Incubation & Embryology

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MacFarlane PHEASANTS

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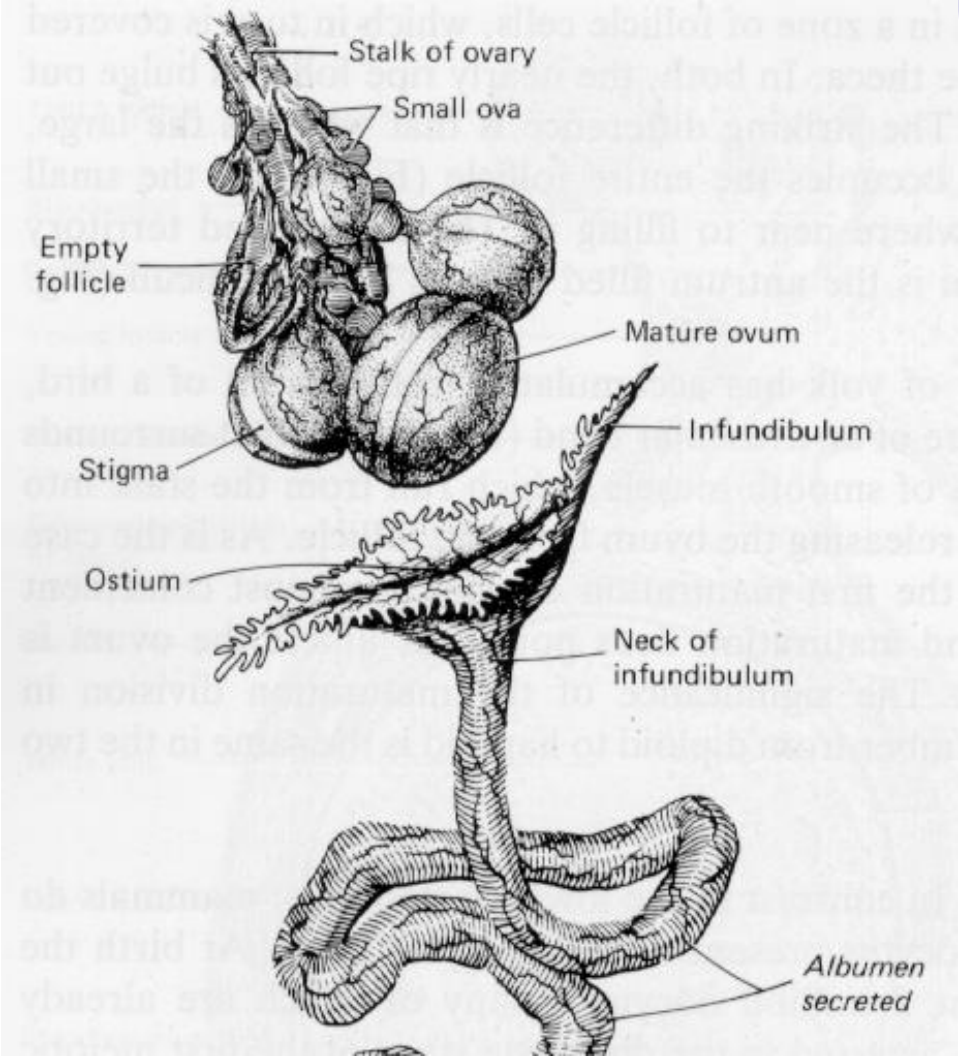
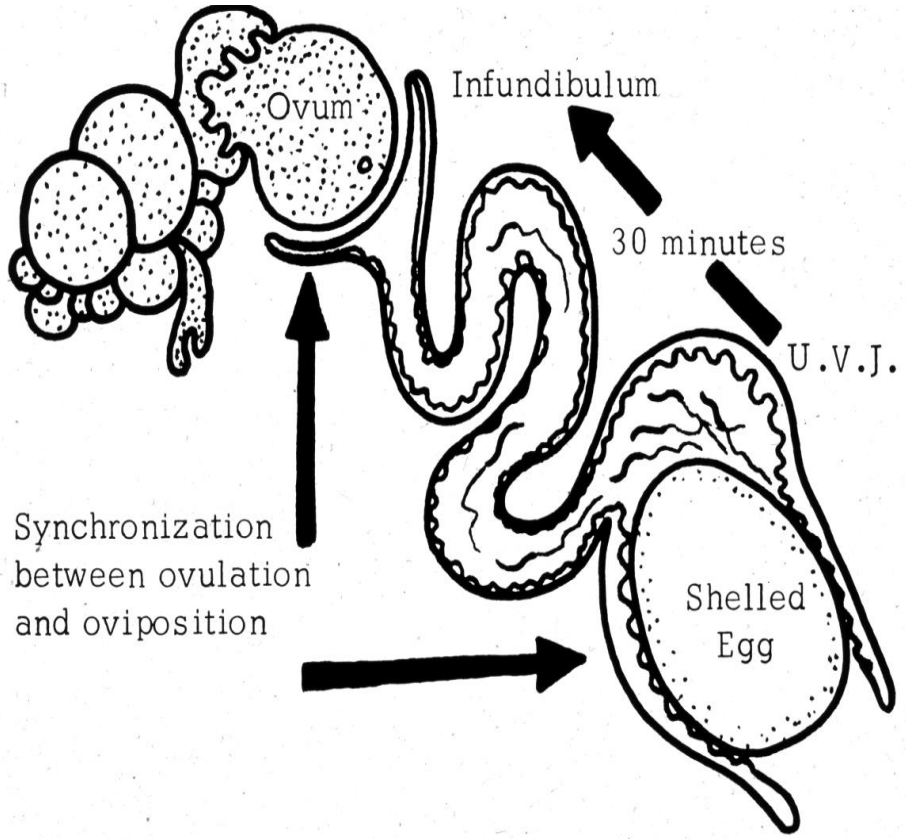
Fertilization

- Location - infundibulum
- Funnel shaped - acts to engulf ovum



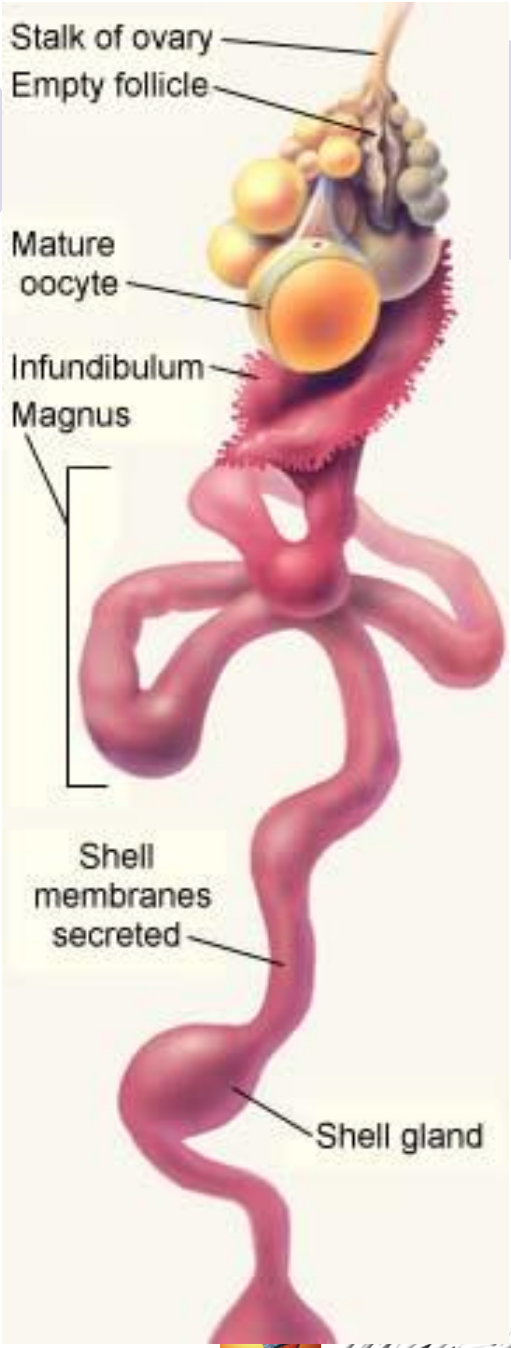
Fertilization

- Fertilization occurs < 5 minutes after ovulation
- Capture of ova is not necessarily a result of ovulation
- Ova present ~ 15 minutes (in chickens)



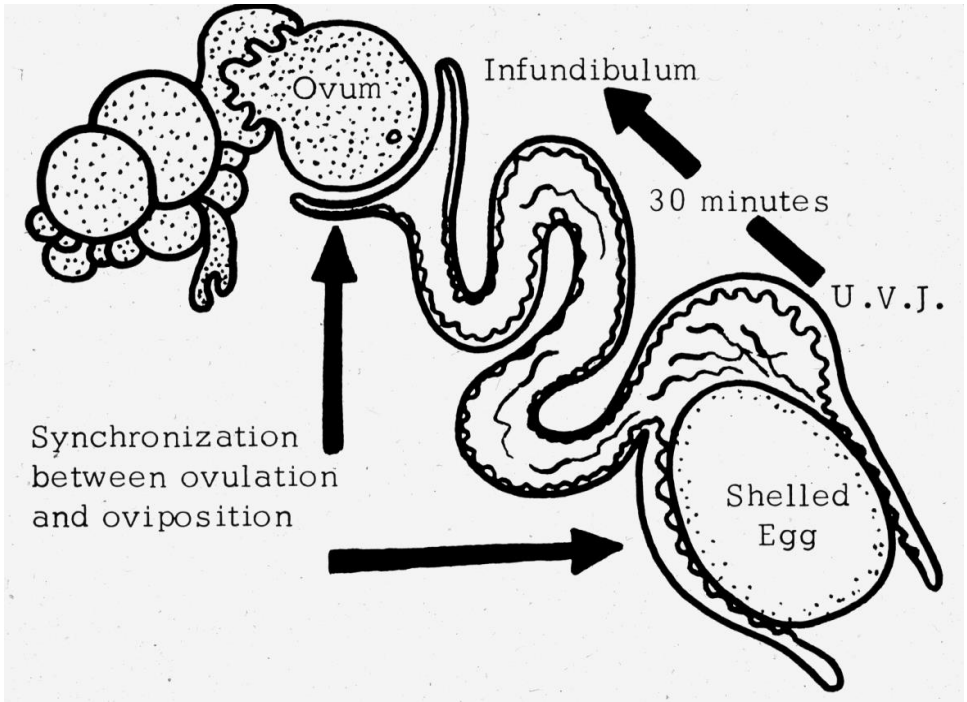
Fertilization

- Shell formation takes 24-26 hours to complete
- Hen's body temperature 104 - 106^{o} F

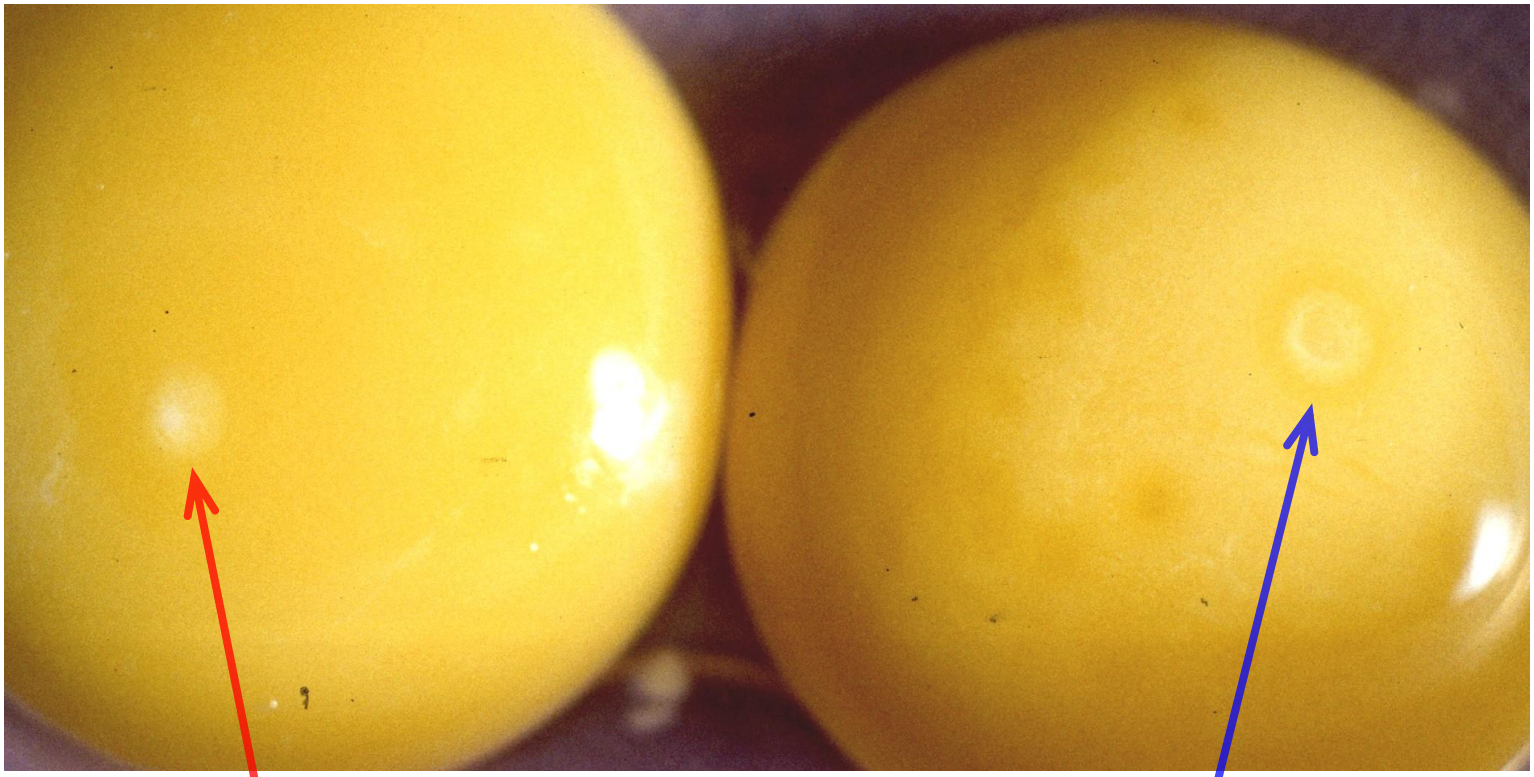


Sperm Cell Storage

- A biological necessity to produce fertile eggs in the avian system



Fertile and Infertile Eggs



Fertilization & Embryo Development

- Fertilization occurs within 5 minutes after ovulation
- Shell formation takes 24-26 hours to complete
- Hen's body temperature 104 - 106^{o} F
- A laid egg represents 1 days embryonic growth (20,000 - 40,000 cells)

Egg Handling

- Needs more attention and has a huge impact on hatch of fertile.
- Egg handling starts at the farm and continues until the eggs are set in the incubator.

Eggs Evaluated

- Control
- Broken/cracked
- Cull/shell Quality
- Dirty
- Sanded
- Wiped
- Upside Down

Effect of Egg Storage Temperature on Hatchability

Keith Bramwell, Savannah Henderson, Doug Yoho
The University of Arkansas,
Scott Martin, Cobb-Vantress, Inc.

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- What does egg storage and storage temperature do to embryo growth and hatchability?

Why Are Eggs Stored?

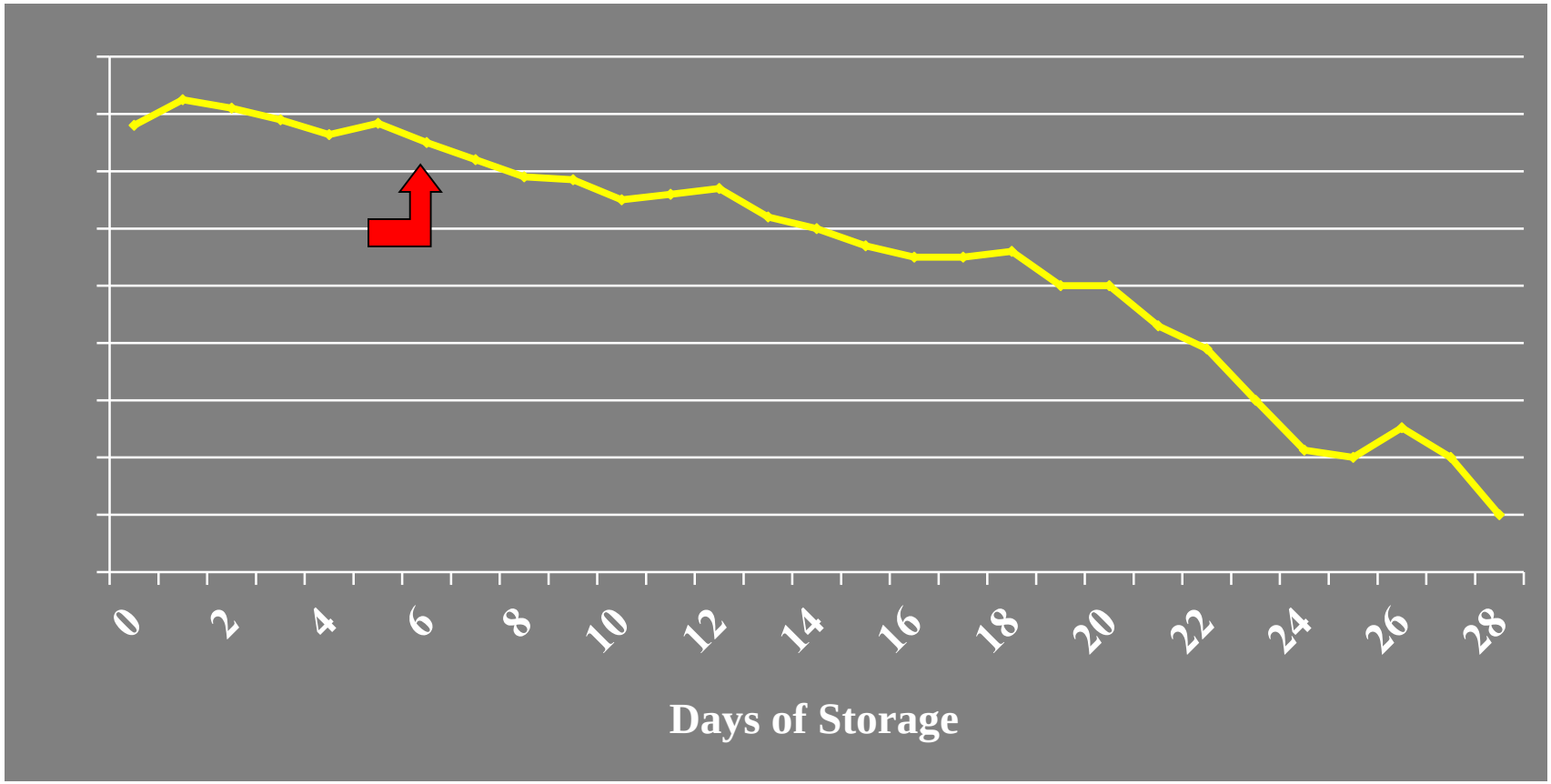
- Management perspective
  - To obtain sufficient egg numbers from each flock
  - Egg management, to fill machines/orders
- Physiological goals
  - Stop (or slow) embryo development

Effects of Egg Storage

- Main effects of storing eggs:

- 1) Prolongs incubation time
  - 1 day storage adds 1 hour to incubation time
- 2) Hatchability depressed with storage
  - After 7 days 0.5 to 1.5% hatch loss per day stored
- 3) Chick quality depressed
  - After 14 days egg storage

Effect Of Egg Storage On Hatchability



Purpose of Storing Hatching Eggs

- “Arrest” embryo development
- “Physiological Zero” - The temperature at which embryonic development stops, or is appreciably decreased
- In order for embryonic development to be virtually stopped, on-farm egg coolers are typically set between 63°F and 70°F

Embryo Development
(Germinal Disc Size in mm)

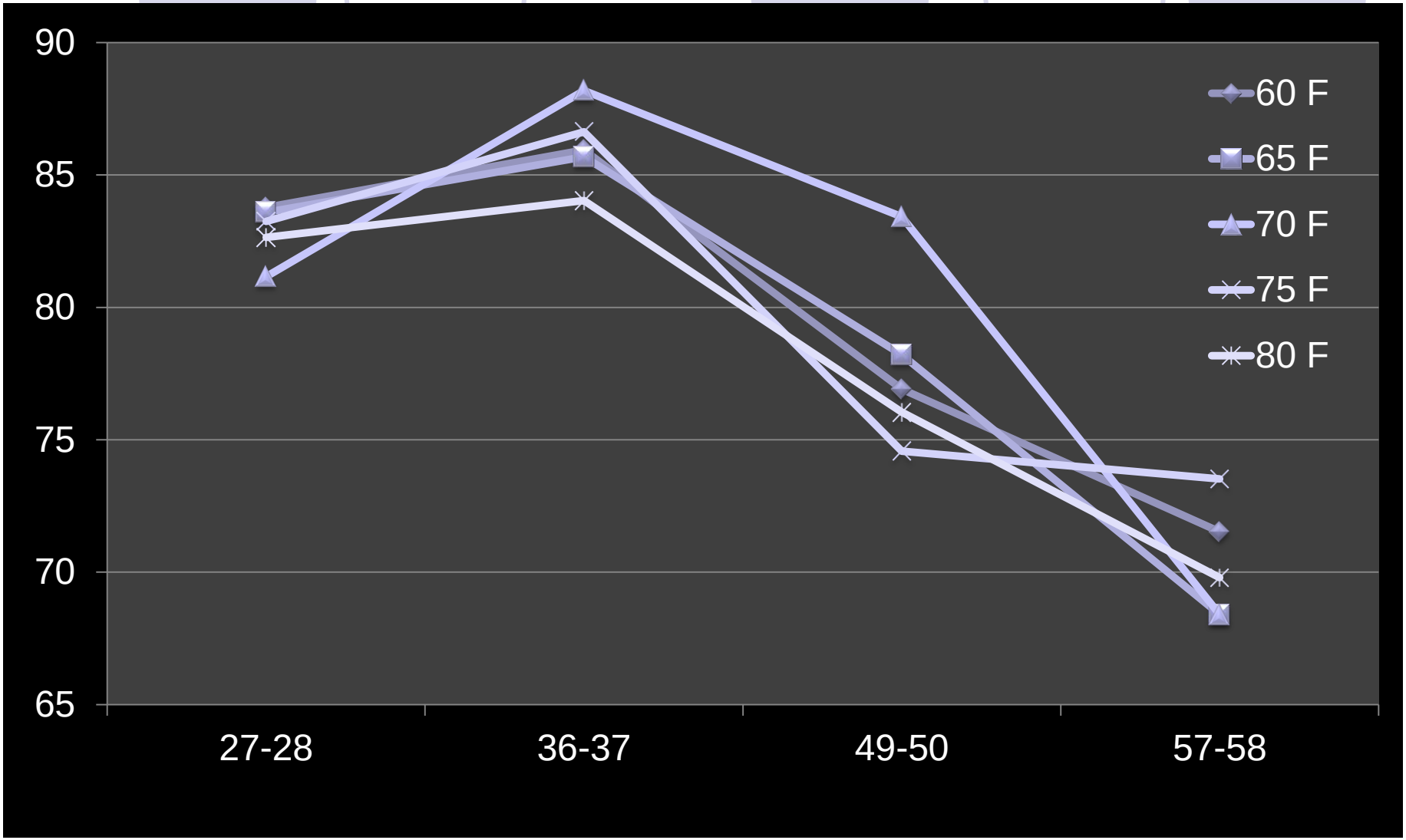
Storage time	75.0 ºF	80.0 ºF	85.0 ºF	90.0 ºF	100 ºF
24 hr	**4.96**	5.44	6.01	7.41	12.29
48 hr	**4.78**	6.08	10.19	15.48	-
72 hr	**4.87**	6.54	16.68	28.23	-
96 hr	**4.86**	9.13	22.62	38.96	-

Time Required to Cool Eggs From 100ºF (37.8ºC) to 65ºF (18.2ºC)

Sealed Egg Cases	Egg Cases with Holes in Side	Wire Baskets	Incubator Egg Trays
4-5 days	1-2 days	1 day	¾ day

Commercial Chicken Production Manual

Hatchability



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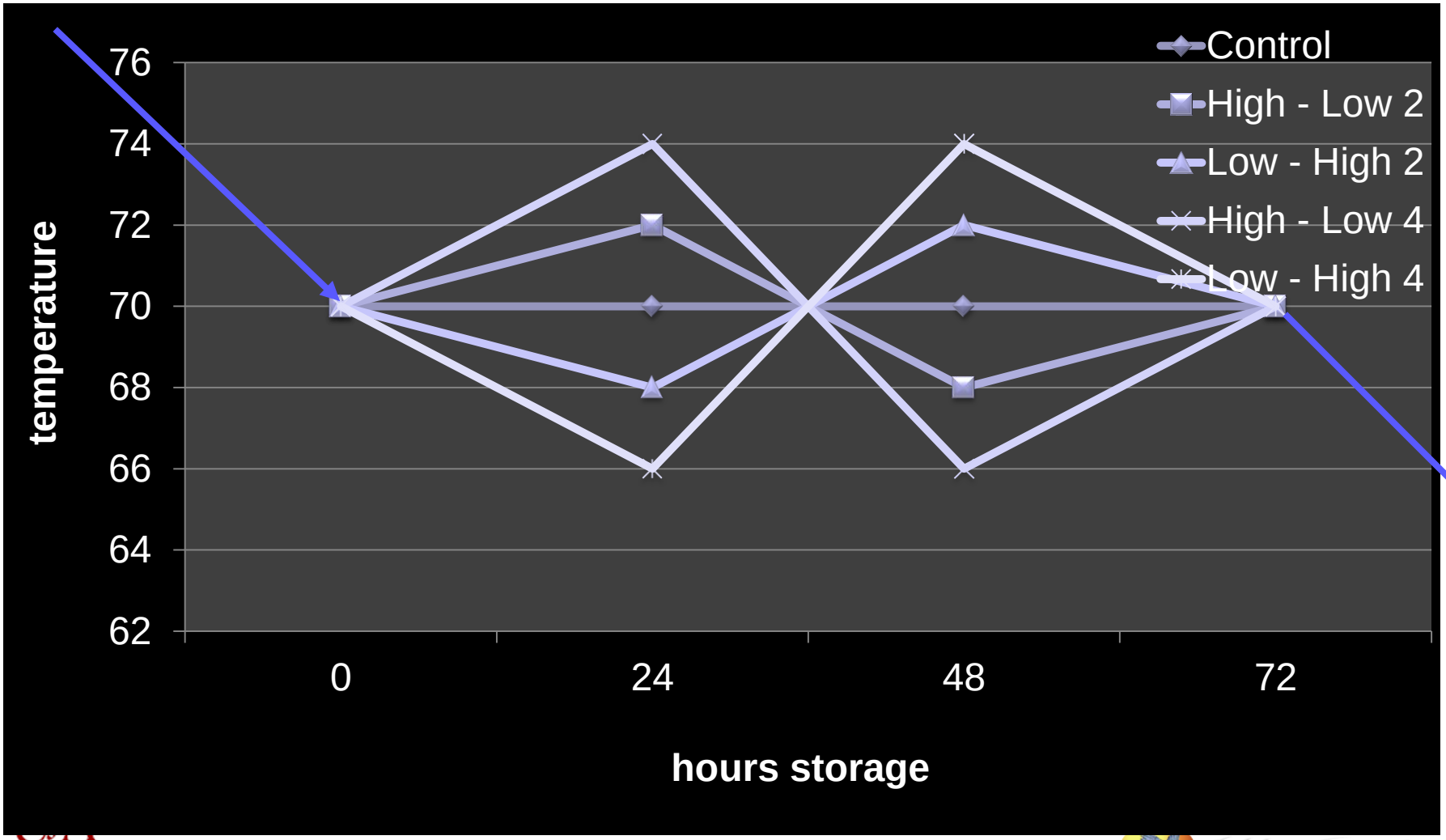
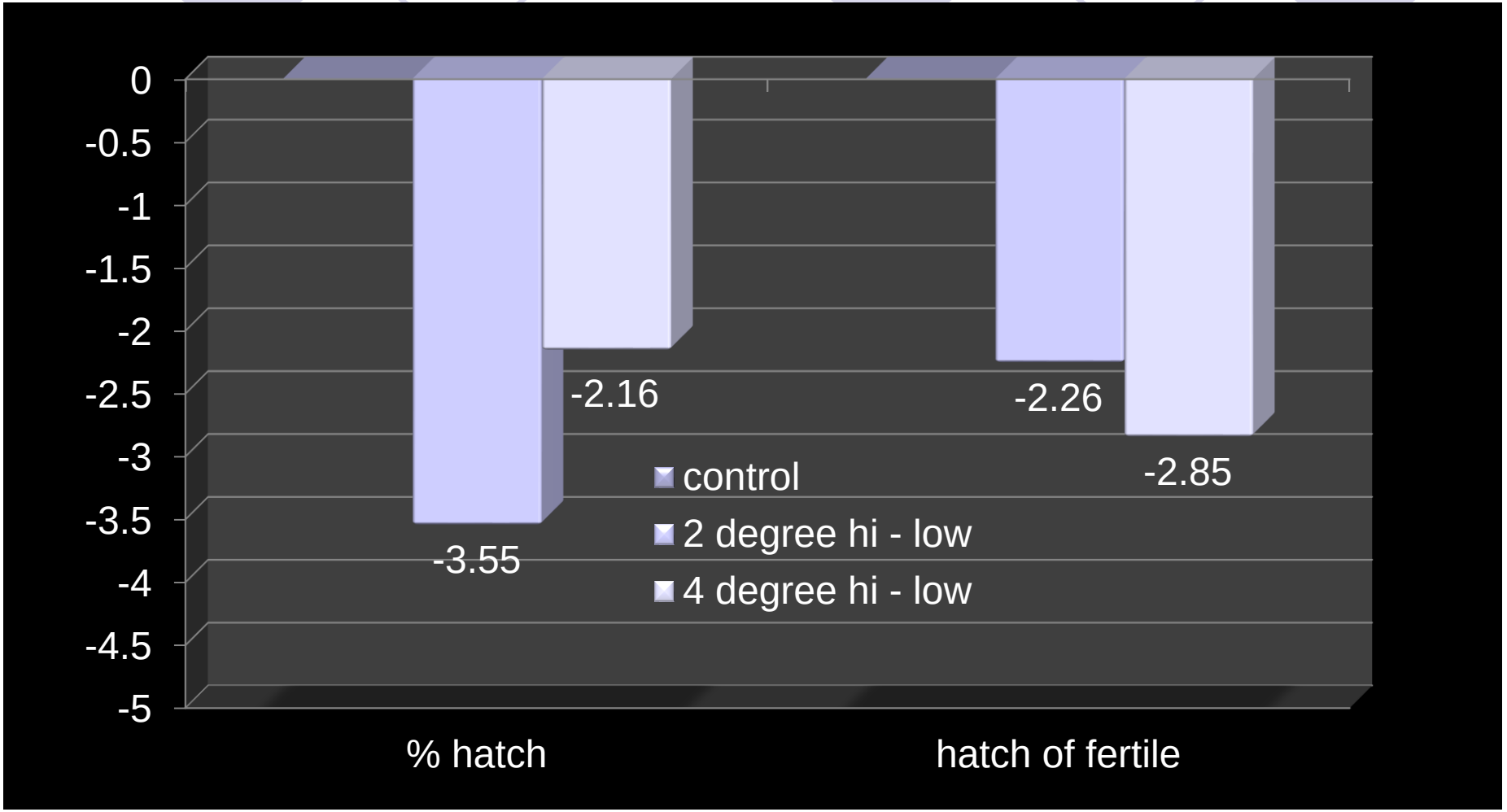
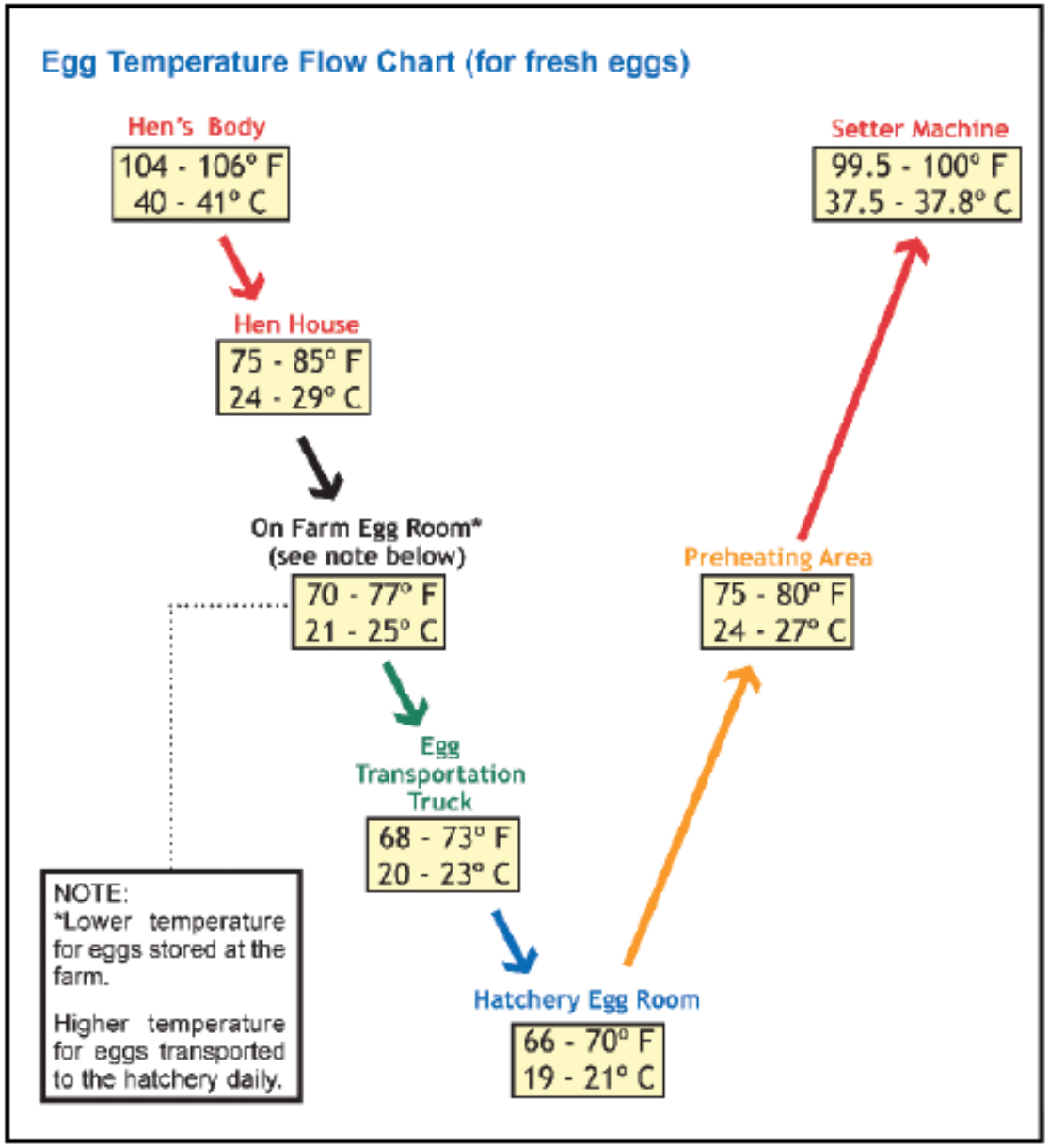
- What does variations in on-farm hatching egg storage do to hatchability?

Fluctuating Egg Storage Temperature



Hatch Loss Caused by Storage Temperature





While the industry recommends storage temperature of 20 C, actual on-farm storage temperature can range from 15.6 C to 23.9 C.

Data Loggers

- An important tool today is following egg room temperatures with data loggers.
- Data loggers can also follow temperature in the nest and belt.
- Many problems have been solved using data loggers to correct fluctuations or re-insulate farm coolers.

Summary

- Most hatchability problems are a result of poor fertility
- However, when egg production is attained, and the flock maintains high levels of fertility, how we care for hatching eggs can have a tremendous effect on the overall hatchability

Incubation and Hatchery Management

Keith Bramwell, PhD
Department of Poultry Science
The University of Arkansas

Introduction

- Advances in hatchery and incubation technology and the equipment available continues to improve and provide opportunities previously unavailable

Incubation Time

- Three factors influence incubation time:
- 1) Temperature of incubation
  - Somewhat fixed, but can be adjusted for age of flock, hatchery equipment, etc.
- 2) Age of eggs
  - Stored egg take longer to incubate (add 1 hour per day storage)
- 3) Size of the eggs
  - Larger eggs take longer to incubate

Setter Operation

- Requirements for incubation (embryo growth)
  - Correct temperature (~ 98.0 – 100.3 F)
  - Correct humidity (~ 54%, ~ 82 F wet bulb)
  - Adequate gas exchange (~ 12% weight loss)
  - Regular turning of eggs (~ 1 x per hour)

Setter Operation

- There are three types of commercial incubation systems
  - Multi-stage fixed rack
  - Multi-stage buggy loading
  - Single-stage buggy loading

Incubation Types

- Three main types of machines:
- 1 Multi-stage fixed rack
-
-

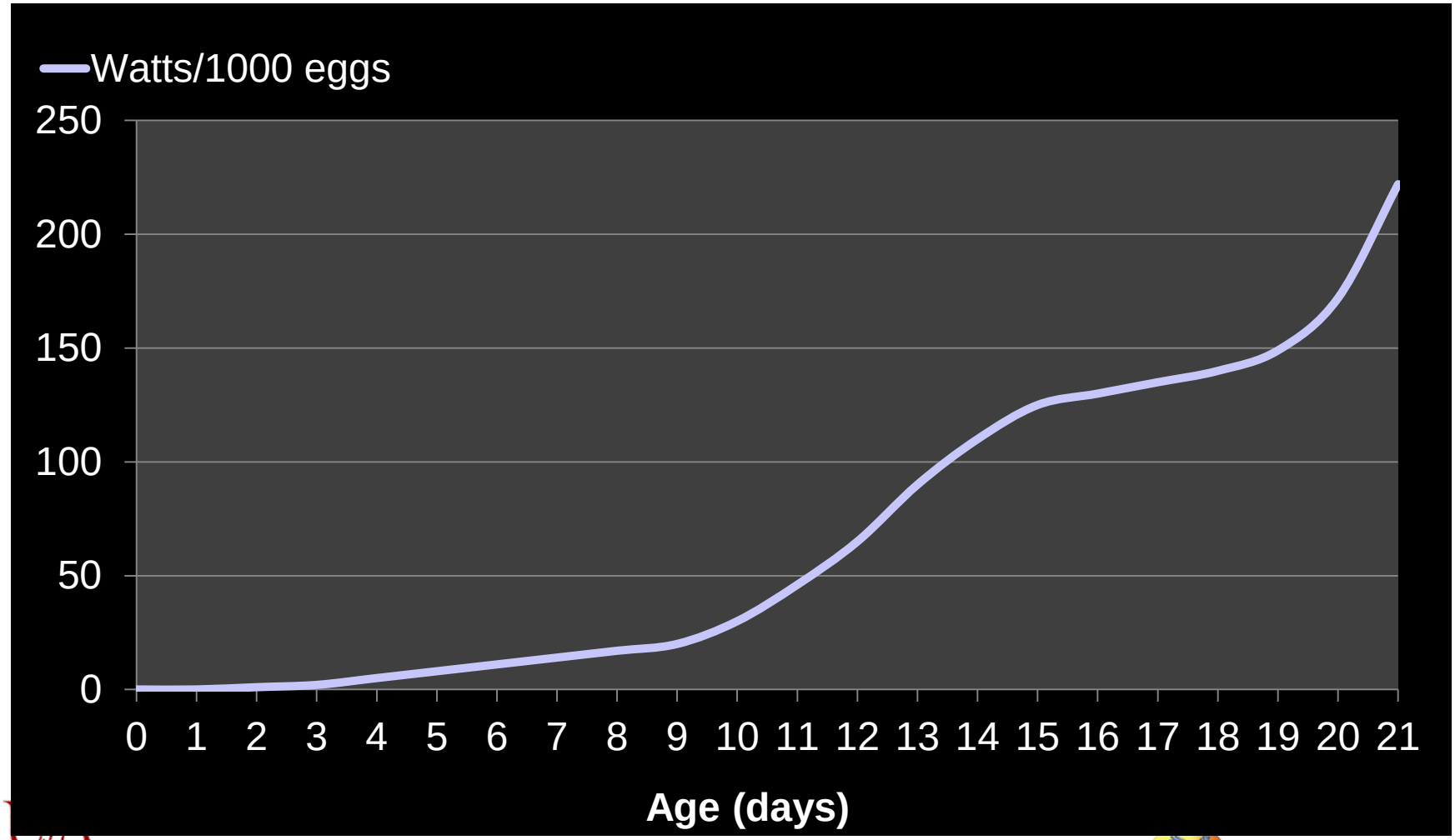
Incubation Types

- Three main types of machines:
- 2 Multi-stage buggy loading
-

Incubation Types

- Three main types of machines:
-
-
- 3 Single-stage buggy loading

Heat Production of Incubating Eggs



Incubator Profile July 2008				
Day/Hr	Temperature	Humidity	Damper %	Damper CO2
0.00	100.3F	70%	0	
3.00	1003 F	70%	0	
4.00	100.1F	70%	0	
6.00	100.0F	70%	0	
8.00	99.9F	67%		10000 PPM
9.00	99.8F	65%		10000 PPM
10.00	99.7F	60%		4000 PPM
10.09	99.6F	55%		4000 PPM
10.18	99.5F	50%		4000PPM
11.03	99.4F	45%		4000 PPM
11.12	99.3F	45%		4000 PPM
11.21	99.2F	45%		4000 PPM
12.06	99.1F	45%		4000 PPM
12.15	99.0F	45%		4000 PPM
13.00	98.9F	45%		4000 PPM
13.09	98.8F	43%		4000 PPM
13.18	98.7F	42%		4000 PPM
14.03	98.6F	42%		4000 PPM
14.12	98.5F	42%		4000 PPM
14.21	98.5F	42%		4000 PPM
15.06	98.4F	42%		4000 PPM
15.15	98.4F	42%		4000 PPM
16.00	98.3F	42%		4000 PPM
16.12	98.2F	42%		4000 PPM
17.00	98.2F	42%		4000 PPM
17.12	98.1F	42%		4000 PPM
18.12	98.0F	42%	100%	

Incubator Set Up

Turn

1. Turn Every 60 Minutes
2. Stop Turn @ Day 15

Humidity

1. Humidity on @ Day 10
2. Dehumidifier on @ Day 10
3. Auto Damper Off

Fans

Hold	0 – 1	1 – 3	3-10	10-14	14+
40%	100%	75%	90%	100%	100%

CO2

1. Span Conc. @ 5000 PPM
2. Min. Damper @ 15%
3. Hysteretic @ 300 PPM
4. High CO2 @ 12000 PPM
5. Safety Day @ 10
6. Damper Duty @ 30%

Note: Do Not Pre – Cool Incubator before loading from egg room – Use Dry Down Mode – Set Holding Temperature @ 68F and Humidity @ 75% RH

Ventilation

- Setters draw fresh air from the room they are in and expel CO_2 and excess heat
- Setters have internal humidity and temperature control, but incoming air (from the room or hallway) is pre-humidified and temperature controlled

Temperature Control

- Temperature determines the metabolic rate and development of the embryo
  - Multi-stage incubation - temperature remains constant
  - Single-stage incubation – temperature can be altered to best stimulate growth. Starting with a higher temperature then reduced thereafter. (incubation profiling)
  - Temperature variations due to incorrect loading will create incubation problems

Humidity

- Egg shell contains pores from which water vapor is lost from the egg during incubation
- Humidity can control the moisture loss
- Approximately 12% weight loss should occur by 18 days incubation
  - Weigh eggs at day 0, and weigh the same eggs again at 18 days.

Turning

- Eggs musts be turned during incubation about ~ 1 time per hour (3 or 5 x per day)
- Prevents embryo from sticking to membranes of the shell and aids in development of embryonic membranes
- Necessary first 2/3 of incubation period

Egg Transfer

- Eggs are transferred from the setter to the hatcher at 20-21 days of incubation for several reasons
  - 1) To lay eggs on their side to allow freedom of movement during the hatching process
  - 2) Better hygiene as fluff from hatched chicks and eggs is contained in hatchers and hatcher halls, this helps reduce contamination
  - 3) Eggs and embryos are sorted and processed at this time

Operation of Hatchers

- Most commercial hatcheries hatch 4 times per week, twice from each hatcher
  - Monday and Thursday
  - Tuesday and Friday
- Hatchers are washed between each hatch to ensure cleanliness
- Construction must be durable to handle these factors

Operation of Hatchers

- Ventilation & Humidity
  - Initially the same as in the setters
  - As chicks begin to pip humidity rises to keep shell membranes moist
- Temperature
  - Usually slightly lower than in the setters

Success???

- ***Hatchability*** is an indication of the breeder-hatchery program

- ***Hatch of Fertile*** is an indication of the hatchery management

Embryodiagnosis

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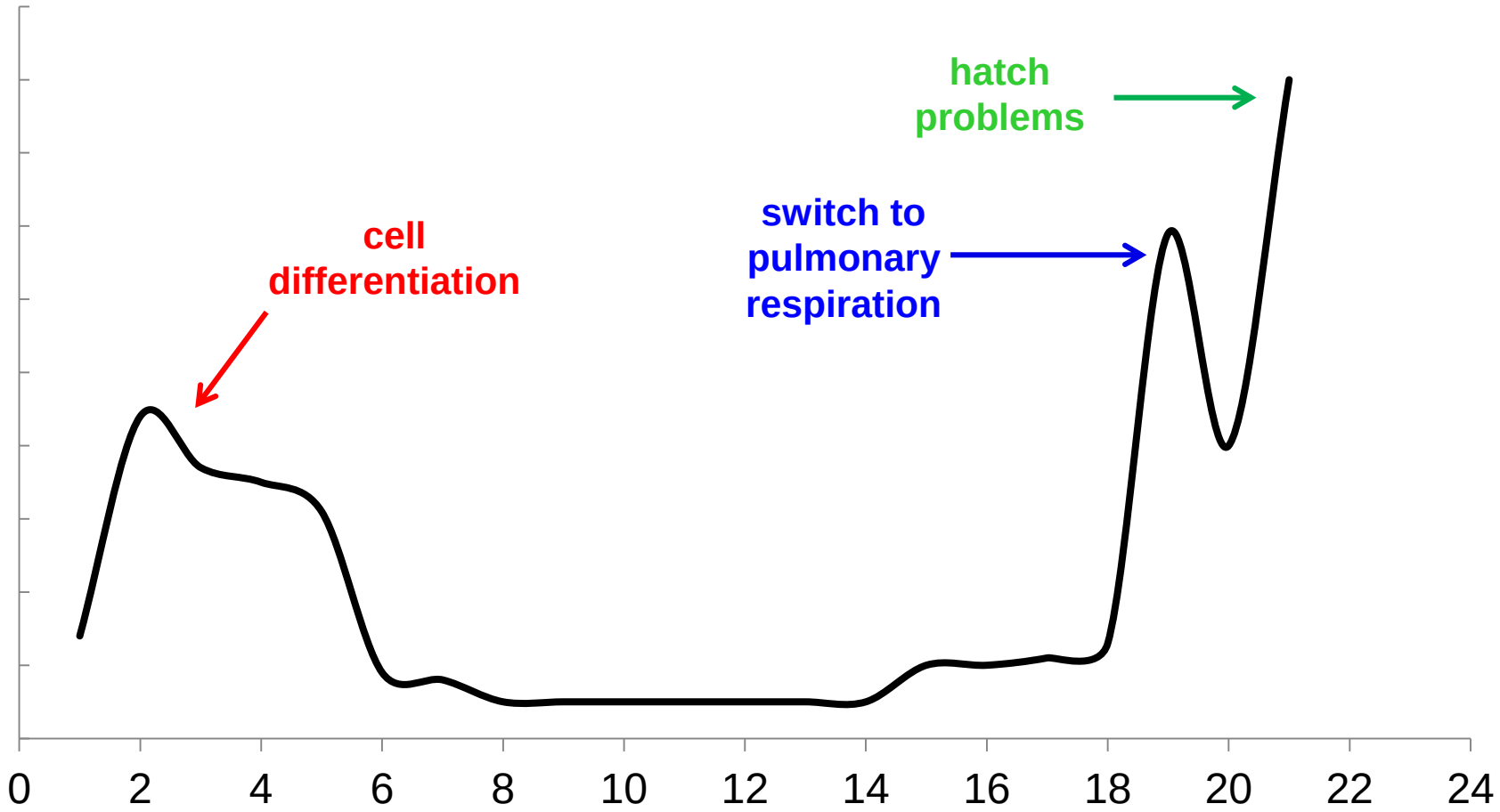
Department of Poultry Science
The University of Arkansas

Methodology

- Important for managers to have direct knowledge of breakout results
- Managers should monitor candling and breakout procedure routinely and correlate with people doing breakout
- Best if managers can assist on breakouts, especially when problems exist or decisions are to be made based on breakout

Percent Mortality of Fertile Eggs



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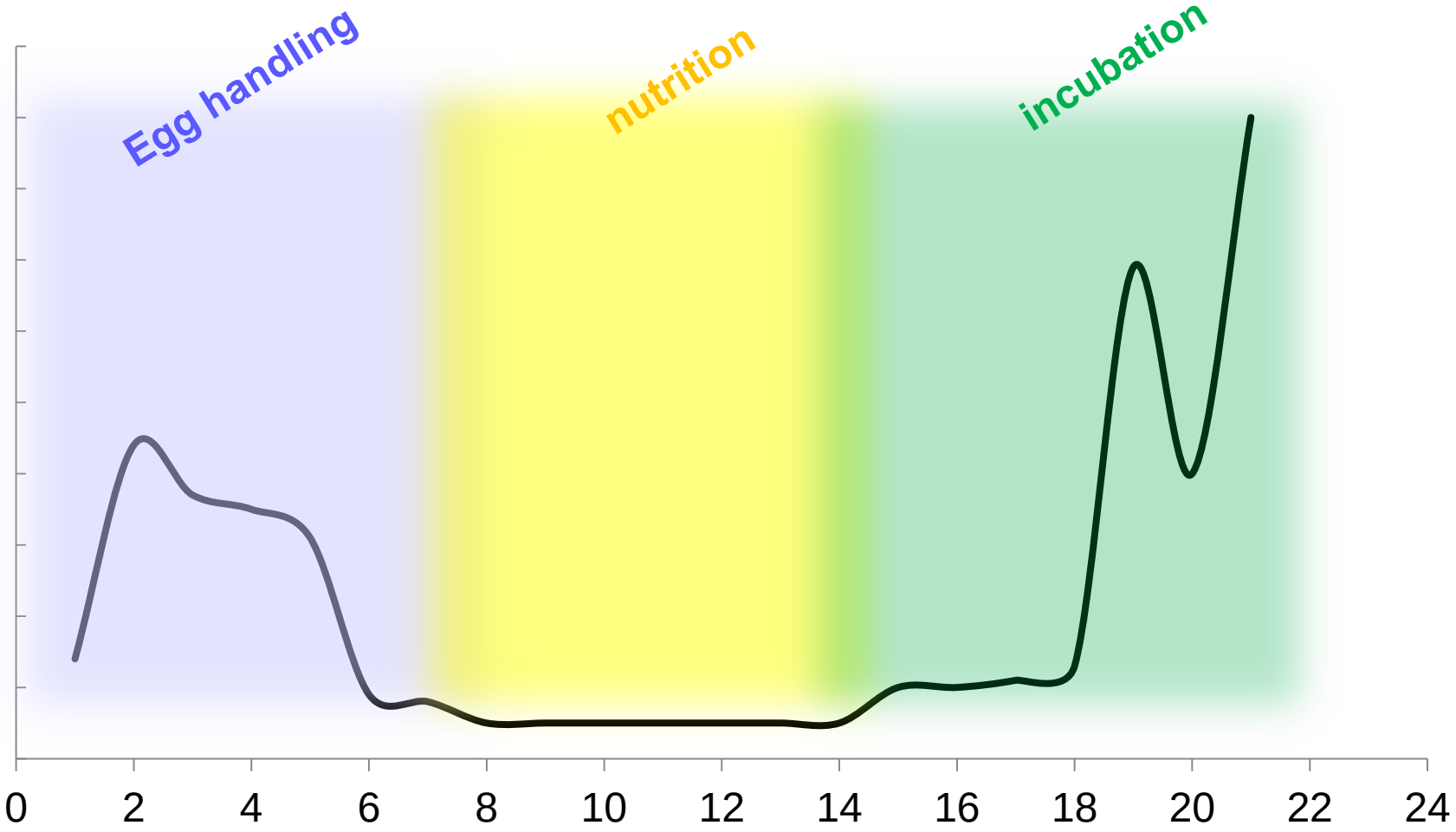

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Embryonic Mortality Pattern

- 1-7 days (2 - 4 days)
  - ~ 3.0 %
  - Blood & circulation system developing
- Potential causes
  - Poor egg handling (gathering & storage)
  - Aged flocks (infrequent mating)
  - Incubator problems

Embryonic Mortality Pattern

- 8 -18 days
  - ~ 0.5%
- Potential causes
  - Incubator problems
  - Breeder nutrition
    - Riboflavin
    - Vitamin B12
    - Manganese
    - Pantothenic acid

Embryonic Mortality Pattern

- 19-25 days
  - ~ 2.5 %
  - Switch to pulmonary respiration
- Potential causes
  - Increase moisture loss (pull time, low humidity, poor shell quality, etc)
  - Aged flocks
  - Contamination
  - Egg orientation

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Hatchery Residue Breakout

DATE	FLOCK #	BREED _____	AGE
% PRODUCTION	% ACTUAL HATCH	SET DATE	SETTER #

			DEAD EMBRYOS						CRACKS				
	eggs/tray unhatched	infert.	early 1-3 days	early 4-7 days	mid	late	pipped	cull chicks	farm	trans	contaminated	cull eggs	up-side down
TOTALS													
PERCENT													

EGGS / TRAY = 144 eggs * 2 trays = **288 eggs**

Fertility = **100.00**

Hatch of Fertile = **0.00**

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Action Plan

- Accurate egg break-out
  - Hatchery manager & supervisor involvement
- Standard summary
- Analysis of data
- Action plan of correction
- Use information as a management tool

Flock Examination & Record Keeping

- Breakout analysis of a sample of unhatched eggs and record incidences of:
  - Infertiles
  - Dead embryos in one of the 3 stages
  - Pips
  - Cull chicks and cull eggs
  - Farm & transfer cracks
  - Contamination
  - Misplaced eggs (small end up)

Flock Examination & Record Keeping

- Determine percent weight loss from samples of eggs
  - Weigh eggs prior to incubation
  - Weigh eggs at transfer
  - Calculate weight loss (moisture)
    - Ideal range 0.6 - 0.65 % per day
    - Acceptable 0.55 - 0.7 % per day

Trouble Shooting Hatchery Problems

- Can the problem be identified with:
  - Specific flocks or flock ages?
  - Specific setters, hatchers or other equipment?
  - Any unusual weather patterns?
  - Seasonal changes?
  - Recent changes in management practices or personnel?

Trouble Shooting Hatchery Problems

- Does the problem persist?
- Do you know what is *normal,* or what should be expected?
- How has this same bird or combination performed in the past?

Hatch Residue Analysis

- **BREAK OPEN UNHATCHED EGGS!!!!**
- Record results for each hatch.
- Why? You can't fix poor hatchability if you don't know why they aren't hatching!!!

Strategy

- Learn to use egg break-out data to develop action plans for hatch improvement and monitor results of the action plan.

Summary

- Obtain appropriate data and keep good records
- Try and identify flocks or equipment as potential problems and/or eliminate areas that are not a factor

Summary

- Try and determine if any other changes have occurred that may affect the problem
- Make necessary adjustments where needed

Fertile vs. Infertile

- Do not classify abnormal conditions as fertile
  - Blood spots (not blood ring remnants)
  - Meat spots
  - Mottled yolks
  - Contamination (esp. Yeast)
  - Chalaza

Pipped

- Signs
  - Dead in shell
  - Full-term embryo

- Causes
  - **Low humidity or temperature for long periods**
  - **Hatcher humidity low**
  - **High temperatures during hatching**
  - Nutritional deficiencies
  - Breeder disease
  - Poor ventilation
  - Inadequate turning (day 1-12)
  - Injury during transfer
  - Prolonged egg storage

Not Pipped

- Signs
  - Dead in shell
  - Full term embryo
  - Large yolk sac
  - Yolk sac may not be fully engulfed by abdominal wall
  - May have residual albumen

- Causes
  - **Inadequate turning**
  - **Humidity high**
  - **Setter temperature low**
  - Eggs chilled (transfer)
  - Nutritional deficiencies
  - Genetics
  - Embryo accidental development
  - Breeder disease
  - Poor ventilation
  - Prolonged egg storage

Partially Pipped

- Signs
  - Embryo alive
  - Embryo dead
- Causes
  - Same as for pipped, full-term embryos
  - Excessive fumigation during hatching
  - Egg set small end up

Malpositioned Chicks

- Signs
  - Normal position after 19 days
  - Embryo long axis same as egg long axis
  - Head in large end of egg
  - Head to the right and under right wing
  - Beak towards air cell
  - Feet towards head
- Causes
  - Eggs set small end up
  - Improper egg turning
  - Setter temperature too high or too low
  - Humidity too high
  - Old breeders
  - Round shaped eggs or very large eggs
  - Nutritional deficiencies
    - Vit A and vit B_{12}
  - Poor egg handling or storage
  - Retarded development

Chicks Hatching Early

- Signs
  - Excessively noisy chicks
  - Thin chicks
  - Dry skin around legs and feet
  - Increased 7 day field mortality
- Causes
  - Small eggs
  - Breed differences
  - Setter temperature too high
  - Setter humidity too low

Chicks Hatching Late

- Signs
  - Called ‘green chicks’
  - Swollen abdomen
- Causes
  - Large eggs
  - Old breeders
  - Eggs stored too long
  - Setter temperature too low
  - Weak embryos
  - Inbreeding (genetics)
  - Setter humidity too high

Slow Hatch

- Signs
  - Protracted or ‘drawn-out’ hatch
  - Mixture of early and late hatched chicks
  - Chicks begin hatching early but slow to finish
- Causes
  - Mixture of eggs stored too long and too short
  - Mixture of eggs from young and old breeders
  - Mix of large and small eggs
  - Improper egg handling
  - Hot or cold spots in setters or hatchers
  - High or low temperatures in setters or hatchers
  - Poor ventilation in machines and rooms & hallways

Poor Chick Quality

- Signs
  - Hatching trays not hatching uniformly throughout machine
- Causes
  - Mix of large and small eggs
  - Mix of eggs from young and old breeders
  - Mix of eggs from different strains (breeds)
  - Variation in egg storage
  - Setter or hatcher ventilation not uniform
  - **Disease or stress in some breeder flocks**
  - Variation in on farm egg storage procedures

Open or Unhealed Navel

- Signs
  - Open and unhealed navels
  - Dry, rough down feathers
- Causes
  - Setter temperature too high or variation in temperature
  - Hatcher temperature low
  - Hatcher humidity too high, or not lowered at hatch completion
  - Poor breeder nutrition

Stringy Navel

- Signs
  - Dry, rough down
  - Unhealed navel
  - ‘string’ attached to navel
- Causes
  - Setter temperature too high or too low
    - Wide fluctuations in temperature
- Hatcher humidity too high
- Inadequate breeder nutrition

Unhealed Navel, Infection

- Signs
  - Wet, odorous chicks
  - Large, mushy
  - Soft bodied, lethargic
- Causes
  - Omphalitis, navel infection and contamination
    - Egg contamination from breeder farm, egg transport, hatchery
    - Unsanitary trays, machines, etc
  - Setter temperature too low
  - Setter or hatcher humidity too high
  - Poor ventilation

Red Hocks

- Signs
  - Red hocks
    - hatched chicks
    - unhatched chicks
  - Red abrasion on upper beak

- Causes
  - Difficulty during hatching and pipping
    - Thick shells (pullet flocks)
    - High setter humidity
    - Low setter temperature
  - Vitamin deficiency

Chicks Stuck in Shell

- Signs
  - Some chicks stuck in shell
  - Chicks dry
  - Shell fragments stuck to down
- Causes
  - Humidity too low during egg storage, incubation, and/or hatching
  - Improper egg turning
  - Cracked eggs or poor shell quality

Skeletal Malformations

- Signs
  - Posterior duplication
  - Any multiple truncated development
- Causes
  - Poor egg storage and handling
  - Genetics
  - Nutritional deficiencies
    - Examples: biotin, riboflavin, zinc, manganese
  - Inadequate turning
  - Improper egg orientation (small end up)
  - Setter temperature too high or too low
  - Breeder disease
  - Poor venitilation or poor conductivity of eggs

Brain Hernia (Exposed Brain)

- Temperature too high
- Egg turning problems
- High CO_2 level

- Equipment malfunction

Cross Beak & Missing Eye

- Temperature too high
- Egg turning problems