

# CHICK EMBRYOLOGY

*Hatching Eggs in the Classroom*

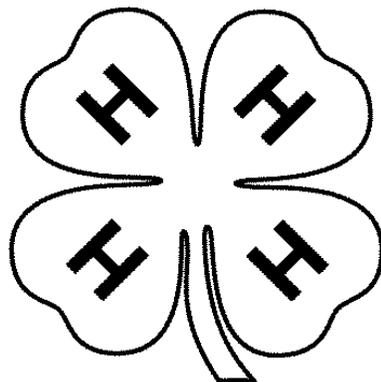
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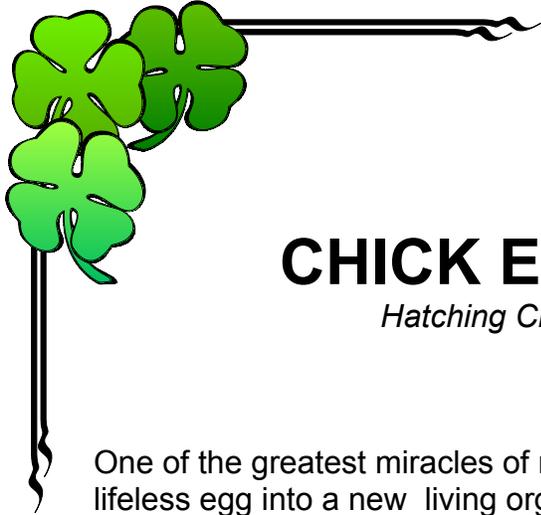




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# CHICK EMBRYOLOGY

## *Hatching Chicks in the Classroom*

One of the greatest miracles of nature is the rapid transformation of a seemingly lifeless egg into a new living organism. Egg hatching provides a rare opportunity to study the stages of embryonic growth during the 21 days of incubation, and gives students a chance to relate the stages of chick development to that of other embryos.

Although chick embryos start to develop as soon as they are formed in the hen's body, many things can affect their speed of growth and their ability to form healthy chicks. Variations in temperature can have a large impact on the growing embryo. Growth will temporarily or permanently cease if the temperature drops below 96°F or above 103°F. Too much or too little humidity can result in weak embryos or a reduced number of chicks that are able to hatch.

This lesson will help guide students through the process of controlling several environmental variables during the incubation process as they watch the growth and development of chick embryos in the classroom.

*How do chicks grow and develop while they are in the egg?*

*What factors affect embryo growth?*

*How can healthy chicks be hatched in the classroom?*

## OBJECTIVES

- U Students will describe the 21 day process of chick embryo development
- U Students will list the factors that affect the development of the embryo
- U Students will compare and contrast the development of the embryos of various animals
- U Students will demonstrate their knowledge of classroom incubation and record keeping procedures

## MATERIALS

- Incubator  
(May be purchased at the store or constructed in the classroom)
- Fertile chicken eggs  
(Your school will receive information and order forms from Sedgwick County Extension 4-H in early February. Fertile egg pick-up day is usually scheduled for late March or early April.)
- Chick Embryology video  
(Available for purchase or loan from Sedgwick County Extension 4-H)
- “Charlie the Chick” handouts (One per student)
- Chick Incubation Calendar (One per class)
- Brooder box (Large cardboard, wood or metal box with heater or lamp)
- Water Container with marbles or medium-sized pebbles
- Chick starter food and chick feeder container

## PREPARATION ACTIVITIES

& Introduce students to the chick embryology project with a classroom discussion. Use the following questions as a guide:

- \* Have you ever hatched a chick before?
- \* If so, what do you remember about it?
- \* Was there anything that surprised you about the chick hatching you did before? What was it?
- \* When we hatch our chicks in the classroom, there are some things we will need to do to make sure that the eggs hatch. What do you think they might be?  
(Make a list- some items might be care of eggs before they go into the incubator, temperature and humidity control during incubation, turning eggs, recordkeeping, care of chicks after hatching, etc)
- \* Why do you think each one is important?
- \* What will happen if the eggs are not cared for before or during incubation?
- \* How might we make sure that the eggs get proper care during incubation?

Discuss the use of the calendar chart as a way to make sure that the eggs get the care they need to hatch into healthy chicks. Make plans as a class to share responsibility for temperature monitoring, egg turning, keeping the water reservoir filled (for adequate humidity), and recordkeeping.

& Many changes need to happen inside the egg before the chick is ready to hatch. There are several ways that students can observe embryonic growth before and during the incubation process:

- \* Show the Chick Embryology video available from the Sedgwick County Office of K-State Research and Extension
- \* Click on the “Chick Embryology” link on the Sedgwick County Extension website:

<http://www.SedgwickCountyExtension.com>

\* Share the poster “A Closer Look” found in Hatching Classroom Projects lesson plan books. The books are available from:

4-H Cooperative Curriculum Service Distribution Center  
405 Coffey Hall  
1420 Eckles Ave.  
St. Paul, MN 55108-6069

Phone 1-800-876-8636  
Fax (612) 625-6281  
Email [Order@extension.umn.edu](mailto:Order@extension.umn.edu)  
Website [Http:// www.n4hccs.org](http://www.n4hccs.org)

\* Search the internet or school library for information and pictures of the development of chicks and other embryos. Several educational web sites may be accessed directly from the Sedgwick County Extension “Chick Embryology” link.

- & Construct (or purchase) an incubator using the directions on pages 2.40 - 2.41 Review with your students the importance of the constant temperature and humidity that the incubator provides.
  
- & Construct a classroom egg candler using the directions below.

### **Materials**

1 overhead projector  
Black poster board or construction paper  
1 small thin box similar to a pencil, bank check or small candy box

### **Procedure**

Cut a sheet of black posterboard or construction paper large enough to completely cover the bottom glass plate on an overhead projector. Cut a hole about one inch in diameter in the center of the sheet.

A small box, such as a pencil box, is used as an egg stand. Cut a 1" hole in one side of the box. Place the open side of the box over the hole in the posterboard.

Turn the overhead projector on and lay the egg on the 1" hole opening. The light will shine through the egg and you will be able to see any defects in the egg before placing it in the incubator. If candled every third day, the students will be able to watch the embryo's growth until it becomes too large to see detail (at about 10 days of incubation).

Be careful not to candle any one egg too frequently. It is very easy to damage or kill the developing embryos if the eggs are handled excessively during incubation.

- & Order your eggs from Sedgwick County Extension 4-H (or another supplier) well in advance of the start of your embryology project. Your school will receive information and order forms for fertile eggs from 4-H in early February each year. The completed order forms and payment are due about a month before the eggs will arrive (usually late March or early April).

If you have questions about the egg ordering process, please feel free to contact the Sedgwick County Extension 4-H Office at:

7001 W. 21<sup>st</sup> St. N.  
Wichita, KS 67205  
<http://www.SedgwickCountyExtension.com>

Phone (316) 722-7721  
Fax (316) 722-7727  
Email [Drescher@oznet.ksu.edu](mailto:Drescher@oznet.ksu.edu)

- & According to the Kansas Department of Health and Environment, there have been some reported cases of salmonella transmission from chickens to humans under laboratory conditions. Although there has never been any documented case of disease in any of the 200,000 students who have participated in 4-H chick embryology over the past 20 years, some simple health and safety precautions are prudent.

Research studies have shown that most germs can be killed by effective handwashing procedures or the use of hand sanitizing solutions. Please discuss the health and safety guidelines on page 2.42 with your students. It is highly recommended that all students and teachers wash their hands ***every time*** the eggs or chicks are handled.

# INCUBATOR DIRECTIONS



## SUPPLIES:

- \* Two 14" tall cardboard boxes, one at least 2" smaller than the other OR a foam or plastic cooler
- \* Single pane of glass that is larger than the smallest box
- \* 1/4" mesh hardware cloth
- \* Pan for water
- \* Glue (for box incubator only)
- \* Masking or packing tape
- \* Newspaper, packing peanuts, or foam, etc ( for box incubator only)
- \* Two thermometers (one wet bulb and one dry bulb)
- \* Porcelain or plastic electric socket and cord with plug and 40 watt light bulb **OR**
- \* Commercial incubator heating element
- \* 6" X 6" square plywood board
- \* Empty oatmeal (or similar sized round) box

## DIRECTIONS FOR PREPARING BOXES:

1. Place the small box inside the large box. It should be about 2" smaller in both length and width.
2. Mark a line on the inside box about 1/4" below the top of the outside box. Cut off the top of the inside box.
3. Glue the inner box bottom to the outer box bottom, leaving a 1" space between the sides of the boxes. Let glue dry overnight.
4. Fold the flaps of the outer box in and mark where they meet the inside edge of the inner box. Cut off the extra cardboard.
5. Fill the space between the boxes with crumpled or shredded newspaper, packing peanuts, foam or other insulating material. DO NOT bulge the sides of the incubator.
6. Tape the flaps of the outside box to the edge of the inside box. The incubator should look like one thick-walled box when finished.

## MAKING THE INCUBATOR:

1. Use metal shears to cut a rectangle of hardware cloth that is 4" longer and wider than the inside measurement of the prepared box or cooler.
2. Cut out a 2" square at each corner of the hardware cloth.
3. Wear heavy work gloves for this step! Fold down 2" of the hardware cloth all around the rectangle to a 90E angle.
4. Place the water pan in the bottom of the incubator and put the hardware cloth over it.
5. Install a commercial heating element in the incubator as directed in the instructions sent with the unit OR
6. Mount a porcelain or plastic socket on a board 6" square. Place the mounting board in the center of the hardware cloth. Put a 40 watt light bulb in the socket.
7. Place a cardboard tube around the light (an oatmeal box is good). To reduce the fire hazard, do not let the tube come in contact with the light bulb or the glass cover.
8. Tape the edges of the glass cover and position it on top of the incubator. The glass is adjusted to regulate the temperature and humidity. It should NOT completely cover the opening- the eggs need air to develop properly.
9. Install the thermometers so the bulbs are level with the eggs, but do not let them touch the eggs.
10. You may wish to cover the inside of the box with self-stick plastic to help with clean-up after the hatch.
11. The temperature on the dry bulb thermometer should ideally be 99.5E-100.5E (acceptable range is 98.5E to 101.5E).
12. The humidity for the first 18 days of incubation should ideally be 60%. The temperature of the wet bulb at this humidity should be between 83E and 87E. For the last 4 days of incubation increase the humidity to 65% to 70%; a wet bulb temperature of 87E to 91E.

## PROTECT HEALTH WITH PROPER HANDWASHING SKILLS



The Center for Disease Control has expressed concern about chicks and ducklings as pets because of the possibility of salmonella infections. Since 1980, more than 200,000 Kansas students have participated in classroom 4-H Chick Embryology programs. There has not been a single reported case of salmonella infection from contact with eggs or chicks during that time.

In the interest of insuring the health of your students during this exciting and important project, here are some handwashing guidelines to follow EVERY time the chicks or eggs are handled during this project.

Most disease-carrying organisms can be effectively "washed away" by following these recommended steps.

- \* Use SOAP and warm RUNNING WATER
- \* RUB your hands vigorously with soap and water for 20 seconds  
(about the time it takes your students to sing the Alphabet song)
- \* WASH the back of hands, wrists, between fingers and under fingernails
- \* RINSE well
- \* DRY thoroughly with a paper towel
- \* TURN OFF water faucets with an elbow or paper towel

If there is no access to running water try anti-bacterial lotions or hand sanitizers. Two products investigated at K-State (Vionex No Rinse Gel Antiseptic Handwash and Purell Instant Hand Sanitizer) are extremely effective in killing salmonella typhimurium bacteria. Within 30 seconds, both products killed 98.78% to 99.99% of the bacteria. Other similar products may equally be as effective, even though they were not part of this clinical trial.

A variety of anti-bacterial lotions and hand sanitizers are available at most grocery, drug or department stores. Your school nurse and food service personnel may already have access to these products at your school.

(Handwashing instructions adapted from information presented by Helen Stucky Risdon, R.N.)

## PROCEDURAL STEPS

- â Find a place in the school for the incubator where the temperature will ALWAYS be above 65E. It is important to locate the incubator away from sources of sunlight and/or drafts which might affect the temperature inside. Even a little sun shining on the incubator for part of a day can easily raise the temperature inside to a lethal level (over 103E or under 96E for several hours, or 105E for even a few minutes)!

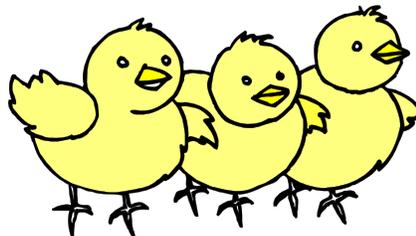
Check to make sure that the outlet you will use is “on” 24 hours a day and the incubator will not be unplugged for cleaning or other purposes at night. If the eggs will be turned by hand, you will need to make arrangements to get into the school at least once a day on weekends and/or holidays to turn the eggs.

Plug in the incubator and regulate the temperature for 48 to 96 hours before you plan to begin the egg incubation. Still air incubators (the most commonly available type) are most effective when the temperature inside is 99.5E- 100.5E. If the incubator is a purchased or used one, you may wish to check the temperature with a scientific thermometer before placing the eggs inside.

- ã After picking up the eggs, use your egg candler to check for cracked or infertile eggs before placing them in the incubator. If you have access to the internet at your school, you and your students can practice candling virtual eggs on the 4-H Cooperative Curriculum Service (CCS) website at:

<http://ulisse.cas.psu.edu/4hembryo/index.html>

- ä Place the eggs in the incubator within 24 to 48 hours of picking them up if at all possible. Be very careful to keep the eggs at a temperature between 50E and 65E and 70% humidity while they are out of the incubator. Store them in an egg carton with the small end down and turn them once a day if they are held out of the incubator for more than 24 hours.



- ǎ Place the eggs in the regulated incubator. If using an automatic turner, put the small end of the eggs down into the cups.

If turning the eggs by hand, use a pencil to write an “X” on one side of the egg, and an “O” on the other. Lay the eggs carefully on the screen with all the “X” or all the “O” marks facing up. Make sure that the eggs are turned 180° three times a day. The “X” and “O” marks can help students make sure that all the eggs are turned each time.

Check the temperature every time the eggs are turned. As the embryos grow they begin to produce their own body heat, so minor adjustments of the incubator may be needed. Remember to adjust the temperature **only a little at a time**. You will need to wait **at least 4 hours** for the incubator to reach its new equilibrium temperature.

Keep the water pan(s) full at all times by pouring lukewarm water into the reservoirs as needed. NEVER allow the water to touch the eggs.

- æ Turn the eggs three times each day (and at LEAST once a day on weekends) until the 18<sup>th</sup> day of incubation. Use the incubation calendar on page 2.45 and/or individual learning journals to record all egg care activities (turning times, incubator temperatures, water added, candling, etc.) and student observations throughout the incubation process.

Stop turning the eggs three days before hatching (18 days of incubation). If using an automatic turner, remove the eggs from the turner and lay the eggs carefully on the incubator screen. Clean the turner and disinfect it with a solution of liquid chlorine bleach and water (1:4) that is sprayed or wiped over ALL the surfaces (do not rinse), and put it away.

- ç About 24 hours before the eggs will hatch, it is possible to hear the chicks peeping in the shell. You may begin to see cracks and chips in the shells soon after this. Some chicks may hatch very quickly; others will take as long as 24 hours to emerge.

Increased incubator humidity will help the chicks hatch, so you may want to place several dish sponges in the incubator on the 18<sup>th</sup> day of incubation. Keep them moist until the last chick has hatched, then remove and discard them.

Do NOT help the chicks from the shell. If they are unable to hatch on their own, there are usually have developmental abnormalities that will prevent the chicks from surviving once they are hatched.

- è Leave the hatched chicks in the incubator until they are mostly dry (about 3 hours), then move them to a brooder box (see page 2.51) to continue the drying process. The temperature in the brooder should be about 95E .

It is easy to tell by observation if the temperature in the brooder box is correct:

\* If chicks are clustered together under the light (or heat source), the temperature is not high enough

\* If the chicks are as far as possible away from the light (or heat source), the temperature is too high.

\* If chicks are evenly spaced throughout the incubator, the temperature is just right.

- é Provide clean water at least once a day in chick watering jar or in a shallow dish filled with clean pebbles or marbles. You will need to allow 1/2 gallon of water daily for each 25 chicks. NEVER allow the chicks to run out of water!

For the first 2 days add 3 tablespoons of table sugar to each quart of lukewarm water to give the chicks extra energy. Use plain water after that. ***DIP THE BEAK OF EACH CHICK IN THE WATER BEFORE YOU TURN IT LOOSE.*** This teaches the chicks how and where to drink and increases their survival rate.

Provide a commercial chick starter as soon as the chicks are dry enough to go into the brooder. Sprinkle some feed on a piece of cardboard for the first 2 days, then put the feed in low troughs or a chick feeder if either is available. Never let the chicks run out of feed!

- ê If you do not have access to a suitable home for your chicks, you may return them to Sedgwick County Extension 4-H on the chick return day listed in the information packet. The unwanted chicks will be placed with local 4-H members or sent to a nearby family farm.

If you have questions or concerns about any part of the chick embryology program, please contact the Sedgwick County Extension 4-H Office at

Address	7001 W. 21 <sup>st</sup> St. N. Wichita, KS 67205
Phone	(316) 722-7721
Fax	(316) 722-7727
Email	<a href="mailto:Drescher@oznet.ksu.edu">Drescher@oznet.ksu.edu</a> <a href="mailto:Cschlege@oznet.ksu.edu">Cschlege@oznet.ksu.edu</a>

- ë About 60 hours after the first chicks have hatched, turn the incubator off and discard the remaining unhatched eggs. Some classes like to open the unhatched eggs and examine the partly formed embryos. Use caution during this process since some eggs may be decayed enough inside for the contents to “explode” when the shell is cut.

As soon as the incubator cools enough to handle safely, scrub the inside with a soap solution to remove dirt and debris. Rinse thoroughly. An incubator that is allowed to sit even overnight is MUCH more difficult to clean! Disinfect the incubator with a solution of liquid chlorine bleach and water (1:4) that is sprayed or wiped over ALL the surfaces (do not rinse), and put it away.

- ① After completing the chick incubation project, use one or more of the activities below to help your students analyze and integrate their experience.

\* Calculate the daily, weekly, and 3-week average incubator temperatures. Chick embryos develop best at a steady temperature of 99.5E to 100.5E that does not vary significantly over the course of the 21 day incubation period.

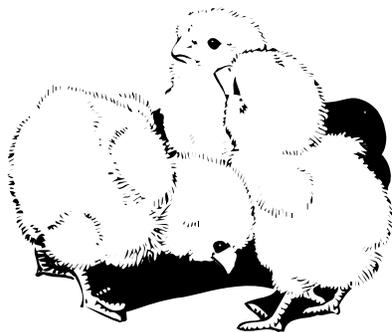
- What were the average temperatures during this incubation?
- Were the temperatures steady for the entire 21 days?
- Were the temperatures consistently within the target range?
- Was it difficult to keep the incubator temperature constant? What might affect it and why?
- Using the information you have gathered, how might you change the incubation process next time? Why?

\* Have a class discussion about the chick embryology experience using the following questions as a guide:

- Why was it important to mark the eggs in the incubator?
- How did you keep the humidity at the proper level in the incubator?
- Was it difficult to keep the incubator at the correct temperature and humidity? Why or why not?
- Can you think of other ways that you could have kept a constant temperature and humidity?
- Could you have done it if there was no electricity? How?

- Was there anything that surprised you about the process of hatching eggs? What was it? Why did it surprise you?
- Was there anything that you would do differently if you were to hatch chicks again? What is it?
- Compare the development of a chick embryo to that of other kinds of embryos. How are they the same? How are they different?
- What does the chick embryo need to grow? How does it get what it needs? Does every embryo need these things? Do other embryos get what they need in the same way? Why do you think that is so?
- Once the chick is hatched, what does it need to grow? Compare the needs before hatching with the needs after hatching. How are they the same, and how are they different?
- How do the needs of other animal babies compare to the needs of chicks? List the differences and similarities.
- What things do you need to grow up strong and healthy? Compare your needs to a chick's needs. How are they different and the same?
- How is the life cycle of a chick the same as yours? How is it the same as other animals? What are some things that all animals have in common?

\* Divide the class into teams of 3 to 5 students. Each team should make a display, design a game, draw pictures, or write stories about chick embryology. Encourage the students to share their information with a group of younger students at your school.



# CHICK INCUBATION CALENDAR



Day 1 _____ Eggs Set: _____ Turned: Temperature _____ _____	Day 2 _____ Turned: Temperature _____ _____	Day 3 _____ Turned: Temperature _____ _____	Day 4 _____ Turned: Temperature _____ _____	Day 5 _____ Turned: Temperature _____ _____	Day 6 _____ Turned: Temperature _____ _____	Day 7 _____ Turned: Temperature _____ _____
Average _____	Average _____	Average _____	Average _____	Average _____	Average _____	Average _____
Day 8 _____ Turned: Temperature _____ _____	Day 9 _____ Turned: Temperature _____ _____	Day 10 _____ Turned: Temperature _____ _____	Day 11 _____ Turned: Temperature _____ _____	Day 12 _____ Turned: Temperature _____ _____	Day 13 _____ Turned: Temperature _____ _____	Day 14 _____ Turned: Temperature _____ _____
Average _____	Average _____	Average _____	Average _____	Average _____	Average _____	Average _____
Day 15 _____ Turned: Temperature _____ _____	Day 16 _____ Turned: Temperature _____ _____	Day 17 _____ Turned: Temperature _____ _____	Day 18 _____ <b>STOP TURNING EGGS!</b> Temp. _____ _____	Day 19 _____ <b>DO NOT TURN EGGS!</b> Temp. _____ _____	Day 20 _____ <b>DO NOT TURN EGGS!</b> Temp. _____ _____	Day 21 _____ <b>HATCHING DAY!</b> Temp. _____ _____
Average _____	Average _____	Average _____	Average _____	Average _____	Average _____	Average _____

Fill in the days of the week at the top of the chart. Write in the date on the top line in each box.  
 Write in the times the eggs are turned and the incubator temperature in each day's box.  
 Use this information to help analyze the success of this project at the end of the 21 day incubation period.

## INQUIRY AND FOLLOW UP ACTIVITIES

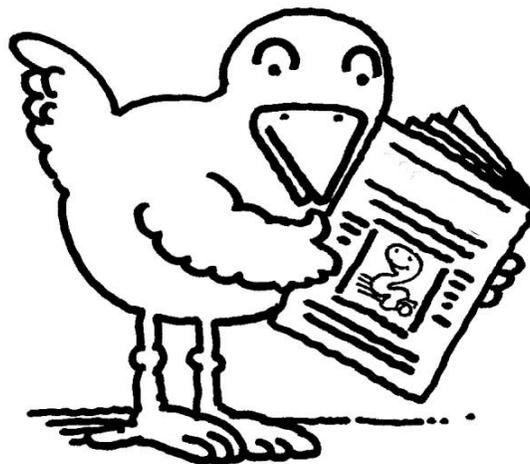
### h Calculate the Relative Humidity in Your Incubator.

Relative humidity is the ratio of the actual amount of moisture in the atmosphere to the amount of moisture the atmosphere can hold. A relative humidity of 100% means the air can hold no more water, and a relative humidity of 0% indicates there is no moisture in the atmosphere. A relative humidity of about 85% is important for the proper development of the chick embryo.

Relative humidity can be determined from wet bulb and dry bulb temperatures. Dry bulb temperature is the actual air temperature, measured by the thermometer in the incubator. Wet bulb temperature can be determined by using a wet shoe lace to cover the bulb of a thermometer. As the water evaporates, energy is used and the temperature decreases. Record this temperature as the "wet bulb" temperature.

The chart below is measured in degrees Fahrenheit; if your thermometer is calibrated in Celsius, use the equation below to convert the temperature before using the chart:

$$\text{Temperature in degrees Fahrenheit} = (1.8 \times \text{Temperature in degrees Celsius}) + 32$$



You can use the following table to determine the relative humidity in your incubator.  
Remember to convert your thermometer readings from Celsius to Fahrenheit!

### RELATIVE HUMIDITY CHART FOR WET AND DRYBULB THERMOMETER READINGS FOR INCUBATION PURPOSES

B. Gould, BARBS BIRDS, Scottsdale, AZ 85255

Dry Bulb Reading in °fahrenheit  
(the actual temperature in the incubator)

	97°	98°	99°	100°	101°	102°
56	1					
57	1	1				
58	4	3	2	2	1	
59	5	4	4	3	2	2
60	7	6	5	5	3	3
61	9	8	7	6	5	5
62	10	9	8	8	7	6
63	12	11	10	9	8	8
64	14	13	12	11	10	9
65	16	14	13	13	12	11
66	17	16	15	14	13	12
67	19	18	17	16	14	13
68	21	20	19	18	17	16
69	23	22	21	19	18	17
70	25	24	23	21	20	19
71	27	26	24	23	22	21
72	29	26	26	25	24	23
73	32	30	28	27	26	24
74	34	32	31	29	28	26
75	36	34	33	31	30	28
76	38	36	35	33	32	30
77	41	39	37	35	34	32
78	43	41	39	38	36	34
79	45	43	42	40	38	36
80	48	46	44	42	40	39
81	50	48	46	44	43	41
82	53	51	49	47	45	43
83	56	53	51	49	47	45
84	58	56	54	52	50	48
85	61	59	56	54	52	50
86	64	62	59	57	55	52
87	67	64	62	59	57	55
88	70	67	65	62	60	58
89	73	70	68	65	63	60
90	76	73	71	68	65	63
91	79	76	74	71	68	66
92	83	80	77	74	71	68
93	86	83	80	77	74	71
94	89	86	83	80	77	74
95	93	89	86	83	80	77
96	96	93	90	86	83	80
97	100	96	93	90	86	83
98		100	96	93	90	86
99			100	96	93	90
100				100	96	93
101					100	97
102						100

(this is the number reading on the wet bulb)  
 Wet Bulb Reading

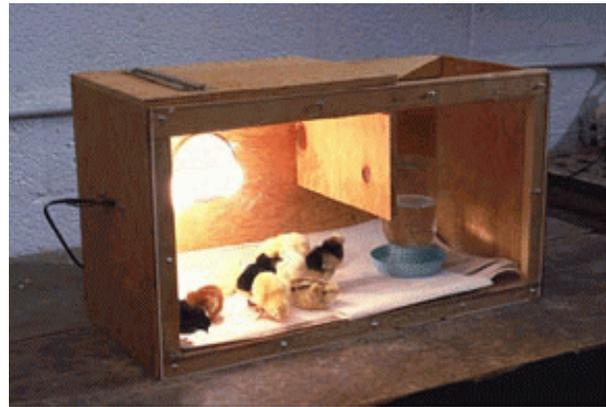
Relative Humidity Reading  
 read down the fahrenheit column\* and across the wet bulb column to get actual humidity reading

To increase Wet Bulb reading ADD water

To decrease Wet Bulb reading REMOVE water

## h **Build a Wooden Brooder**

A plywood brooder is easy and inexpensive to build; the proportions can be changed if necessary. The brooder is designed to trap heat in half of the unit to keep the chicks warm. The other half allows you to observe the chicks eating and moving about. A hinged top above the light bulbs allows you to clean the brooder and catch the chicks.



### **Materials:**

3 - pieces of 3/4" thick plywood, 18 inches by 36 inches each

1- piece of 3/4" Plywood, 9 inches by 18 inches

2- pieces of 3/4" plywood, 18 inches square.

1- 18" square of wire or plastic mesh with 1/2" to 1" openings

2- Two inch hinges

2- insulated light sockets with cords

1- Staple gun

1- Thermometer

1- Poultry Watering Jar or flat pan with enough marbles to cover the bottom

1- Chick feeder and chick feed

Nails

Newspapers, texture paper towel or fresh pine shavings

### **Directions:**

\* Nail one of the 18-inch by 36-inch pieces of plywood (the bottom of the box) to two of the 18-inch by 36-inch pieces (the sides of the box).

\* Nail on the ends (the two 18-inch square pieces). You now have a box without a top.

\* Looking down from above the open top, measure 18 inches from the ends on both sides. Place the 9" X 18" piece of plywood at the 18-inch mark with its edge flush with the top. Nail it along the sides to make a light trap. It will divide the box into two halves with a space at the bottom.

\* In the right half of the box, screw the insulated light sockets to each side, facing each other. (The middle of each light socket should be at the bottom of the light trap.). You may want to drill holes in the side of the box for the electric cords to go through.

\* Screw the hinges onto one end of the remaining 18-inch-square piece of wood. Screw the hinges to the right end of the box. This is the hinged plywood top. The top above the light bulbs should be hinged to allow you to open the top so you can clean the brooder and catch the chicks.

\* Staple or nail the 18-inch-square piece of chicken wire or mesh across the left side top of the box. Use two light bulbs on the heated end of the brooder. If one burns out, the other will help maintain heat in the brooder. In a classroom, two 25-watt bulbs usually will produce enough heat. If more heat is needed increase the size of the bulbs (One bulb at a time).

\* Place a layer of newspaper about five pages thick in the bottom of the brooder and cover with two layers of paper towel. This will keep the chicks from slipping and hurting their legs.

\* Add a waterer and feeder, and your brooder is ready for the chicks.

The temperature of the brooder should be 95°F for the first week. Decrease the temperature by 5 degrees F each week by decreasing the light bulb size. Use two light bulbs on the heated end of the brooder and adjust the size of the bulbs to regulate the temperature. If one burns out, the other will help maintain heat in the brooder. In a classroom, two 25-watt bulbs will usually produce enough heat.

Written by Phillip J. Clauer , Senior Extension Associate, 4-H Youth and Specialty Poultry at Pennsylvania State University

## OTHER RESOURCES

The Sedgwick County Office of K-State Research and Extension maintains a chick embryology website each spring, usually from mid-March until late April. The website includes an on-line chick hatch, links to other chick embryology websites, lists of educational resources and equipment suppliers, and a guest book for students' and teachers' comments. The website can be found at:

<http://www.SedgwickCountyExtension.com>

The following websites have more information about poultry and poultry products:

American Poultry Association <http://ampltya.com/>

National Chicken Council <http://www.eatchicken.com/>

National Turkey Federation <http://www.turkeyfed.org>

U.S. Poultry and Egg Federation <http://www.poultryegg.org/>

The American Egg Board has an interesting website that includes recipes, egg nutrition and food safety information, an "eggyclopedia", and information about the egg industry. It also has a free educational unit for 4<sup>th</sup> to 6<sup>th</sup> graders that features Albert Eggstein, Beggsy Ross, William Sheggspere, and Crepe Suzegg. It can be found at:

<http://www.aeb.org>

## LESSON SOURCES

### **Lesson Resources:**

“Chick Embryology 4-H School Enrichment Program”

K-State Research and Extension Publications Distribution Office

24 Umberger Hall

Manhattan, Kansas 66506

### Hatching Classroom Projects

4-H Cooperative Curriculum Service

Distribution Center

405 Coffey Hall

1420 Eckles Ave.

St. Paul, MN 55108-6069

R. Scott Beyer

Associate Professor, Poultry Nutrition and Management

K-State Research and Extension

130 Call Hall

Manhattan, KS 66506

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# CURRICULAR CORRELATIONS

## Kansas Science Standards

### h 2<sup>nd</sup> Grade

#### Standard 1: Science as Inquiry

As a result of activities in grades K-2, all students will experience science as full inquiry. In the elementary grades, students begin to develop the physical and intellectual abilities of scientific inquiry.

**Benchmark 1:** All students will be involved in activities that develop skills necessary to conduct scientific inquiries.

*Indicator 4:* Ask and answer questions about objects, organisms, and events in their environment.

*Indicator 5:* Describe an observation orally or pictorially.

#### Standard 2: Physical Science

As a result of activities in grades K-2, all students will explore the world by observing and manipulating common objects and materials in their environment.

**Benchmark 1:** All students will develop skills to describe objects

\* *Indicator 1:* Observe properties and measure those properties using age appropriate tools.

#### Standard 3: Life Science

As a result of activities in grades K-2, all students will begin to develop an understanding of biological concepts.

**Benchmark 1:** All students will develop an understanding of the characteristics of living things.

\* *Indicator 1:* Discuss that living things need air water and food.

*Indicator 2:* Observe life cycles of different living things

# CURRICULAR CORRELATIONS

## Kansas Science Standards

### h 4<sup>th</sup> Grade

#### Standard 1: Science as Inquiry

As a result of activities in grades 3-4, all students will experience science as inquiry.

**Benchmark 1:** All students will develop the skills necessary to do full inquiry. Full inquiry involves asking a simple question, completing an investigation, answering the question, and sharing the results with others.

\* *Indicator 3:* Employ appropriate equipment and tools to gather data.

#### Standard2: Physical Science

As a result of activities in grades 3-4, students will increase their understanding of the properties of objects and materials that they encounter on a daily basis. Students will compare, describe, and sort these materials by observable properties.

**Benchmark 1:** All students will develop skills to describe objects.

\* *Indicator 1:* Observe properties and measure those properties using appropriate tools.

#### Standard 3: Life Science

As a result of activities in grades 3-4, all students will develop an understanding of biological concepts through direct experience with living things, their life cycles, and their habitats.

**Benchmark 2:** All students will observe and illustrate the life cycles of various organisms.

\* *Indicator 1:* Compare, contrast and ask questions about life cycles of various organisms

\* = assessed indicator

# CURRICULAR CORRELATIONS

## Kansas Science Standards

### h 8<sup>th</sup> Grade

#### Standard 1: Science as Inquiry

As a result of activities in grades 5 - 8, all students will develop the abilities to do scientific inquiry, be able to demonstrate how scientific inquiry is applied, and develop understandings about scientific inquiry.

**Benchmark 1:** the students will demonstrate abilities necessary to do the processes of scientific inquiry.

\* *Indicator 3:* Use appropriate tools, mathematics, technology, and techniques to gather, analyze, and interpret data.

#### Standard 3: Life Science

As a result of activities in grades 5 - 8, all students will apply process skills to explore and understand structure and function in living systems, reproduction, and heredity, regulation and behavior, populations and ecosystems, and diversity and adaptations of organisms.

**Benchmark 1:** The students will model structures of organisms and relate functions to structures.

\* *Indicator 1:* Relate the structure of cells, organs, tissues, organ systems and whole organisms to their functions.

**Benchmark 3:** The students will describe the effects of changing external environment on the regulation/balance of internal conditions and processes of organisms.

\* *Indicator 2:* Identify behaviors of an organism that are responses made to internal or environmental stimuli.

\* *Indicator 3:* Explain that all organisms must be able to maintain and regulate stable internal conditions to survive in a constantly changing external environment.

**Benchmark 5:** The students will observe the diversity of living things and relate their adaptations to their survival or extinction.

\* *Indicator 1:* Conclude that millions of species of animals, plants and microorganisms may look dissimilar on the outside but have similarities in internal structures, developmental characteristics, and chemical processes.