

Hatching Eggs in the Classroom: A Teacher's Guide

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Incubating and hatching chicken eggs is a hands-on learning experience you can use with students from kindergarten to 12th grade. Classroom experiments with chicken embryos can help you teach complex systems such as nutrition and the circulatory system, or more basic skills such as data measurement, collection, and analysis. These projects help students learn biological concepts and develop a deeper understanding of the life sciences. Examining embryos at different stages of growth, and observing a beating heart are just two of the projects you can use.

Below are guidelines for incubating and hatching chicken eggs in a classroom.

Only fertile eggs will hatch

Use fresh, clean, fertile eggs. Eggs sold in food stores are not fertile. Eggs from unreliable sources can disappoint and frustrate students because many are infertile and will not hatch. Eggs from commercial hatcheries are reliably fertile; however, some companies will not ship only a few eggs.

The Poultry Science Department at Texas A&M University does ship small quantities of fertile eggs. Ordering instructions and contact informa-



tion for other reliable hatcheries are listed at the end of this publication.

Storing fertile eggs

Fertile eggs are alive and for them to develop then hatch, you must care them properly throughout the project.

Handle the eggs carefully; an egg with a cracked shell will not hatch. Discard cracked eggs to prevent contaminating the incubator and other eggs.

Discard extremely dirty eggs. If a small area of an egg is soiled with dirt or fecal material, make sure that what appears to be dirt is not simply a stain on the surface of the egg, then clean the egg by gently rubbing the soiled surface with fine sand-

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paper. The eggshell is porous so do not use water to clean the shell.

Storage time

Hatchability decreases the longer you store the eggs. For best results, set the eggs to incubate within 7 to 10 days of being laid. Chicken eggs hatch about 21 days after they are set in the incubator. Planning activities around this time frame will allow the students to enjoy the complete process.

Storage temperature and humidity

Store fertile eggs at 55 to 69°F. If the temperature is too low, embryos will die; if the temperature is too high, the embryos will develop abnormally and weaken. A normal refrigerator is much too cold for storing fertile eggs to be hatched.

The relative humidity for storing fertile eggs should be about 75 to 80 percent.

Eggshells are porous, which allows air in and out of the eggshell. If the humidity is too low, the shell membrane can become dry, and cause the embryo to die.

Humidity above 80 percent can cause condensation to form on the egg and suffocate the embryo by blocking the shell's pores. Condensation can also carry contaminants into the egg.

Position of eggs

If the eggs will be stored for less than 10 days, place them in egg flats or egg cartons with the large end up. If they will be stored for more than 10 days, position them with the large end down.

Turning eggs

Eggs do not have to be turned if they will be incubated within 1 week of being laid. Eggs held for longer than 1 week should be rotated from side to side over a 90-degree angle once a day.

One method for turning the eggs during the holding period is to place a 6-inch block under one end of the carton (or flat) holding the eggs, rotating the block's location each day.



Storage reminders

- The temperature should range from 55 to 69°F.
- Keep the relative humidity at 75 percent.
- Turn the eggs if they are stored longer than a week.
- Position them large end up if stored less than 10 days, large end down if stored more than 10 days.
- Handle the eggs with care!

Incubating eggs

Preparing the incubator

Before setting the eggs, clean the incubator and then run it for 2 or 3 days. Starting early will allow you to adjust the incubator and verify that it is working properly. Adjusting the incubator while the eggs are set will speed or slow the hatch and may kill the embryos.

If the incubator has an automatic turner, make sure it is working properly. Ensure that there is proper airflow around the incubator and that any ventilation holes are not blocked.

Set the incubator where there are no drafts or direct sunlight as these can affect incubator func-

tion. The incubator and its environment need to be stable for the 3-week duration of the project.

If possible, connect the incubator to a backup power supply to keep the incubator operating during a power failure.

If the power will be shut off or if the air conditioning or heating is changed during the weekend, provide alternative power. Make sure that the possible changes in temperature and humidity do not affect the incubator function.

The temperature in an incubator without a circulating fan fluctuates more than in one that has a fan. As long as the temperature does not exceed 102°F, the hatch should not be harmed.

Do not set the eggs until you have verified that the automatic turner is working and that the temperature and humidity are correct and stable.

Setting the eggs

If the eggs have been stored, give them 2 to 4 hours to reach room temperature before setting them in the incubator. Setting the chicken eggs on a Tuesday or Wednesday makes it more likely the chicks will hatch during the school week. Species other than chickens may hatch at different rates, so plan accordingly (Table 1).

If the incubator does not have an automatic turner, use a pencil to mark each egg with an *X* on one side and an *O* on the opposite side. These marks will help you verify that the eggs are being turned properly. There is no need to mark eggs if the incubator has a working automatic turner.

Once the eggs are in the incubator, do not change the temperature and humidity settings unless the temperature exceeds 102°F. After the eggs have been in for 4 hours, you may make adjustments. The incubating temperature should vary only from 99 to 100°F.

Place the large end of the egg higher than the small end in the incubator. The embryo orients itself so that the head develops toward the large end of the egg, where the air cell is located.

Table 1. Incubation periods for common birds. (Do not incubate different species together because their incubation periods may differ.)

Species	Number of days
Chicken	21
Duck	28
Muscovy duck	33–35
Goose	29–31
Guinea	26–28
Chukar partridge	22–23
Peafowl	28
Ring-neck pheasant	23–24
Mongolian pheasant	24–25
Pigeon	16–18
Bobwhite quail	23
Japanese quail	17–18
Turkey	28

If the small end of the egg is higher than the large end, the chick's head can orient away from the air cell; embryos that orient away from the air cell will not hatch.

Turning the eggs

The first 19 days of incubation are known as the set stage. Turning the eggs during this stage prevents embryo death and unhealthy hatches. Eggs must be turned at least three times every day (five times is even better), even over the weekend.

An automatic turner is recommended if your school restricts access to classrooms on weekends. However, hand-turning eggs is a great way involve students in the process directly.

To turn eggs by hand, rotate the egg 180 degrees so that the *X* and the *O* alternately face up at each turn. Because dirt and oils can block the pores of the egg, the students must wash their hands before touching the eggs during incubation.

Throughout the incubation process, the large end of the egg should always be higher than the small

end. Always replace the incubator lid quickly to keep the temperature inside constant.

Ventilation, temperature, and humidity in the incubator

The chick embryo consumes oxygen and gives off carbon dioxide. This gas exchange is small during the early part of incubation or when just a few eggs are being incubated. Follow the manufacturer's recommendations to guarantee that the developing chicks have adequate oxygen. Leave enough space around the incubator and ensure that all ventilation holes are unobstructed. Doing this will allow fresh air in and stale air out.

The temperature in the incubator should be 99.5°F. If the temperature fluctuates more than 0.5° either side of 99.5°F, the hatch is likely to be poor. Place a thermometer in the incubator and check the temperature at least twice a day.

Relative humidity, is vital for the incubation process. To maintain humidity, every incubator must have a moisture source. The easiest way to provide this moisture is to put a shallow pan of water in the bottom of the incubator. Add water to the pan every day to maintain proper humidity.

Although humidity monitors are readily available, it is easy to make such an instrument with your students as an added science lesson. You need only a normal thermometer, a 6-inch piece of shoelace, and a short piece of dental floss:

1. Slip the bulb end of the thermometer about 1 inch into the open end of the shoelace.
2. Tie the dental floss around both the shoelace and the thermometer directly above the bulb. This will keep the shoelace from sliding off.
3. Place the opposite end of the shoelace directly in the pan of water.

The reading on the thermometer will now be your wet-bulb temperature (Figure 1). The wet bulb temperature is an index of relative humidity and because of evaporation; it will be less than that of a dry thermometer.

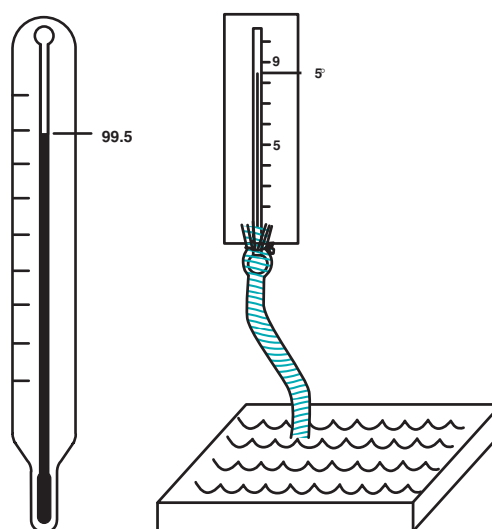


Figure 1. A wet-bulb thermometer is easily made using a dry thermometer. The wet bulb registers a lower temperature than the dry bulb because evaporation cools the thermometer. The wet-bulb reading is an index of relative humidity.

The wet-bulb temperature should be 85 to 87°F (55 to 60 percent RH). Humidity should not fluctuate more than 1 or 2 wet-bulb degrees.

To increase the humidity, add a second pan of water. To reduce it, use a smaller pan. If the incubator temperature is correct, the only factor governing humidity is the surface area of water inside the incubator.

The eggs should decrease in weight during incubation as they will lose moisture during incubation.

Record keeping

Record the incubator environment daily using a record sheet like the one in Figure 1. Record keeping can teach measurement skills, time series perception, and data manipulation; however, its main purpose is to monitor and correct conditions that might damage the project. These records can also be reviewed in the event of a poor hatch (Figure 2).

Candling

Shining a light through an egg to observe embryo development is called “candling.” You can use a

small flashlight for candling or you can buy a candler at a reasonable price. White eggs are easier to candle than are dark or speckled eggs, and candling in a dark room will give the best visibility.

Embryos can be seen easily after 8 to 12 days of incubation. The embryo appears as a dark spot that becomes larger and fills the egg as incubation progresses. It will often move away from the light during candling. Eventually, only a dark mass and the air cell will be visible. You can use a sterile, or unincubated, egg for comparison.

Only 80 to 90 percent of incubated eggs are fertile; you can use this technique to identify infertile or dead eggs. These should be removed because they can rupture and contaminate the incubator. If you are apprehensive about these decisions, contact someone with experience for advice.

To identify dead embryos look for a ring or smear of blood in the egg or a dark spot dried inside the shell. A living embryo will appear as a dark spot in the large end of the egg surrounded by a faint outline of blood vessels. Infertile, dead, or dirty eggs should be removed from the incubator when possible as they may explode and contaminate the incubator.

Hatch stage

The hatch stage is the final 2 to 3 days of incubation. Chicks communicate with each other while inside the egg and synchronize their hatching; most chicks will hatch out within a 24-hour period.

After Day 18, do not turn the eggs at all. If you have an automatic turner, remove it and lay the eggs on cloth or rough paper (not newspaper) inside the incubator. This will give the chicks a good surface to walk on. Make sure the paper does not obstruct air flow or contact the water or heating element.

The temperature should remain at 99.5°F, and humidity should be at

least 86 to 90°F, wet bulb. You can increase the humidity by adding a wet sponge or wet paper towels to the incubator. On Day 21 of incubation, the chicks should start to pip out of the shell.

When the chicks hatch

Hatching requires great exertion by the chick, which alternates between activity and long periods of rest. The entire hatching process requires nearly 24 hours. Do not be concerned about the amount of time that any individual chick requires to hatch, unless it takes more than 24 hours.

Chicks use an egg tooth to peck their way out of the shell. Once chicks leave the shell, leave them in the incubator for 24 hours. The warmth of the incubator helps them rest and dry. Increase the ventilation to give the chicks enough oxygen. Some incubators have plugs that can be removed for this purpose. When all the chicks have hatched, lower the temperature to 95°F.

Discard eggs that do not hatch by the end of Day 22. Do not help a chick free itself from the shell; that does more harm than good. Weak or deformed chicks should be disposed of humanely.

There is no need to provide food or water for the first 2 or 3 days the chick is outside the shell. Just before the chick hatches, it absorbs the remaining yolk in the egg and uses it as nourishment for several days after hatching. The chicks may be moved to a brooder 24 hours after hatching.



Incubation reminders

- Set the incubator in a room with a stable temperature, away from drafts and direct sunlight.
- Incubate together only species with the same incubation period.
- Keep a daily record of incubator data. Check the temperature daily to make sure it is 99.5°F (Table 2). Verify that the water trough is full and that the wet bulb temperature is 86°F.
- Always wash your hands before touching eggs. Keep germs, dirt, and oil away from incubating eggs.
- Turn the eggs three to five times a day for the first 18 days.
- The large end of the egg should always be higher than the small end.
- Do not turn the eggs for the last 3 days of incubation.
- When the chicks hatch, provide a cloth or rough paper surface for them to walk on.

Glossary

Air cell – A compartment of air located under the shell in the large end of the egg. The chick “taps” into air cell and begins to breathe air on Day 20 of incubation

Blood ring – A ring formed when an embryo dies during the first 4 days of Incubation; the egg looks normal except for a small circle of blood on the yolk

Brooder – Housing that provides the environmental requirements of chicks from 1 day to 3 weeks old

Candling – Examining an egg in front of a light to observe the development of the embryo

Egg flats – Containers or cartons that store eggs; egg flats do not have lids and hold 30 eggs

Hatchability – The percentage of eggs that hatch successfully.

Pipping – The first stage of hatching, when a bird breaks or pecks a hole through the eggshell

Setting – Correctly preparing and placing eggs into an incubator for incubation

Table 2. Possible causes of hatching problems.

Observations	Possible causes
Eggs rupturing	Dirty eggs; improperly cleaned eggs
No embryonic development	Infertile eggs; rough handling of eggs; incubation temperature too high; incubation temperature too low
Blood ring	Old eggs; incubation temperature too high; incubation temperature too low
Dead embryos, second week	Incubation temperature too high; incubation temperature too low; electric power failure; eggs not turned
Air cell too small	Large eggs; humidity too high, days 1–19
Air cell too large	Small eggs; humidity too low, days 1–19
Chicks hatch early	Small eggs; temperature too low; humidity too high
Chicks hatch late	Large eggs; old eggs; temperature too low; humidity too high
Chicks dead after pipping shell	Eggs not turned first 2 weeks; thin-shelled eggs; incorrect temperature, days 1–19; temperature too high, days 19–21; humidity too high, days 1–19; humidity too low, days 19–21
Unhealed navel	Temperature too low, days 19–21; wide temperature variation in incubator; humidity too high, days 19–21
Malformed legs and toes	Improper temperature, days 1–21; improper humidity, days 1–21

Figure 2.

Incubation Data Chart											
This record is important. Keeping data will help you prevent problems during your incubation project.											
Day #	Date	Time Eggs are Turned					Temperature				Remarks
		1	2	3	4	5	Room Temp	Incubator Temp	Wet Bulb	Water Checked	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19		XXX	XXX	XXX	XXX	XXX					
20		XXX	XXX	XXX	XXX	XXX					
21		XXX	XXX	XXX	XXX	XXX					

Resources

Professional advice and support

The Texas A&M AgriLife Extension Service office in your county listed in the telephone directory under the county name.

Gregory S. Archer
MS 2472 TAMU
College Station, TX 77843-2472
Telephone: (979) 845-4319
E-mail: garcher@poultry.tamu.edu

PowerPoint presentation: An accompanying slide-show is available at your local Extension office or the Texas A&M Department of Poultry Science.

Sources of fertile eggs

There are many sources of fertile eggs. Some sources are convenient and the eggs affordable, but egg quality and fertility can be a problem.

One source of fertile eggs is Texas A&M University, which will ship as few as 2 dozen fertile eggs. Prices and other information are subject to change.

To order fertile eggs from Texas A&M, please complete and submit the form at <http://agrilife.org/poultryforms/egg-order/>

Or contact Dale Hyatt at (979) 845-4367

No credit cards are accepted

Eggs are sold in dozen and half dozen quantities only, with a minimum 2 dozen order. Eggs are \$7 per dozen plus a \$3 handling fee per order, plus shipping.

Shipping within Texas:

Eggs are shipped via Greyhound Bus Lines to the nearest bus terminal.

Please check with Greyhound for shipping times between Bryan, Texas and your destination. Shipping charges vary according to the number of eggs ordered and the distance from shipping point.

When ordering, request fertile chicken eggs for a school project. You will be billed at the **end of the month.**

Sources of fertile eggs, incubators, and equipment

Cackle Hatchery
PO Box 529
Lebanon, MO 65536
(417) 532-4581
cacklehatchery.com

Carolina Biological Supply Company
P.O. Box 6010
Burlington, NC 27216
(800) 334-5551
www.carolina.com

GQF Manufacturing Co.
2343 Louisville Rd.
Savannah, GA 31415-1619
(912) 236-0651
www.gqfmfg.com

Hoffman Hatchery Inc.
P.O. Box 129
Gratz, PA 17030
(717) 365-3694
www.hoffmanhatchery.com

Ideal Poultry
PO Box 591
Cameron, TX 76520
(254) 679-6677
www.ideal-poultry.com

Kemp's Incubators
3560 West 18th Ave.
Eugene, OR 97402
(888) 901-2743
www.poultrysupply.com

Lyon Technologies, Inc.
1690 Brandywine Avenue
Chula Vista, CA 91911
(888) 5966-872
www.lyonusa.com

McMurray Hatchery
P.O. Box 458
191 Closz Drive
Webster City, Iowa 50595
(800) 454-3280
www.mcmurrayhatchery.com

Meyer Hatchery
626 State Route 89
Polk, OH 44866
(888) 568-9755
www.meyershatchery.com

Randall Burkey Co., Inc.
117 Industrial Dr.
Boerne, TX 78006
(800) 531-1097
www.randallburkey.com

Stromberg's Chicks and Game Birds
P.O. Box 400
Pine River, MN 56474
(800) 720-1134
www.strombergschickens.com

Ridgway Hatcheries, Inc.
615 North High St. Box 306
Larue, OH 43332
(740) 499-2163
ridgwayhatchery.com

Welp Hatchery
P.O. BOX 77
Bancroft, Iowa 50517
(800) 458-4473
www.welphatchery.com

Helpful books

Bird, Egg, Feather, Nest, by Maryjol Koch. Smithsonian Publishing, 1999.

Chicken and Egg, by Christine Back, and Olesen Jens. A&C Black Publishers Ltd, 1992.

Chicks & Chickens, by Gail Gibbons. Holiday House, 2005.

Eggs and Chicks, by Fiona Patchett. Usborne Books, 2007.

Eyewitness Books: Bird, by David Burnie. DK Children, 2008.

From Egg to Chicken, by Anita Ganeri. Heinemann-Raintree, 2006.

From Egg to Chicken, by Gerald Legg. Children's Press, 1998.

From Egg to Chicken, by Robin Nelson. Lerner Publications, 2003.

See How They Grow: Chick, by Jane Burton. DK Preschool, 2007.

The Chicken or the Egg?, by Allan Fowler. Children's Press, 1993.

Where Do Chicks Come From?, by Amy Sklansky. Collins, 2005.

Websites

<http://www.enchantedlearning.com/subjects/birds/info/chicken/egg.shtml>

http://chickscope.beckman.uiuc.edu/resources/egg_to_chick/development.html

www.4-h.org/Resource-Library/.../Emb-Help-Guide-Beginner.dwn

www.4-h.org/Resource-Library/.../Emb-Help-Guide-Advanced.dwn

Wall charts

Chicken Development, Chart by Carolina
<http://www.carolina.com/>

Chicken Development, Poster by Ward's Natural Science
<http://wardsci.com/>

Chicken Embryo, by American Educational Products, LLC
<http://www.amep.com/>

Chicken Embryology, Poster Set" by eNasco
<http://www.enasco.com/>

Technical references

A Guide to Better Hatching, by Janet Stromberg. Stromberg Publishing Company, 1975.

Hatching Manual, Lyon Electric Company, Inc. 1988.

Practical Incubation, by Rob Harvey. Hancock House Publishers, 1993.

Hatching Eggs in the Classroom: Question Set

1. How long does it take for a chicken egg to hatch?
 - a. 14 days
 - b. 18 days
 - c. 21 days
 - d. 28 days
2. What is the ideal temperature during incubation?
 - a. 97.0°F
 - b. 98.6°F
 - c. 99.5°F
 - d. 105.0°F
3. What is the ideal relative humidity range during incubation?
 - a. 25–35%
 - b. 55–60%
 - c. 65–70%
 - d. 80–90%
4. What part of the egg becomes the chicken embryo?
 - a. The yolk
 - b. The white
 - c. The germ spot
 - d. The chalaza
5. Why do eggs need to be turned during incubation?
 - a. To warm the eggs evenly
 - b. To prevent the embryo from sticking to the side of the egg
 - c. To prevent embryo death and unhealthy hatches
 - d. Both b and c
6. What is the minimum number of times per day that incubating eggs need to be turned?
 - a. 1
 - b. 3–5
 - c. 12
 - d. 24
7. When do you stop turning the eggs?
 - a. Day 15 of incubation
 - b. Day 18 of incubation
 - c. Day 20 of incubation
 - d. Never
8. Why shouldn't you use water to clean the eggs you are going to incubate?
 - a. It can contaminate the egg
 - b. It can decrease hatchability
 - c. a and b
 - d. It is okay to wash eggs with water
9. How soon should eggs be incubated after they are laid?
 - a. Within 1 day
 - b. Within 10 days
 - c. Within 21 days
 - d. Within 30 days
10. Should you store fertile eggs in a refrigerator?
 - a. Yes, you need to keep them cold
 - b. No, that is too cold for them
 - c. No, they need to be stored at room temperature
 - d. No, they should be stored somewhere warm
11. Which end should be up when you place the eggs in an incubator?
 - a. The small end
 - b. The large end
 - c. Either end
12. What does candling mean?
 - a. Making candles
 - b. Using light to look in an egg
 - c. Cooking an egg with a candle
 - d. All of the above
13. How long should you leave a chick in the incubator after it has hatched?
 - a. 10 minutes
 - b. 24 hours
 - c. 2–3 days
 - d. 1 week
14. When do chicks need food and water after they hatch?
 - a. Immediately
 - b. In 2–3 days
 - c. In 4–5 days
 - d. In 1 week
15. What three environmental factors are important during incubation?
 - a. Humidity, temperature, ventilation
 - b. Humidity, sound, temperature
 - c. Sound, temperature, ventilation
 - d. Humidity, light, sound,

16. What does pipping mean?
 - a. Turning egg from side to side
 - b. The chick breaking through the eggshell
 - c. Putting an egg in the incubator
 - d. Looking at the egg with a light
17. Can you have too much or too little humidity in an incubator?
 - a. No, humidity is not important
 - b. Yes, too much can kill the embryo
 - c. Yes, too little can kill the embryo
 - d. Both b and c
18. Should you wash your hands before touching eggs in the incubator?
 - a. No, it doesn't matter
 - b. No, only after touching the eggs in the incubator
 - c. Yes, germs on your hands could contaminate the egg
 - d. Yes, but only if you have just eaten
19. What do the pores in an egg do?
 - a. Allow the egg to breath
 - b. Allow light into the egg
 - c. Allow food into the egg
 - d. Allow the egg to sweat
20. What is the purpose of the air cell in an egg?
 - a. To give a cushion to the embryo
 - b. To tell you what end is up on an egg
 - c. To give the chick a place to breathe
 - d. To help the chick hatch
21. What does hatchability mean?
 - a. Percentage of eggs to hatch
 - b. Number of eggs
 - c. Percentage of eggs to pip
 - d. None of the above
22. Why do chicks hatch at or around the same time?
 - a. They talk to each other
 - b. They are more likely to survive
 - c. Both a and b
 - d. They don't, chicks hatch randomly
23. Why should you NOT open the incubator repeatedly?
 - a. It alters the temperature
 - b. It alters the humidity
 - c. It can decrease hatchability
 - d. All of the above
24. How long can it take a chick to hatch?
 - a. 1 hour
 - b. 5 hour
 - c. 24 hours
 - d. 48 hours
25. What does "setting" an egg mean?
 - a. Turning it from side to side
 - b. Placing it in the incubator
 - c. Removing infertile or dead eggs
 - d. Spinning the egg
26. What types of eggs might explode while being incubated?
 - a. Dirty eggs
 - b. Infertile eggs
 - c. Both a and b
 - d. Neither a nor b
27. What is the purpose of the egg yolk?
 - a. It becomes the chick
 - b. It serves no purpose
 - c. It helps protect the chick
 - d. It is the embryo's food
28. Is an egg shell permeable?
 - a. Yes
 - b. No
29. Do eggs from different species of birds take different numbers of days to hatch?
 - a. Yes
 - b. No
30. What four factors control the hatching of an egg?
 - a. Humidity, temperature, time, rotation
 - b. Color, light, temperature, time
 - c. Candling, food source, temperature, time
 - d. Color, humidity, temperature, time,
31. If you incubate an egg from the grocery store, will a chick hatch?
 - a. Yes
 - b. No
32. As the embryo grows, does the egg gain or lose weight?
 - a. The egg will weigh more
 - b. The egg will weigh less
 - c. The weight will not change
33. How does a chick get out of the egg?
 - a. It kicks its way out
 - b. It uses an egg tooth to peck its way out
 - c. It grow until the egg cracks open
 - d. The mother or a human cracks the egg for it

34. Should you help a chick break out of its shell?
 - a. Yes
 - b. No
35. Will all the eggs in an incubator hatch?
 - a. Yes, if they are all fertile
 - b. Yes, if the temperature is correct
 - c. No, even some fertile eggs don't hatch
 - d. a and b
36. Why should you NOT incubate a cracked egg?
 - a. It will not hatch
 - b. It will contaminate the incubator
 - c. It will contaminate the other eggs
 - d. All of the above
37. When storing eggs, what should the relative humidity of the room be.
 - a. 55–60%
 - b. 10–20%
 - c. 75–80%
 - d. 30–40%
38. A chick begins to breathe air from the air cell on day 20 of incubation.
 - a. True
 - b. False
39. True or false: How you handle eggs before you incubate them will not affect hatchability.
 - a. True
 - b. False
40. In which kind of incubator will the temperature will fluctuate more?
 - a. One with a fan to circulate air
 - b. One without a fan to circulate air
 - c. Neither, it will fluctuate the same amount with or without a fan
41. Can you incubate eggs of different species (ducks, chicken, quail, and geese) in the same incubator?
 - a. Yes, an egg is an egg
 - b. No, they will hatch at different times
 - c. No, they require different temperatures during incubation
 - d. Both b and c
42. What is a good way to increase the humidity in the incubator:
 - a. Place a dish of water in it
 - b. Place a damp sponge in it
 - c. Open the incubator
 - d. Both a and b
43. Best case scenario: What percentage of incubated eggs will hatch?
 - a. 70–75%
 - b. 80–90%
 - c. 95–100%
 - d. 50–65%
44. Which of the following is correct?
 - a. Eggs stored less than 10 days should be stored with the large end up
 - b. Eggs stored more than 10 days should be stored with the large end down
 - c. Eggs should be incubated with the large end higher than the small end
 - d. All of the above
45. What is the correct order, from shortest to longest, for the number of days to hatch?
 - a. Pigeon, chicken, turkey, goose
 - b. Chicken, pigeon, goose, turkey
 - c. Turkey, chicken, pigeon, goose
 - d. Chicken, pigeon, turkey, goose
46. Why do chicks hatch late?
 - a. The eggs are large
 - b. The eggs are old
 - c. The temperature is too low
 - d. The humidity is too low
 - e. All of the above
47. Why do chicks hatch early?
 - a. The eggs are small
 - b. The temperature is too low
 - c. The humidity is too low
 - d. All of the above
48. What could cause chicks to die after pipping the shell?
 - a. The eggs were not turned the first 2 weeks
 - b. The humidity was too high during Days 1–19
 - c. The humidity was too low during Days 19–21
 - d. All of the above
49. When do chicks begin to breathe air?
 - a. Day 1 of incubation
 - b. Day 18 of incubation
 - c. Day 20 of incubation
 - d. The day they hatch
50. Chicks may hatch with malformed legs and toes due to:
 - a. Improper temperature
 - b. Improper humidity
 - c. Eggs that are too small
 - d. Both a and b

- | | | | | |
|-------|-------|-------|-------|-------|
| 1) c | 11) b | 21) a | 31) b | 41) d |
| 2) c | 12) b | 22) c | 32) b | 42) d |
| 3) b | 13) b | 23) d | 33) b | 43) b |
| 4) c | 14) b | 24) c | 34) b | 44) d |
| 5) d | 15) a | 25) b | 35) c | 45) a |
| 6) b | 16) b | 26) c | 36) d | 46) e |
| 7) b | 17) d | 27) d | 37) c | 47) d |
| 8) c | 18) c | 28) a | 38) a | 48) d |
| 9) b | 19) a | 29) a | 39) b | 49) c |
| 10) b | 20) c | 30) a | 40) b | 50) d |

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