A Guide to Artificial Incubation

By Julie Gabbard

Introduction

Few experiences in life compare to the wondrous event of witnessing a baby chick labor with instinctive determination and emerge from an egg. Being a spectator of this miraculous event is the motivation that prompts many people to attempt incubating and hatching eggs.

Other poultry fanciers participate in this exciting venture for very different reasons. The minimum order requirements for baby chicks at most hatcheries are 25 chicks (too many for some people to manage). A desire for a rare or unusual breed that may not be available from your hatchery and simple affordability can also be important factors in the decision to incubate hatching eggs. Regardless of the reason behind your decision, being prepared and having good basic knowledge of the requirements of artificial incubation will greatly increase your chances of a successful outcome.

The first traces of artificial incubation were found in China around 3000 b.c. If visiting Egypt today, you can still see how their incubators called *manals* operate. These monuments were built over 4000 years ago for artificial incubation. Each *manal* included a number of furnaces heated with the dehydrated manure of camels. Some had capacities of nearly 90,000 eggs! Candling was achieved by the skillful direction of a sunbeam. Proper temperature was monitored by the contact of the shell with the eyelid. Specialists in this profession passed down their successful principles and trade secrets from Father to Son. Surprisingly, in spite of these crude methods, the results of these hatchings were quite successful. [1]

Acquiring hatching eggs has never been easier. The resources are vast and hatching eggs can be found as close as your own hen house, through online auction sites and specialized poultry websites. Incubating your own hatching eggs can be very rewarding and enjoyable.

Proper technique and planning will reward you with an incubator full of peeping chicks. Note} The following instructions are intended for the incubation of chicken eggs. The fundamental principles for incubation preparation and technique are the same regardless of the type of poultry you are attempting to hatch. The length of incubation, as well as temperature and humidity requirements can be more or less depending on the species. Please refer to the tables at the end of this e-book for general temperature and humidity requirements for other types of poultry. The guidelines below are generally intended for (but not exclusive to) the novice who will most likely begin with a simple table top incubator.

Chapter 1} Egg Selection and Preparation

Local Hatching Eggs

- When hatching your own chicken eggs or eggs purchased locally, choose eggs that are of a good shape and quality. Eggs that are misshapen, porous, cracked or excessively dirty will most likely not hatch successfully and should be discarded. Eggs that are only slightly dirty may be very gently cleaned with warm water. Be careful not to scrub hard enough to remove the protective coating (bloom) from the egg. Removing the bloom from the egg shell may result in bacteria entering the egg and causing contamination. Store your eggs pointy end down in an egg carton or hatching tray.
- Chicken eggs may be gathered for up to 7 days prior to incubation. After 7 days, viability (having the ability to live and grow) begins to decline. *Other breeds of poultry may be*

successfully stored for longer periods of time. Chicken eggs can be stored for longer periods of time but careful measures must be taken with regards to temperature during storage and diligent turning of the eggs. For best results, the general rule of thumb is to store eggs for 7 days or less.

- Eggs stored for incubation purposes should be kept cool at approximately 45-55 degrees and turned twice daily. Keeping eggs cool slows the evaporation and aging process within the egg. Turning the eggs during storage can extend their shelf life and improve your results.

Tip} A thick book placed under the end of a carton (or flat) of eggs (producing a 45 degree angle) makes for a quick and easy way to turn your eggs. When you are ready to turn, simply remove the book and place it under the opposite end. This works nicely and lowers the risk of dropping the eggs while hand turning each one.

- When you are ready to incubate, move the eggs from cool storage into a warmer room and allow them to slowly (4 to 6 hours) come to room temperature (70 degrees). *Cold eggs placed into a warm, humid incubator will become covered in condensation. This may increase the possibility of bacterial contamination.*

Shipped Hatching Eggs

When discussing shipped hatching eggs with an individual, I always try to remind them of the risk involved when purchasing eggs that will travel through the mail and the difference between an infertile egg and a nonviable egg. Shipped hatching eggs may travel a great distance and experience excessive variations in climate, including temperature, humidity and pressure changes that may occur with fluctuations in altitude. These conditions, coupled with the possibility of simple human error with the handling of your package, can lessen the likelihood of a successful hatch.

Because of these factors, a perfectly fertile and viable egg can be packed into a box, shipped to you and arrive in a nonviable state. These *clear* eggs (no development) are seemingly infertile when cracked open upon completion of incubation, however, were in fact quite fertile and became nonviable from exposure to extreme conditions. With careful preparation and correct incubation technique you can improve your chances of successfully hatching your own chicks from eggs that have been shipped through the mail.

- To increase your chances of success, a couple of days prior to the arrival of your shipped hatching eggs, prepare and turn on your incubator. Be certain that your incubator is maintaining proper and consistent temperature and humidity before your eggs are added. *We will discuss this further in Chapter 2.*
- When your eggs arrive, carefully unwrap each egg and inspect them. Discard any broken or cracked eggs and notify your supplier of the damage. If the eggs are a bit dirty, a light and gentle rinsing under warm water will not harm them. Very fine sandpaper may also be used to gently buff dirt away if preferred, but extreme care must be taken to not remove the protective bloom from the egg.
- Place the eggs pointy end down into an egg carton or egg hatching tray and store them unmoved for 18 to 24 hours at room temperature (70 degrees) prior to placing in your preheated incubator. This "resting" period is important and can greatly increase your chances of a successful hatch by allowing the air cell within the egg to settle back into proper position.

Important} It is generally agreed upon, that a successful outcome for shipped hatching eggs is when 40%-50% of the set eggs result in live chicks. Knowing what to reasonably expect when purchasing shipped hatching eggs can make your experience much more pleasurable and helps to ease disappointment. Understanding and accepting the reality that even the most experienced person has unsuccessful hatches, will help avoid the disappointment that we all have felt from a failed attempt at hatching shipped eggs. You must be able to accept the risks involved with the purchase of shipped eggs to have a positive experience.

Thankfully, successful hatches from shipped eggs reward our diligence, offering students a fascinating education in embryology and poultry enthusiasts the opportunity to obtain highly desired breeds or genetically diversified lineage that we may not have been able to acquire otherwise.

Chapter 2} Preparing your Incubator

There are a wide variety of options when it comes to selecting an incubator. Basic and more economical foam incubators (GQF Hova-Bator, Miller Little Giant) Incubators can be very successful and may be a perfect choice for the backyard flock owner, hobbyist or school teacher. More expensive units and cabinet type models (GQF Sportsman 1502, Brinsea Octagon 40) can cost considerably more but offer the options of nearly hands free operation and monitoring as well as the ability to incubate larger quantities of eggs at a time. Features such as automatic turners, digital thermostat controls and forced air fans can save considerable time, improve performance and increase hatch rates. The internet offers endless instructions for building your own economical incubator from normal household items. With precision and practice, these units can be quite successful. Regardless of the model you choose, incubation can be accomplished successfully if you prepare and follow proper procedure. You can have very similar results with an inexpensive incubator as you can with a larger more costly model. The inexpensive model will generally require more work, practice and careful technique. The more costly model will make the process easier for you. Guidelines for preparation and technique are generally the same with all types.

2-3 days prior to setting your hatching eggs in your incubator, you will need to make sure your unit and your automatic turner (if applicable) are clean and sanitized. The best antimicrobial product will be ineffective if your incubator is excessively dirty. Water, detergent and elbow grease are your best defense against bacteria. A simple bleach and water solution diluted to 10% works well and is inexpensive. *Allow yourself plenty of ventilation and rinse*

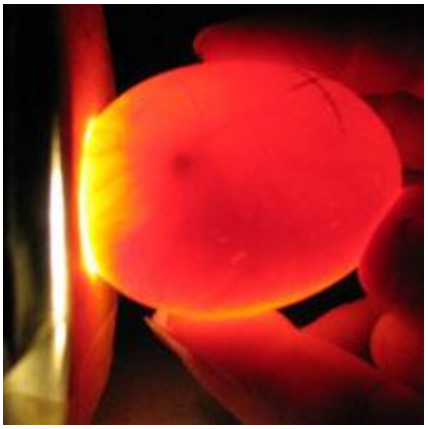
thoroughly when using bleach as it can be corrosive. There are also commercial sanitizers available (Tek-Trol) that work very well and are preferred by some. Cleaning and sanitizing your incubator is crucial and will greatly increase your chances of success.
Tip} Foam incubators tend to harbor bacteria more than other models. Some people prefer to incubate and hatch in two different incubators, using a less expensive unit (no fan, no turner etc…) for the last three days of incubation. The less expensive model will wear out sooner due to the excessive cleaning required after hatching. This can be a good option for some.

- Your incubator should be located in a room with a stable temperature (70 degrees F) away from heavy drafts or direct heat and cold sources, such as sunlight or air conditioner vents.
- If you are using a foam incubator that came with a small thermometer, it is recommended that you purchase another thermometer as a precaution, to confirm your thermometers accuracy. A small duo digital thermometer/hygrometer can be purchased inexpensively and will allow you to easily monitor both the temperature and humidity levels in your incubator at a glance. Thermometer/Hygrometers If possible, place this within easy viewing through the window of your unit (if applicable). This small investment can pay for itself with one conserved hatch, should your original thermometer prove to be inaccurate, *which they often are.*
- If you are fortunate enough to have an incubator that is pre-set to the proper temperature from the manufacturer such as the GQF "Genesis" Hova-Bator, Genesis you will not have to worry with setting or adjusting your thermostat. Likewise, incubators with digital and electronic thermostats make temperature settings a snap. Follow the manufacturer's instructions for setting these units. Smaller incubators will have a dial or knob that will adjust your temperature up or down. These dials are *extremely* sensitive to adjustments. Make very small adjustments and wait 3-5 hours between additional modifications. Your incubator should maintain the proper temperature without adjustments for 24-48 hours before your eggs are added.
- The temperature for still-air incubators (no fan) should be set to 101.5 to 102 degrees F. The temperature in these units, *sometimes referred to as thermal flow,* may fluctuate a bit more than units with fans. Thermal Flow You should check your temperature at least twice daily. Temperature readings for still-air units should be taken near the top of the egg due to the stagnant air resting in layers, cooler at the bottom and warmer at the top. Too high of a temperature is more harmful than too low.
- The temperature for forced-air incubators (with fan) should be set to 99.5 to 100 degrees F. The fan can be to your advantage and seems to make a considerable difference in the

consistency of temperature and humidity inside the unit. Fan Driven If possible, I suggest purchasing a unit with a forced air fan or upgrading your still-air unit and purchasing a fan kit to add to your incubator. Too high of a temperature is more harmful than too low.

- Ventilation is crucial. The developing embryo is a living organism that exchanges oxygen and carbon dioxide through the shell during the incubation process. The amount of air exchange needed increases as the embryo develops. The vents located in your incubator should be gradually opened until they are fully opened the final three days of incubation. *Please remember, proper ventilation inside your incubator and throughout the room is crucial. If the room where the incubator is located is small, keep the doors to the room open to allow the free exchange of fresh air.*
- Humidity is equally important because of the eggs porosity. If the water pan or troughs (located in the bottom of some foam incubators) are filled with water and cover at least half of the surface area of the floor of your incubator, the humidity should be adequate for the first 18 days of incubation. Ideally, the humidity inside of your incubator should be between 45% and 55% for the first 18 days and between 65% and 75% for the remainder of the incubation period. During the last three days, adding a large sponge inside the incubator should increase the surface area of the water enough to give the necessary boost to humidity. Exact humidity levels are not crucial but trying to stay within these levels is recommended. The lid should not be lifted during the last three days of incubation unless absolutely necessary.

Tip} *If you have a foam incubator and your vents are located on the top of your unit, you can easily add water to your unit without lifting the lid. Place a large sponge directly under one of the vent holes. Use a clean Turkey Baster to squirt fresh water through the vent hole onto the sponge as needed for additional humidity during the last three days.*



Chapter 3} Setting the Eggs

- Before handling hatching eggs, it is always a good idea to wash your hands to help prevent the spread of bacteria.
- Chicken eggs take 21 days to hatch. Hatching eggs must be turned for the first 18 days while in the incubator. If your incubator does not have an automatic turner, you will need to mark each egg with an X on one side and an O on the other. When the eggs are turned all the Xs or Os should be face-up at the same time.
- Place your eggs pointy end down in the automatic turner cups and turn it on. (Follow manufacturer's instructions for your unit) Automatic Turner
- If you do not have an automatic turner, lay the eggs down in your incubator with the Xs face-up. Manual turning can be as equally successful as mechanical turning if done regularly. Eggs should be manually turned at *least* every 8 hours (e.g. 6:00 a.m., 2:00 p.m. and 10:00 p.m.). Regularity and careful handling are very important aspects to establish favorable hatches.

Interesting fact} Some people believe that turning the eggs "exercises" the developing embryo or perhaps keeps the yolk from "sticking" to the sides of the shell. Embryology shows us this is most likely not so.

The albumen (white) of an egg contains virtually no fat particles and has gravity near that of water. The yolk, however, has a high fat content. Fats have lower gravities and float on water. The egg yolk tries to do the same thing -- float on the albumen. If an egg is left in one position, the yolk tends to float upward through the albumen toward the shell.

The developing embryo always rests on top of the yolk. When an egg is turned, the yolk turns in the albumen so the embryo is again positioned on top of the yolk. Nature may do this so the embryo is always in the best position to receive body heat from the mother hen.

If the egg is not turned, the yolk tends to float upward toward the shell and pushes the embryo nearer the shell. If the yolk raises enough, the developing embryo is squeezed between the yolk and shell. The embryo can be damaged or killed. Turning the egg causes the yolk to be repositioned away from the shell, making it safe for the developing embryo. [2]

- Once your eggs have been placed in your incubator, you may have an initial decrease in temperature. Resist the urge to immediately adjust your thermostat. If your incubator was maintaining proper temperature for 24-48 hours prior to adding the eggs, it will adjust over the next several hours. Check the temperature after 12-18 hours and make *very* small

adjustments if needed, with waits of 4-6 hours between each one.

- Mark your calendar with the date the eggs were set, the day you should stop turning and your hatch day.
- Add water when needed to maintain proper humidity levels and check your temperature twice daily for the first 18 days.
- Any foul odor coming from your incubator should be dealt with immediately. Open your incubator and locate the bad egg. A spoiled egg may be weeping or small crystals may be seen on the shell. Once you remove the egg, you will want to clean out the now empty egg cup (if using an auto turner) if any liquid or residue from the egg is present. An antibacterial wipe works well for this. If no visual evidence of spoilage is present, gently lift each egg and place the large end close to your nose. A quick sniff will quickly expose the foul smelling offender.
- Candling may be done without harm on days 7, 14 and 18 to check for viability. After day 14, eggs found to be *clear* (showing no signs of development) may be removed. A professional Candler may be purchased Candler or a strong flashlight (Mini Maglite) also works well.

Tip: Candling with the Mini-Maglite} *In a dark room, wrap your fist tightly around the lighted end of the small flashlight. Make a nickel sized circle with your index finger and thumb, creating a cup for the egg to rest in. Rest the large end of the egg in the cup of your index finger and thumb allowing the bright beam of light to penetrate up through the egg. Spidery veining should be present in viable eggs.*

Chapter 4} The final 3 days

- When your eggs have been in the incubator for 18 days you will need to stop turning them for the remaining three days of incubation.
- Remove your eggs from the automatic turner (if applicable) and carefully set them aside in cartons or flats while removing the turner from your incubator.

- Add water to your incubator at this time, completely filling the troughs in the bottom of your unit, adding a wet sponge (s) or an additional container of water. Be cautious when adding a container of water that your chicks are not able to fall into it and drown. The best option for increasing the humidity will depend on the type of incubator you are using. You will learn with time which method works best for your particular unit based on the outcome of your hatches.
- Return the eggs to your incubator, laying them down on their sides on the mesh wire provided with your incubator (if applicable). You may also place a paper towel down on the wire to help with clean up later, if desired
- Do not close vent holes while attempting to increase humidity. Chicks *must* have proper ventilation to hatch successfully.

Day 21

- Once piping of the shells is present (a small hole pecked out of the shell when a chick first breaks through) lower the temperature of your incubator to 98 degrees.
- If possible, try not opening the lid of your incubator until your hatch is complete.
- Chicks can safely remain in the incubator for up to 24 hours before needing to be removed and relocated to your prepared brooder. They should be completely dry before they are moved.
- It can be several hours after a chick pips the shell before it completely hatches. Try to avoid *helping* the chicks out of their shells when at all possible.
- Late hatches can happen and waiting until 24 days has passed before removal of the remaining eggs is suggested.
- Valuable information can be gained from examining the contents of the eggs that did not hatch. *We suggest doing this outside as this can get messy and sometimes quite smelly.* As distasteful as this can be, your findings can help guide you through your learning experience and your discoveries may help you correct possible errors during your next attempt at incubation.

Note: For an extensive list of symptoms, probable causes and helpful solutions to incubation problems and trouble shooting, we suggest referring to *Incubation Failures* written by Dr. Tom Smith, Mississippi State University. This reference guide can be found at http://poultryextension.psu.edu/Incubation.html#Trouble Shooting

**We have reviewed this site before adding it as a reference However; we do not endorse all the information and content of this site in its entirety.*

Chapter 5} Tables and References

Incubation Tables

Species	Days	Temp F.	Humid	Stop Turning	Humid	Open vent more
Chicken	21	99.5	50	18th day	70	18th day
Turkey	28	99.5	50	25th day	70	25th day
Duck	28	100	60	25th day	80	25th day
Musc. Duck	35-37	100	60	31st day	80	30th day
Goose	28-34	99.5	60	25th day	80	25th day
Guinea	28	100	50	25th day	70	24th day
Pheas.	23-28	100	55	21st day	85	20th day
Peafowl	28-30	99.5	50	25th day	70	25th day
Bobwh. Quail	23-24	100	55	20th day	70	20th day

Coturnix Quail	17	100	55	15th day	70	14th day
Chukar	23-24	100	45	20th day	70	20th day
Grouse	25	100	50	22nd day	70	21st day
Pigeon	17	100	50	15th day	70	14th day

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[References/Sources]

Chapter 1

1 History of Incubation：La Catoire Fantasque

Chapter 3

2 Dr. Tom W. Smith, Emeritus Professor of Poultry Science, Mississippi State University

Chapter 5

3 http://msucares.com/poultry.