NC 4-H Embryology Quickstart Guide

NC STATE EXTENSION

Welcome to 4-H Embryology from NC State Poultry Youth Programs

Have you ever wondered how an egg transforms into a chick? Your 4-H Embryology project will take you on this life cycle journey. Embryology is the study of how life develops from an embryo into a fully developed organism.

To do embryology well, you need to know how to care for fertile hatching eggs, to set up an incubator, keep records, and candle eggs. This Embryology Quickstart Guide (EQG) is provided to give you the basics of what is needed to help ensure you will have 'egg'cellent hatchability so that 21 days after you set your eggs, out 'pips' a chick!

If you really enjoy working with eggs and chicks, did you know that there are jobs like being a Hatchery Manager (someone who directs the hatching of thousands of chicks/day), to being a Flock Supervisor (who help poultry growers best manage their flocks), and to Poultry Veterinarians (who help to keep all flocks healthy)?

If you want to learn more about 4-H Embryology, poultry science, or poultry careers, please reach out to your local county extension agent or poultry extension specialists. If you would like more information on 4-H Embryology, please check out the NC 4-H Embryology Digital Assets (see page 3) or go to shop4-h.org to see the wide variety of hatching/poultry curriculum available for purchase.

In this EQG, there may be new vocabulary; at the back of this manual is a vocabulary guide. Also, there are several Poultry Puns scrambled throughout this text; can you find how many there are?

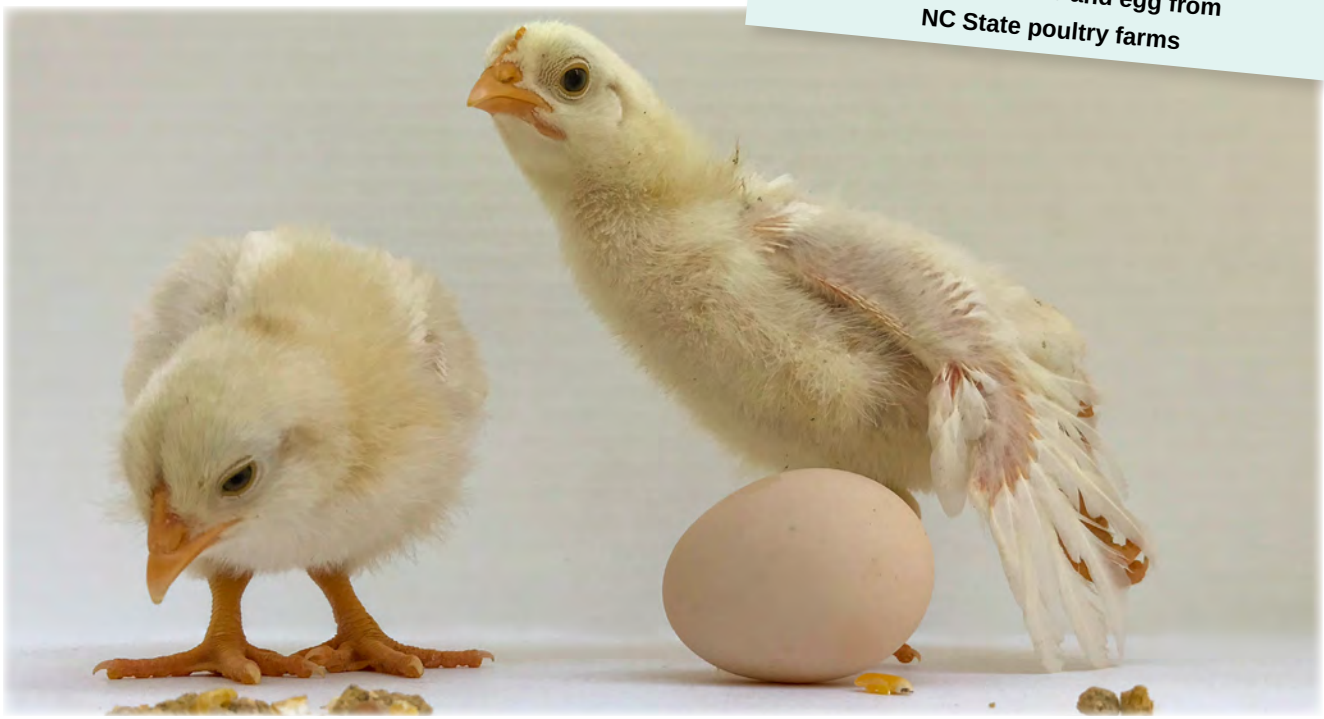
More Resources from NC 4-H Embryology

Check Out the Digital Assets:

go.ncsu.edu/embryology-materials

NC STATE EXTENSION

Table of Contents



Leghorn chicks and egg from NC State poultry farms

Think Before Hatching

For a successful 4-H Embryology Project, there are several important considerations, including choosing the right bird, egg, and incubator (the machine used in place of a broody hen). Lets eggsplore each of these a bit more.

The Right Bird

Before the right egg can be selected, the right breed of bird needs to be decided. Select the right purpose of the breed of bird for the desired use. Some breeds of chickens are more for laying eggs, growing meat, or both (called dual-purpose breeds). Meat chickens, known as broilers, are harvested for food usually by 7 weeks while laying breeds are kept for years. Layers will start producing eggs in 5-6 months. Layers are type of bird kept for a backyard flock.

The Right Egg

Below are some important considerations as to what makes the right egg:

- Fertility
- Storage temperature
- Egg collection practices
- Age of breeder flock
- Age of egg (<10 days)

Fertile

Eggs used in 4-H Embryology must be fertile meaning they are from hens housed with a rooster. Eggs from the grocery store are infertile and will not hatch (as they are laid by hens housed without roosters).

Storage temperature ‘Goldilocks Zone’ 50°-70°F

The ‘Goldilocks Zone for Hatching Eggs’ is between 50°-70°F; above 70°F is Too Hot and below 50°F is Too Cold. If eggs were stored in a refrigerator, they are stored at 40°F which is Too Cold (<50°F) for hatching.

If a 4-H Agent picked up eggs from the Poultry Teaching Unit at NC State University, care was taken when transporting eggs in the car.For example, a cooler was used during the Too Hot times, and eggs were not left in a cold car during the Too Cold times of the year.

Bring a thermometer along when transporting and storing eggs.

Use A Reliable Egg Source

Management of egg collection and breeder flocks can influence egg quality for hatching. Eggs that are collected daily and from nests are less likely to have feces or get broken.

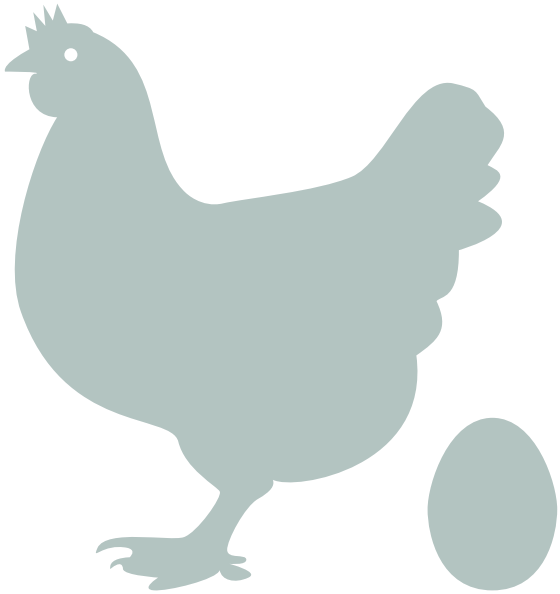
For hatching, clean eggs do not need washed which leaves the protective cuticle (or bloom). This protects egg shell from bacteria. It is best practice to ‘dryclean’ small amounts of dirt from eggs with a sanding block or nail file to leave cuticle intact.

Age of the breeder flock (parent stock) also influences egg quality. Eggs from very young or old hens may result in eggs less able to hatch. Finding a good source of fertile eggs, like the NC

State University farm or a local, reliable hatchery, will help to ensure a good hatch.

Age of Egg <10 days

Storing eggs longer than 10 days leads to decreased hatchability. At the NC State Layer Farms, eggs are usually provided that are < 5 days of age as there may be a day or more between the agent picking up, delivering, and the teacher setting eggs in the classroom.



The Right Incubator

The incubator is the machine that replaces a mother hen's brooding ability. In NC 4-H Embryology, the recommended incubator is GQF Manufacturer's GENESIS Hova-Bator 1588 that is TUV LISTED. This certification along with the safety afforded by its 12 Volt system makes it perfect for classroom use. It is pre-set for bird eggs. Simply plug it in, then add water for humidity and eggs.

4-H Embryology is 'eggcited' to share this equipment with you so that you can learn about life cycles and hatch chicks. These supplies are loaned to you, and with proper care, this equipment can be used by other 4-H members for years to come. Below is a checklist of supplies to ensure all pieces are included. If any parts are missing, please contact your 4-H Agent.

NC State University Has Hatching Eggs Too!

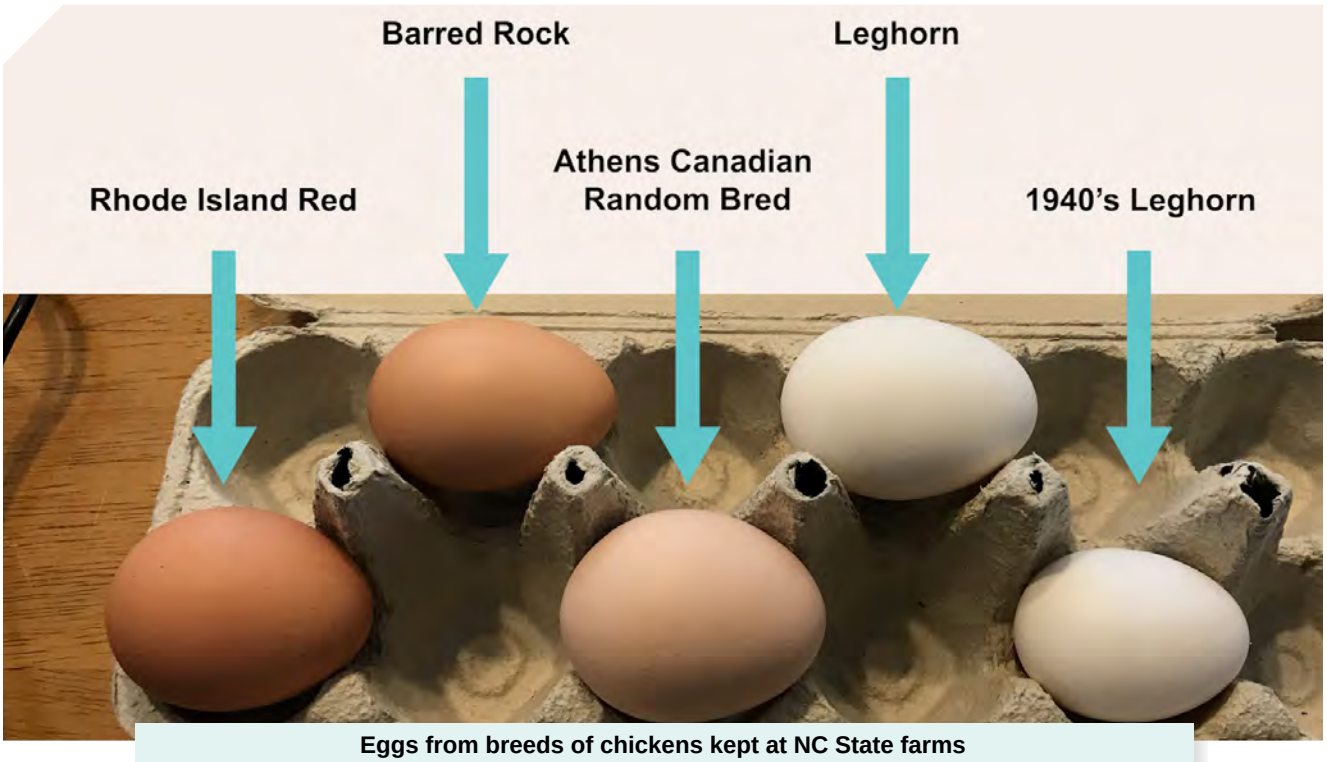
NC State doesn't just have the most students of any campus in North Carolina, they also have poultry farms that supply fertile eggs for 4-H Embryology!

Your NC 4-H Agent may have gotten fertile hatching eggs from the NC State University Layer or Broiler Farms. You may wonder why a university would keep chickens, and that is because the College of Agriculture and Life Sciences at NC State has the Prestage Department of Poultry Science. This department is where students learn what is needed to be a professional to assist in growing poultry as food animals. A farm is needed to help teach the college students that come to this university as well as to support the scientists that work hard to grow chickens healthier and more sustainably. With poultry being the number one agriculture commodity in the state of North Carolina, and it is important that we have a well-trained workforce to assist in growing poultry as food animals. See our careers page in the back of the book for how you can get involved.

Broilers are kept at NC State's Chicken Education Unit, and several breeds of layers are kept at NC State's Poultry Teaching Unit in Raleigh, NC. Most 4-H Embryology projects in NC use layer eggs.

NC State University Layer Farm Breeds

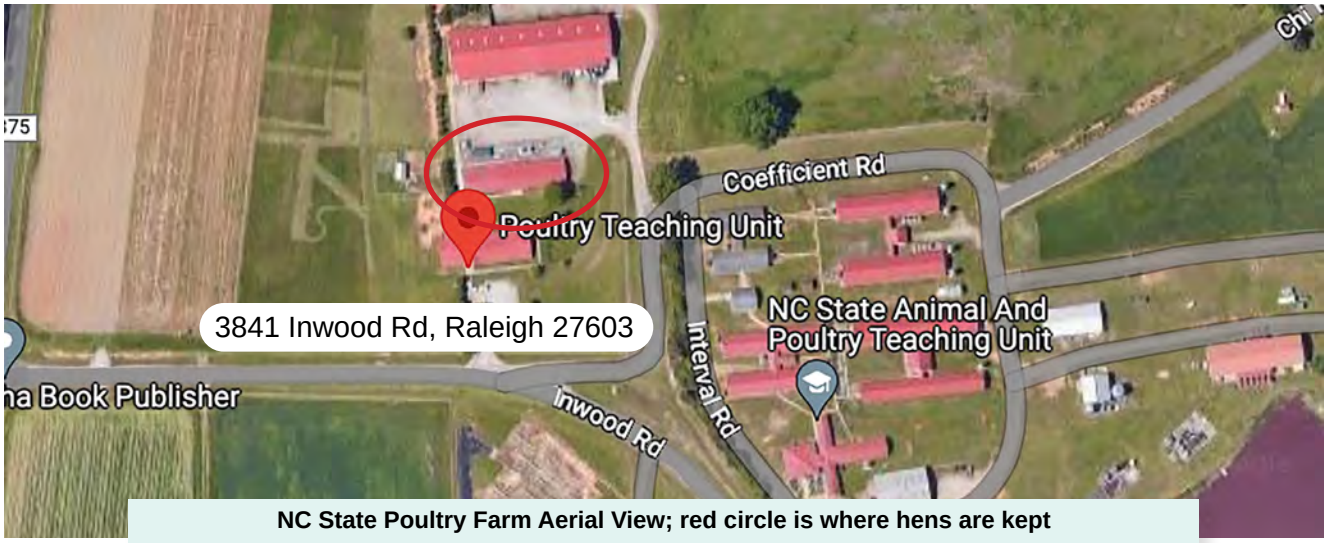
Below are the eggs from a few of the breeds that youth doing 4-H Embryology in NC may be hatching. Learning about different chicken breeds can help in selecting the right breed for a farmer's needs and can be a fun way to learn more about poultry. Breeds are divided into 6 classes, and a class is a group of breeds originating in the same geographical area. Classes include: Asiatic, Mediterranean, Continental, English, American, or Others.



Eggs from breeds of chickens kept at NC State farms to supply hatching eggs for 4-H Embryology

Meet the NC State University Layers

Did your eggs come from the NC State University Farms? This is the location of the Laying Hen Farm (called Poultry Teaching Unit) where college students come to learn Poultry science. Over 400 2nd-grade classrooms across North Carolina get their hatching eggs for 4-H Embryology from NC State Farms. Was your classroom one of them?



NC State Poultry Farm Aerial View; red circle is where hens are kept

Barred Rock Breed Pen at NC State Farms

Leghorn Breed Pen at NC State Farms

Rhode Island Red Breed Pen at NC State Farms

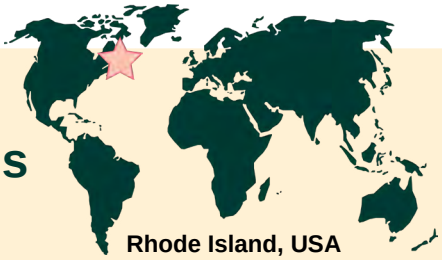
NC State University Laying Hen Breeds

Which breed is right for you to hatch?

Rhode Island Red chick newly hatched as seen by wetness of down

Chicken Breed Details

Rhode Island Reds



Rhode Island, USA
American Class

Eggs laid per week

5-6

Weight

8.5 lb. & 6.5 lb.

Chick and egg

Mainly used for

meat and eggs

Favorite weather

hot and cold

Six day old chick

Skill level

beginner

Life Expectancy

5-8 years

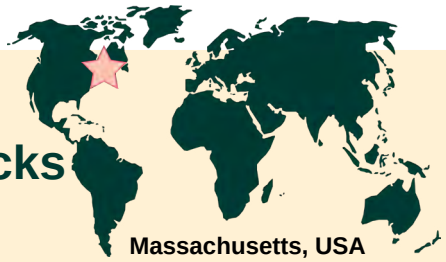
Thirteen day old chick

Temperament

lively, confident, noisy, curious,
can be aggressive, and a bully.

Chicken Breed Details

Plymouth (Barred) Rocks



Massachusetts, USA
American Class

Eggs laid per week

4-5

Weight

9.5 lb. & 7.5 lb.

Mainly used for

meat and eggs

Favorite weather

hot and cold

Skill level

beginner

Life Expectancy

8-10 years

Temperament

Very curious, chatty, calm, can be a bully to other chickens.

Chick and egg

Six day old chick

Thirteen day old chick

Chicken Breed Details

Leghorn

Tuscany, Italy
Mediterranean Class

Eggs laid per week

5-6

Weight

8 lb. & 5 lb.

Mainly used for

meat and eggs

Favorite weather

hot and cold

Skill level

Experienced

Life Expectancy

4-6 years

Temperament

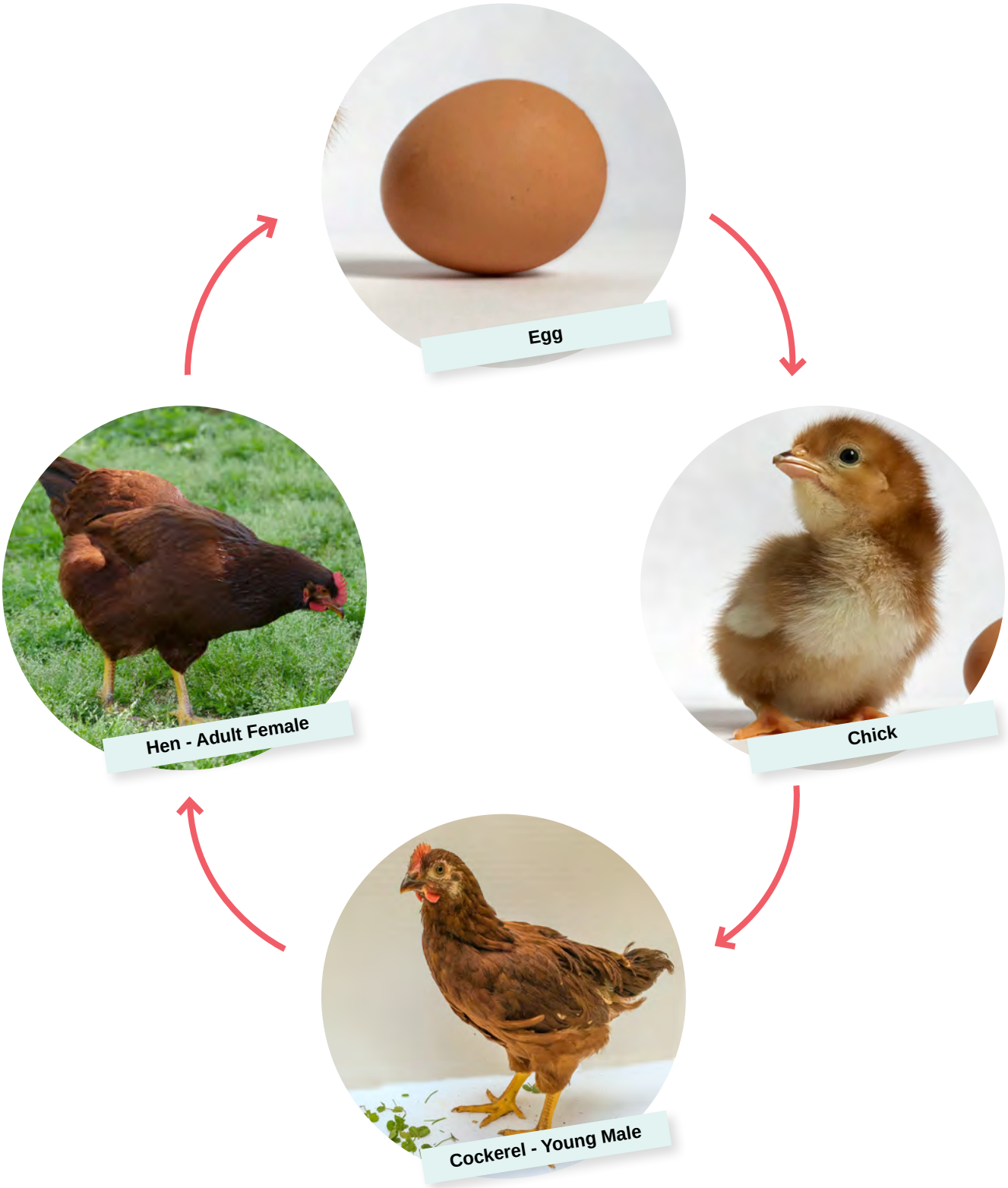
Very active, easily bored, noisy, flighty, and nervous.

Chick and egg

Six day old chick

Thirteen day old chick

Life Cycle of the Rhode Island Red Breed of Chicken



Ready, Set, Incubate!

Let’s go through the process from start to finish.

Leghorn chicks starting to dry as down is getting fluffy

Incubator Parts

(repack incubator parts in box in this order)

1. Styrofoam Incubator Bottom

2. Styrofoam Incubator Top with heat element and fan

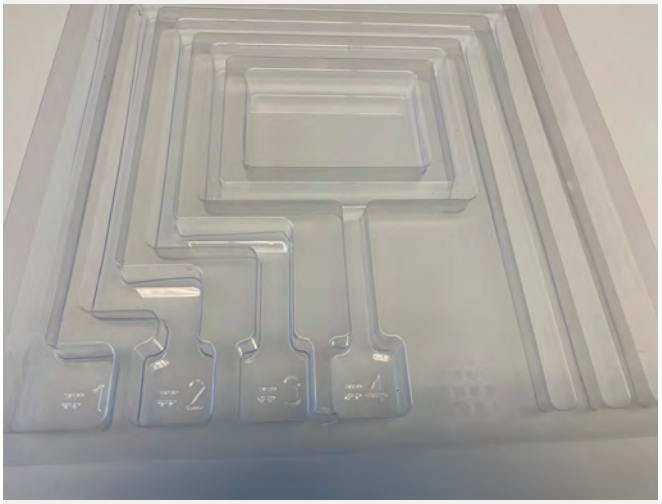
3. Red vent plug

4. Power supply

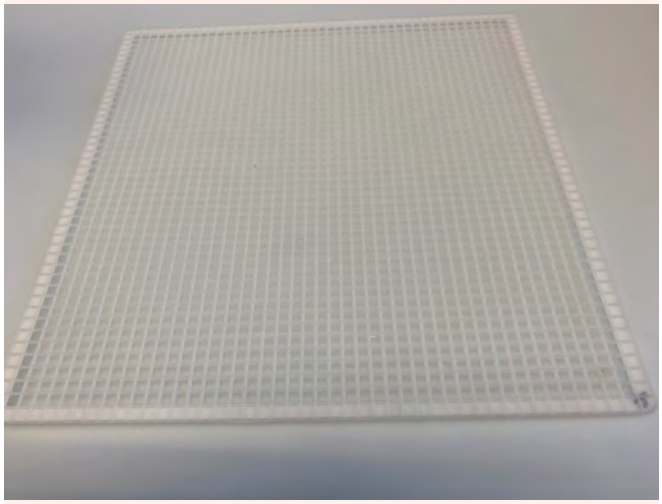
Incubator Parts

(repack incubator parts in box in this order)

5. Plastic liner - with troughs in which water is poured for humidity



6. Incubator floor grid – plastic grid floor piece eggs are placed



7. Instruction manual in plastic sleeve

8. Cardboard Box - kept in good shape for the next group

Getting Ready

Note: This is for the Model 1588 - Genesis Hova-Bator Incubator. Your incubator may differ. Check with your local 4-H agent if you have any questions.

Incubator Video
youtu.be/HOfYb1kCQ-0

At least two days before the eggs arrive:

- ☐ Watch the video, Setting Up the Incubator
- ☐ Unpack the incubator box (save this box - incubator will be repacked in this box).
    - If your incubator is missing any parts or the manual, let your 4-H agent know.
- ☐ Store the box in a safe place - incubator must be returned in this box or a charge may be incurred by the borrower
- ☐ Select a flat, stable surface for the placement of your incubator that
    - Is out of reach for pets, children, or other hazards,
    - Has access to a dedicated electrical outlet that no one else will use during the project, and
    - Is in a temperature-controlled environment.
    - Avoid drafts, close contact with heat or cooling sources, and direct sunlight
- ☐ Place the plastic liner with troughs for water inside the bottom of the incubator.
- ☐ Fill troughs 1 & 4 half full with lukewarm or room temperature water (about 1/2 cup water per trough).
- ☐ Add the plastic grid on top of the water trough and close the incubator.
- ☐ Make sure the little red plug is plugged in the top of the incubator.
    - If your incubator is missing the red plug, you can tape over the hole as a temporary solution. Let your 4-H agent know that the plug is missing.
- ☐ Plug the charger into the top of the incubator and into the wall.
    - If the incubator does not turn on, make sure the charger is plugged all the way in and the outlet is working properly.
    - Check with your 4-H agent if it still does not turn on after troubleshooting.
- ☐ Check the humidity and temperature readings frequently.
    - Humidity should stabilize around 50-60%.
        - ☐ If your humidity is too low, add more water to the troughs. You may need to use troughs 2 and/or 3 as well as 1 and 4. You can pour the water through the plastic grid into the troughs.

- ☐ If your humidity is too high, remove the plastic grid. Add a sheet of aluminum foil over half of the plastic liner troughs to slow the rate of evaporation. Then replace the grid.

- Temperature should automatically be set to 100 degrees Fahrenheit.
  - ☐ Temperature should stay between 99 and 101 degrees. It is best practice to have a second thermometer to verify the readings of your incubator. A hygrometer which measures both temperature and humidity with a probe is ideal for this purpose.

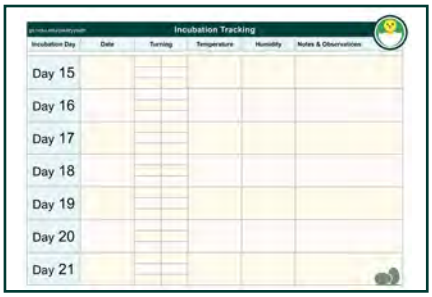
☐ Use the manual to help you troubleshoot issues that arise during the setup.

- Contact your 4-H agent if you need further assistance.

Youth Worksheets

Anatomy of the Egg Activity Sheet

Incubation Tracking Sheet



Egg Tracking Sheet (hatch rates)

Additional embryology videos and worksheets

NC4HCurriculum.org<Virtual Resources<
Embrylogy Hatching Guide

Getting Set

Is your incubator in a secure place and has been maintaining at least a 99.5 F temperature and 50% humidity for the last 24 hours? If yes, it is time to 'set' eggs. Setting eggs means to place eggs in an incubator (or under a broody hen) which will create ideal conditions for embryo development.

Prep Before Setting Eggs

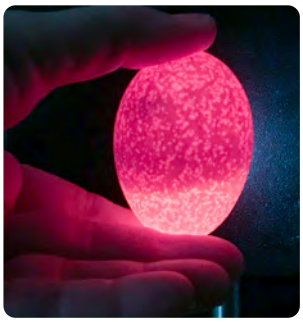
- ☐ Watch the video, Setting the Eggs
- ☐ Wash your hands before and after touching eggs or chicks to prevent introducing or taking away pathogens (germs which can cause disease)

Setting Eggs Video
youtu.be/0c-lwZ5GKbs

- ☐ Cut a paper towel/TP cardboard roll in small rings (¼-½") and place on bottom of incubator
- ☐ Record Keeping - write down daily temperature and humidity levels before opening incubator

Prep Eggs

- ☐ Clean eggs of adhering material with fine grit sandpaper, sanding sponge, or nail file. This keeps cuticle or bloom protecting egg's pores from bacteria
- ☐ Best practice is to 'candle' eggs before setting. Candle by shining small flashlight on large end of egg in a dark room
    - ☐ Observe Air Cell - fresh eggs (like hatching eggs) should have small air cells
    - ☐ Check for cracks or fractures in shell - may happen during transit
        - Best practice is to avoid setting cracked eggs. Dispose properly and do not consume



- ☐ Mark with a pencil the long side of the egg with an X on one side and an O on the other side - to keep track of eggs that you turned (eggs will be turned 3 times/Day 0-18)
- ☐ Place each egg on its side in cardboard ring (to prevent rolling) on the plastic grid floor of your incubator with either all X's or all O's facing up
- ☐ Your eggs are set, and this will be day 0 of your incubation
    - Incubation time will depend on species of poultry, but most 4-H Embryology projects incubate chickens which will take 21 days. Now you have begun the eggventure of incubation!

Other Poultry Incubation Times		
	Bobwhite Quail: 23 days	Muscovy Duck: 36 days
	Turkey: 28 days	Ostrich: 42 days
	Duck: 28 days	

Incubate!

A hen has two important jobs to do when she 'sits' on her eggs; she must give the eggs heat and humidity and turn the eggs. The hen develops a brood patch when she starts to sit on eggs. It is a special type of moult so feathers are lost allowing direct contact of the skin to heat the eggs. The brood patch also develops a supplemental blood supply to bring more heat close to eggs. Also, the hen turns the egg using her beak and gravity to ensure the embryo doesn't 'stick' to the shell membrane, gases move around, and the temperature is evenly distributed. In 4-H Embryology, an incubator replaces the hen, but it requires your assistance. Record daily that the incubator is providing consistent and correct temperatures and humidity, and add water as needed. Turn eggs three times each day by turning from the X to O side of egg.

Prepare

- ☐ Watch the video, Incubation Tips

Incubation Tips Video
youtu.be/85sA8acqRNU

Intro Brooder Box Setup Video
youtu.be/K-IFKlh81cM

Turning Eggs

- ☐ Wash your hands before and after touching eggs or chicks to prevent introducing or taking away pathogens (germs which can cause disease)
- ☐ Record daily temperature and humidity levels before opening incubator
    - ☐ Humidity too low - add ½ cup lukewarm water to trough 1 or 4
- ☐ Turn and record turning of eggs

Candle Eggs to observe Embryo development

- ☐ Candle by shining small flashlight (or cell phone) on large end of egg in a dark room
    - ☐ Observe Air Cell - does it get larger or smaller during incubating? Why?
    - ☐ Check for development of the embryo
        - When are blood vessels visible? Eye? Heartbeat?
- ☐ Check for 'Infertile' eggs - eggs with no development
    - ☐ If certain there is no development - remove and properly dispose
    - ☐ Record number of infertile eggs

Day 18

- ☐ Stop turning eggs - embryo needs to orient itself
- ☐ Increase humidity by 5%
- ☐ Remove red plug and tape to incubator for safe keeping

Day 19 - Prep Brood Box - chicks may arrive early

- ☐ Shavings, Heat Source, Feed (Crumble Starter Feed), Water, Mason Jar, Plate

Incubator Cleaning Instructions

Please clean all supplies as listed below. Pay special attention to plastic liner and incubator bottom to make sure it is free from feces, eggshell, and down so that this will be a safe environment for the next hatch. Do NOT put any part of this incubator in a dishwasher as heat will damage it. At least two days prior to returning the incubator to the 4-H agent, make sure incubators are cleaned and then allowed to dry prior to being put back into the box in which it was given to you. Remember, do NOT throw away the blue box that incubator came packed in.

Cleaning Incubator bottom, plastic liner, and incubator floor

1. Place foam incubator bottom in a laundry sink, bathtub or on the grass outside
2. Add a couple drops of dish soap and fill halfway with warm water
3. Add the plastic liner and incubator floor to the soapy water
4. Let them soak for 5-10 minutes
5. Using a cloth or sponge to wash the items. An old toothbrush works well to clean inside the grooves of the plastic liner
6. Rinse and if any items are still dirty or stained, please repeat steps 1-6
7. Let items dry at least 24 hours so they are completely dry before being returned to the cardboard box

Cleaning Incubator top and power supply

Since the top of the incubator and power supply contains electrical parts, they cannot be immersed in water or they will stop working! If any of these items are dirty, please wipe them with a slightly damp cloth and let them dry completely before placing them back in the incubator and inside the storage cardboard box.

Missing Pieces

Make sure to return incubators with all pieces in working order. Any pieces that are returned dirty or are missing may incur a charge.

To get your incubator to fit back into the box it came in, its parts must be repacked in the order that they are listed on page 14 & 15. Begin with 1) Incubator bottom; turn over 2) Incubator Top and place inside incubator bottom making sure 3) Red Plug is attached; place 4) Power Supply with both cords inside the upside down Incubator Top; in this order, lay 5) Plastic Liner, then 6) Floor Grid, and finally 7) Manual on top of Incubator Bottom and Top. The incubator is now ready to slide into the cardboard box it arrived.

**Make sure all parts are dry before repacking.*

Marek's Disease

Marek's Disease	A highly contageous infectious disease of poultry caused by a herpesvirus, which attacks nerves and causes paralysis or initiates widespread tumor formation.

Remember, all chicks need to be vaccinated for Marek's Disease as soon after hatch as possible, but it is very important for layers.

In 4-H Embryology, your agent will provide the right type of bird for the youth or farmer who will take back the chicks hatched in each classroom.

Obtain vaccine from ValleyVet.com.

Dr. Rocio Crespo demonstrates how to prepare and administer the vaccine in the video below.

go.ncsu.edu/marek-disease

Need help? Reach out to your Poultry Area Specialized Extension Agent.

Extras

Barred Rock hen and chicks

Literacy Resources for Embryology

Books About Chickens

Non-Fiction

Where Do Chicks Come From? *by Amy E. Sklansky*
See How They Grow: Chicks *by Angela Royston*
Life Cycle of A... Chicken *by Angela Royston*
Chickens *by Beverley Randell and Clive Harper*
Face to Face With The Chicken *by Christian Havard*
Chicks and Chickens *by Gail Gibbons*
Chickens *by Gail Saunders-Smith*
Chicken *by David Schwartz*
Chickens on the Farm *by Mari C. Schuh*
Life Cycle of the Chicken *by Lisa Trumbauer*
The Egg- A First Discovery Book *by Gallimard Jeunesse*

Fiction

Hatching Chicks *by Susan Blackaby*
Too Many Chickens! *by Paulette Bourgeois*
Hedgie's Surprise *by Jan Brett*

Books About Eggs and Oviparous Animals

Chickens Aren't The Only Ones *by Ruth Heller*
Out Of The Egg *by Alan Suzuki*
Egg Story *by Anca Hariton*
What Will Hatch? *by Jennifer Ward*
Where Are You From? Oviparous/Viviparous Animals *by In-Sook Kim*
Guess What Is Growing Inside This Egg *by Mia Posada*
Whose Egg? *by Lynette Evans*
First The Egg *by Laura Vaccaro Seeger*
Nature's Perfect Package: Egg *by Steve Jenkins and Robin Page*
An Egg Is Quiet *by Dianna Aston*
Egg- A Photographic Story of Hatching *by Robert Burton*
Watch Me Grow Duckling *by Lisa Magloff*
See How They Grow Duck *by DK Publishing*
See How They Grow Penguin *by DK Publishing*

4-H Avian Bowl

If you enjoy learning about poultry breeds, you may want to consider competing in 4-H Avian Bowl. To learn more about 4-H Avian Bowl, please refer to the 4-H Avian Bowl Quick Start Guide.

To learn more about breeds of chickens, find out more from the 4-H Avian Bowl manual accessed free online.

Quick Start Guide
go.ncsu.edu/quick-start-guide

Avian Bowl Manual
go.ncsu.edu/ab-manual

Vocabulary

Air Cell - air filled pocket at large end of egg between the white (albumen) and shell of the egg; when egg is laid, the cooling takes place making contents contract which draw a vacuum through shell at larger, more porous end of egg

Albumen - four layers of whitish watery substance with protein that surrounds and contains the yolk within the center of the egg

Broiler - chickens kept for meat production and harvested in 1-2 months

Broody Hen - a hen that wants to not lay eggs but sit to hatch out eggs; she develops a 'brood patch' which works like an incubator

Brood Patch - area on breast of hen that allows her to heat eggs during incubation

Chalaza - two white twisted cords of mucin fiber which attach to the yolk and inner membrane holding yolk in center of egg

Chorioallantoic Membrane (C.A.M.) - membranes in egg with blood vessels that provide oxygen and calcium to chick embryo

Cockerel - young male chicken under 1 year of age

Cuticle (or Bloom) - protein layer placed on egg as it is laid which protects pores of egg from bacteria while still allowing air inside needed for the growing chick

Dual Purpose-breeds - animals raised for two purposes; for example, Plymouth Rock is a good layer and meat producing chicken breed

Embryology - the study of how life develops from an embryo into a fully developed organism.

Feces - undigested food that is eliminated from the body; also known as excrement or poop

Fertile - eggs that are from hens housed with a rooster and can be hatched

Germinal Disc - entrance of the channel which leads to point in yolk where fertilization takes place

Goldilocks Zone Storage Temperature - Fertile hatch eggs must be stored at 50°-70°F; < 50°F is too cold and >50°F is too hot.

Hatchability - a fun math equation important for farmers hatching eggs; # chicks hatched/# eggs set x 100= % hatchability. Your hatchability should be above 50%; 100% is a perfect hatch!

Hen - adult female chicken

Incubator - a machine which controls temperature and humidity to hatch eggs

Infertile - eggs that are from hens housed without a rooster and will not hatch

Inner Membrane - the layer which is next to the albumen; helps protect egg from bacteria and too much moisture loss

Layer - chickens kept for egg production and backyard flocks; many breeds to choose

Outer Membrane - the layer tissue which lines the egg shell; helps protect egg from bacteria and too much moisture loss

Pathogen - germs or microscopic organisms which can cause disease

Pip - process from which unhatched chick uses egg tooth to break through the shell

Poultry - all types of birds raised for food feather or fancy

Pullet - young female chicken under 1 year of age

Rooster - adult male chicken

Setting - act of putting eggs in conditions which will begin the incubation or embryo development process

Shell - hard outer covering of egg made of calcium carbonate

Vitelline Membrane - the thin layer which surrounds the yolk of an egg

Yolk - nutrient dense yellow portion of egg located in center which provides pre and post hatch food for the chick

NC STATE UNIVERSITY

Prestage Department of Poultry Science

4-H Embryology is one of the many programs that the NC State University's Prestage Department of Poultry Science Extension programs helps to bring to youth across North Carolina. The Prestage Department of Poultry Science also offers college students many dynamic career paths. Check these out using the QR code below.

This Quickstart Guide is brought to you by the generous support of:

USPOULTRY®
U.S. POULTRY & EGG ASSOCIATION

USPOULTRY
Harold E. Ford®
FOUNDATION

Thank you for participating in the NC 4-H Embryology Program!

NC STATE EXTENSION

There area also many more dynamic Poultry Youth Programs to eggsplore. Check out the info here: go.ncsu.edu/poultryyouth