

Getting Started in the 4-H Embryology Project: Tips for 4-H Agents and Teachers¹

Marcus Boston, Chris Decubellis, and Judith Levings²

Introduction

The 4-H Embryology Project is a wonderful opportunity for young people to begin learning the science of life. This project is often considered a school enrichment project to be conducted in school classrooms. However, this project can also be modified to be available to 4-H clubs or even individual 4-H members.



Figure 1. Children can learn the science of life through the 4-H Embryology Project

Credits: Marcus Boston, UF/IFAS

In the 4-H Embryology Project, young people will use an incubator with the goal of successfully incubating avian embryos (growing inside fertile eggs) through the hatching

process. This project can teach basic biology and life science to students, as the young people eagerly look forward to hatching chicks.

This publication is designed to teach 4-H agents, teachers, and 4-H club leaders what equipment and other resources are necessary to conduct a successful 4-H Embryology Project. The reader can also find tips and suggestions for the purposes of increasing hatchability of fertile avian eggs.

Contacting the School

Agents are encouraged to make direct contact with the participating school at least six weeks before they plan to begin the 4-H Embryology Project. The contact person will vary depending on the school you work with. If you have worked with the same teachers year after year, then it may be as easy as making a phone call or sending an e-mail to establish a beginning date. If you are starting for the first time at a school, then you will first need to speak with the principal, assistant principal, or the director of the school. For more information on partnering with schools, see *4-H School Enrichment: A Guide for 4-H Faculty and Staff* (Tesdaal, 2015) at <http://edis.ifas.ufl.edu/4h324>.

During the initial conversation, set up a meeting with the school's contact person to discuss the objective of the project, what the school is responsible for, and what the agent's role will be during the project. It is recommended

1. This document is 4H367, one of a series of the 4-H Youth Development Department, UF/IFAS Extension. Original publication date April 2015. Reviewed June 2018. Visit the EDIS website at <http://edis.ifas.ufl.edu>.

2. Marcus Boston, 4-H agent, UF/IFAS Extension Leon County; Chris Decubellis, 4-H agent; UF/IFAS Extension Gilchrist County; and Judith Levings, educational design specialist, state 4-H program; UF/IFAS Extension, Gainesville, FL 32611.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. For more information on obtaining other UF/IFAS Extension publications, contact your county's UF/IFAS Extension office.

U.S. Department of Agriculture, UF/IFAS Extension Service, University of Florida, IFAS, Florida A & M University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Nick T. Place, dean for UF/IFAS Extension.

that the agent provide a written agreement for the teacher and agent to sign with the responsibilities of both clearly explained. This will help eliminate any guesswork or confusion as it relates to the expectations of either the agent or the teacher. The agent should make sure the school teachers have a plan for what to do with the chicks when they arrive. This is one of the items that should be discussed during the initial meeting with the school principal or director.



Figure 2. School teachers should have a plan for what to do once the chicks arrive

Credits: Marcus Boston, UF/IFAS

Materials Necessary for a Successful 4-H Embryology Project

- 4-H Curriculum (<http://florida4h.org/embryology/>)
- 4-H marketing materials
- Incubator
- Fertile avian eggs (e.g., chicken, duck, turkey, quail)
- Thermometer (to measure the temperature inside the incubator)
- Source of electricity
- Source of water
- Brooder to keep hatched chicks warm

Other Materials Not Necessary But Extremely Helpful

- Candler to evaluate incubating eggs to monitor chick growth and development
- Automatic egg turner
- Hygrometer to measure humidity inside the incubator

4-H Curriculum

Agents are encouraged to review the 4-H Embryology Program web page (florida4h.org/embryology/index.shtml) to download materials for teachers or club leaders and/or to provide them with direct links to resources.

These resources include informational items that will help new agents, teachers, and club leaders get started on setting up the equipment to hatch chicks. These resources include video introductions on incubators, candling, and brooders as well as a frequently asked questions video section that supplements this publication.

The For Teachers section of the web page also includes:

- Links to the 4-H Embryology Program curriculum and lesson plans.
- Video on how to teach children the “21 Days” song.
- A document that correlates the lesson to current Florida State Standards (“Sunshine State/Common Core Standards”).

The Resources section provides lesson plans that agents and/or teachers can use during the 21-day incubation process. These curricula include:

- *Eggcellent Adventures in Classroom Embryology* (lower elementary) that incorporates science, language arts, and math lessons.
- Powerpoint slide overviews to share with youth and teachers
- *Hatching Classroom Projects* (Grades 2–5)
- *Experiments in Poultry Science* (Grades 6–8)
- *Chickquest: A Classroom Journey* (lower elementary) includes science process skill development.
- Information on how to evaluate the class or club experience.

Promotional materials found in the For Agents section of this website include:

- A 4-H Embryology poster to be posted on the door during the period 4-H is in the classroom.
- Safety Skills in 4-H Embryology poster to be posted above the incubator to remind children to wash their hands before and after handling the eggs.
- Flyers/notes to share with parents before and after the experience to encourage youth to extend their learning by

participating in more county 4-H and UF/IFAS Extension programs.

- Clipart for agents to use.

Types of Incubators

For the purposes of this discussion, an incubator is a device constructed to maintain the proper temperature, humidity, and ventilation to sustain a growing embryo inside an egg. Many types and styles of incubators are available for this project, from homemade incubators to large commercial models that hold thousands of eggs. Typically, the most common incubators used for this project are table-top Styrofoam incubators. These incubators are categorized as either still-air incubators (which do not have a fan to promote circulation of air inside the incubator) or forced-air incubators (which have a fan to move air around inside the incubator).



Figure 3. A still air incubator and an automatic egg turner
Credits: Marcus Boston, UF/IFAS

You must understand which type of incubator you are working with in order to maintain the proper temperature inside the incubator. Still-air incubators should be operated at 102°F, while forced-air incubators should be operated at 99.5°F. Growing avian embryos are extremely sensitive to temperature. Temperatures much lower than the recommended temperatures for the type of incubator will delay hatching and often lead to weakened chicks. Temperatures that exceed the proper temperature by even one degree can kill growing embryos within as little as fifteen minutes.

Setting Up the Incubator

The teacher or 4-H agent should set up the incubator at least 24 hours prior to setting the eggs to ensure the temperature is regulated and stabilized to the appropriate setting (99.5°F for force-air and 102°F for still-air incubators). Some models of incubators have an adjustable thermostat,

and others are pre-set to the proper temperature. Use a thermometer to ensure a stable, correct temperature before setting eggs.

Another purpose of an incubator besides providing the consistent appropriate temperature is to provide the appropriate amount of humidity. This is important to keep the growing embryo from sticking to the shell inside the egg and is usually achieved by placing water in reservoirs located at the bottom of most purchased incubators. On top of the incubator are often one or two plugs. Using the right amount of water in the reservoir along with understanding how to properly use the plugs located on the incubator will help in keeping the proper humidity inside the incubator. Refer to the incubator's instructions to find out how to keep that particular incubator at the proper humidity. Ideally, the relative humidity inside the incubator from setting eggs until three days before hatching should be between 58%–60%, and relative humidity for the final three days should be at 65% or more. The plugs also play a part in proper incubator ventilation—refer to the manufacturer's instructions for proper use.

Securing Eggs

Prior to working with a school, agents should find a reliable source for fertile eggs. Some schools may have teachers that already know of a trustworthy source to get eggs that they can share. Agents are not expected to buy the eggs for the school project but are encouraged to assist the classroom teachers in securing a good source for fertile eggs for the embryology project. This is perhaps the most important step in working with a school, because this project requires *fertile* eggs before it can be successful. (Some teachers may bring in the eggs from their neighbors' chickens, not realizing the neighbor only has hens and there is no way the eggs can be fertile since there has been no interaction with a rooster.)

Fertile eggs can be purchased through the mail or bought from local farms. Some chicken owners may donate the eggs to the school project but may require the school to bring the chickens back to them at the conclusion of the project. If this is the case, agents should make sure both parties have a clear understanding of the agreement. It should also be shared with school classrooms that fertile eggs can also be successfully ordered through the mail from several existing agricultural businesses.

Handling Fertile Eggs

Participants in this project will experience a higher hatch rate the shorter the time is between when eggs are laid and when they are set into the incubator. Fertile eggs should not be stored for more than one week (from when the bird laid the egg). Ideally, fertile eggs should be stored at 50°F–65°F (not stored above 65°F) and at about 70% relative humidity. It is not recommended to wash eggs with water before incubation. Try to incubate eggs with shells free from manure and other organic matter.

Setting Eggs in an Incubator

After your incubator temperature and humidity are regulated and the fertile eggs are available, it is time to set the eggs in the incubator. Eggs should be at room temperature when introduced into the incubator.

The eggs need to be turned at least three times per day from day one of incubation until day 18 of incubation (for chicken eggs). An automatic turner is useful to ensure the eggs are turned. However, many students enjoy turning the eggs by hand. To ensure all the eggs are properly turned when not using an automatic turner, use a pencil to place an X on one side of the egg and an O on the opposite side of the egg. Place all the eggs X side up, and then turn O side up, and so on. The eggs should be turned a minimum of three times daily. If not using an automatic turner, keep in mind eggs still need to be turned on weekends and holidays.

If using an automatic turner, make sure it works. These turn very slowly, so it is difficult to determine if the turner is in fact working. Use this trick to determine if the turner is working: while regulating the incubator, place an index card in such a manner on the automatic turner that it will eventually fall down if it is actually turning. The next day if the card has fallen down, it is a good indicator that the turner is actually working.

Place eggs with the small end down in the automatic turner, with the large end of the egg (with the air cell) facing up. This is extremely important if using an automatic turner.

After the eggs are placed in the incubator, check the incubator often to ensure the incubator goes back to the desired temperature (the temperature will fall while the top is off the incubator.)

Maintenance of the Incubator During the Incubation Process

Monitor the temperature of the incubator often, at least daily, during the incubation process. Also remember to check and fill the water reservoirs in the incubator according to manufacturer's recommendations. If used, check the turner to make sure the eggs are not always in the same position.

Three days before hatching, you should stop turning the eggs. If using an automatic turner, take the eggs out of the turner and lay them flat on the wire floor of the incubator. If turning eggs by hand, do not turn after this time. This time also requires a much higher relative humidity inside the incubator, so follow the manufacturer's recommendations to boost humidity at this time. In drier climates, a sponge soaked in water might be beneficial to include in the incubator.

Allow the chicks to hatch themselves with no or minimal help. They need to go through the process of hatching to build up strength to survive.

After Hatching

Allow chicks to remain in the incubator until they dry off, and then move to a brooder. See the EDIS publication *Care of Baby Chicks* (<https://edis.ifas.ufl.edu/an182>) for more information on taking care of the newly hatched chicks.

Incubators need to be cleaned after hatching. Check the manufacturer's recommendations and specifications and consult your UF/IFAS Extension 4-H agent in order to properly clean the incubator.

Other Considerations

Remember incubators are designed to promote the growth of living things—in this case, fertile avian embryos. This environment is also conducive to growing other living things, such as bacteria. Anyone handling incubating eggs or chicks should thoroughly wash their hands when finished.

Newly hatched chicks need to be kept warm, about 95°F for the first week after hatching. Provide a chick with starter feed and clean water.

Please refer to Table 1 for incubation requirements for various bird species (Mississippi State University Extension Service, 2014).

Table 1. Incubation requirement for various birds

Species	Incubation Period (Days)	Temp (F) ¹	Humidity (F) ²	Do Not Turn After	Humidity Last Three Days ²	Open Vent More
Chicken	21	100	85–87	18th day	90	18th day
Turkey	28	99	84–86	25th day	90	25th day
Duck	28	100	85–86	25th day	90	25th day
Muscovy Duck	35–37	100	85–86	31st day	90	30th day
Goose	28–34	99	86–88	25th day	90	25th day
Guinea Fowl	28	100	85–87	25th day	90	24th day
Pheasant	23–28	100	86–88	21st day	92	20th day
Peafowl	28–30	99	84–86	25th day	90	25th day
Bobwhite Quail	23–24	100	84–87	20th day	90	20th day
Coturnix Quail	17	100	85–86	15th day	90	14th day
Chukar	23–24	100	81–83	20th day	90	20th day
Grouse	25	100	83–87	22nd day	90	21th day
Pigeon	17	100	85–87	15th day	90	14th day

Note. Adapted from "Poultry: Reproduction and Incubation—Important Incubation Factors," by Mississippi State Extension Service, 2014.

¹ Measured in degrees Fahrenheit in a forced-air incubator. For still-air incubators, add 2–3 degrees F.

² Measured in degrees Fahrenheit using a wet-bulb thermometer. Use chart to convert to relative humidity.

References

Mississippi State University Extension Service. (2014).

Poultry: Reproduction & Incubation—Important Incubation Factors. Retrieved from http://msucare.com/poultry/reproductions/poultry_environment.html

Mississippi State University Extension Service. (2015).

Reproduction & Incubation Hatching Egg Storage Period. Retrieved from http://msucare.com/poultry/reproductions/poultry_storage.html

Mississippi State University Extension Service. (2015).

Reproduction & Incubation Washing of Hatching Eggs. Retrieved from http://msucare.com/poultry/reproductions/poultry_wash.html

Tesdall, T. (2015). *4-H School Enrichment: A Guide for 4-H Faculty and Staff*. Gainesville: University of Florida Institute of Food and Agricultural Sciences. EDIS document 4H324.

Retrieved from <http://edis.ifas.ufl.edu/4h324>