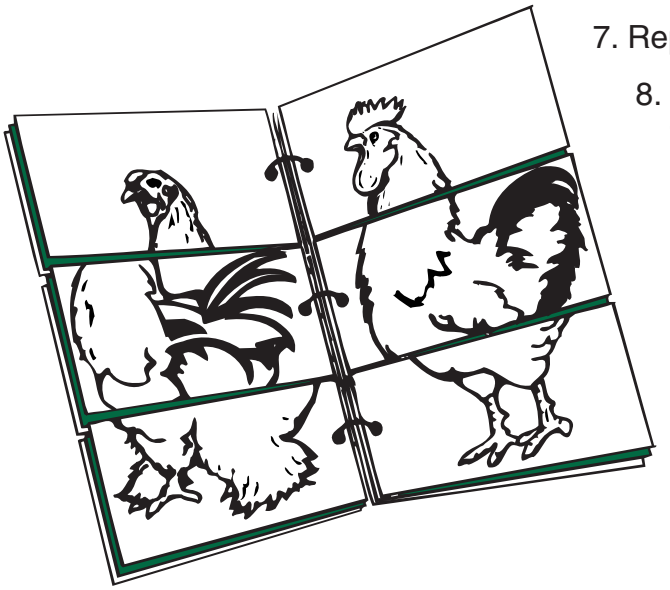
Chick breed-maker notebook

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 3 2/3 inches by 8 1/2 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?

_____

Break out

How does this activity relate to other life experiences?

Have you ever gotten involved in something or started a project and found that your expectations and what actually happened were different?

How did you adjust your approach to the situation?

What did you learn from those situations?

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.

All titles have been reviewed and recommended by the National 4-H Curriculum Jury Review process, signifying their excellence in providing hands-on learning experiences for youth.

Science, Engineering and Technology

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

Environmental Science
- 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

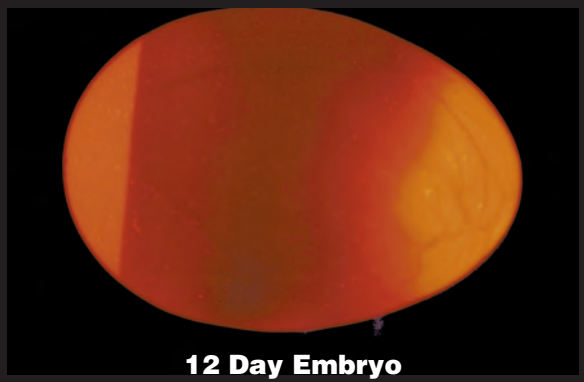
Workforce Preparation
- Be the E—Entrepreneurship
- Get in the Act!

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.

Explore more curriculum projects online at:

www.4-hcurriculum.org