Incubation & Embryology

10th Bi-Annual International
Pheasant Management Seminar
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MacFarlane PHEASANTS

R. Keith Bramwell, PhD
Extension Breeder/Hatchery Management
Department of Poultry Science
The University of Arkansas

Joshua R. Deines
PhD Graduate Student
Department of Poultry Science
The University of Arkansas

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THINK
SAFETY FIRST
Not allowed while hunting at
Rocky Mountain Roosters
NO Running
NO Drinking Alcohol
NO Smoking in the field
NO Hunting with safety off
NO Shooting below head high
NO Shooting over your companions
NO Shells larger than #6 shot
If there is a questionable shot, don't
take it!! NOTHING is worth the
life of a human or a dog.
CARTER'S
CREEK
Miller
HIGH LIFE

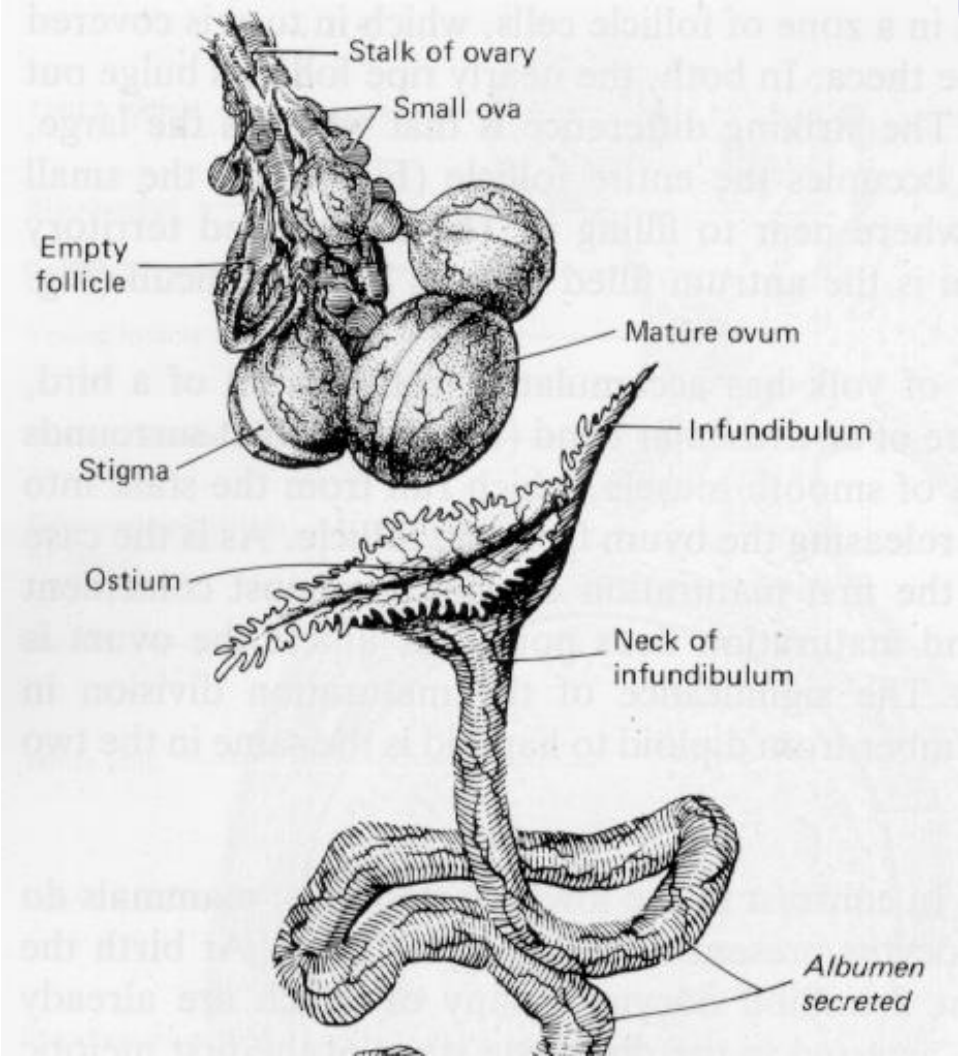
Success???

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

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

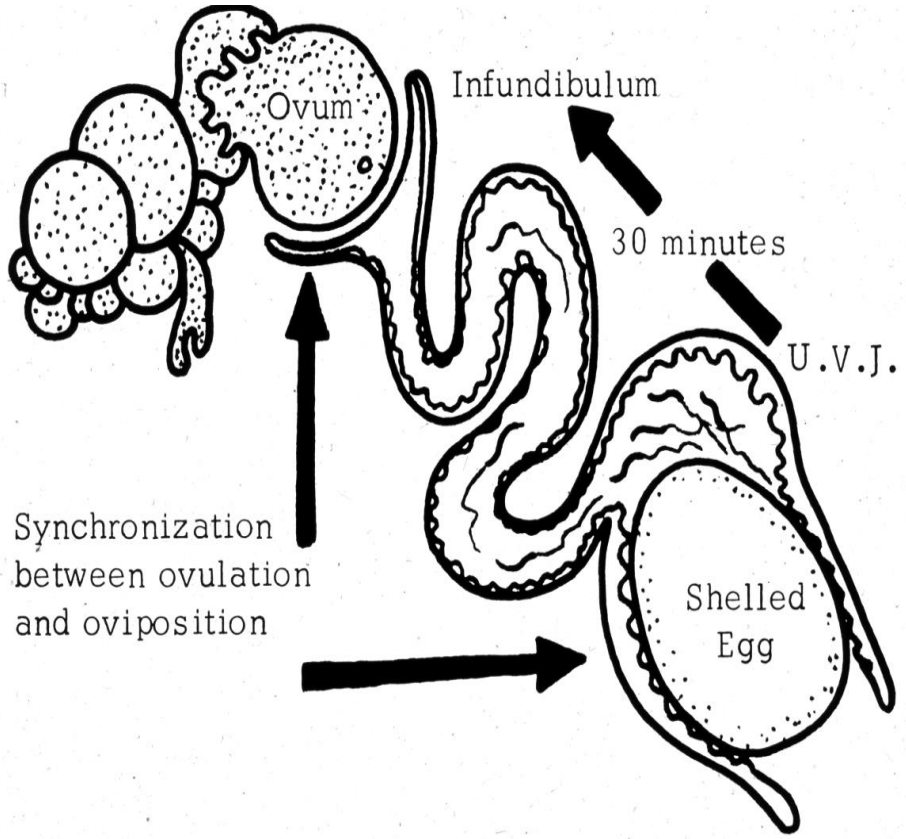
Fertilization

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



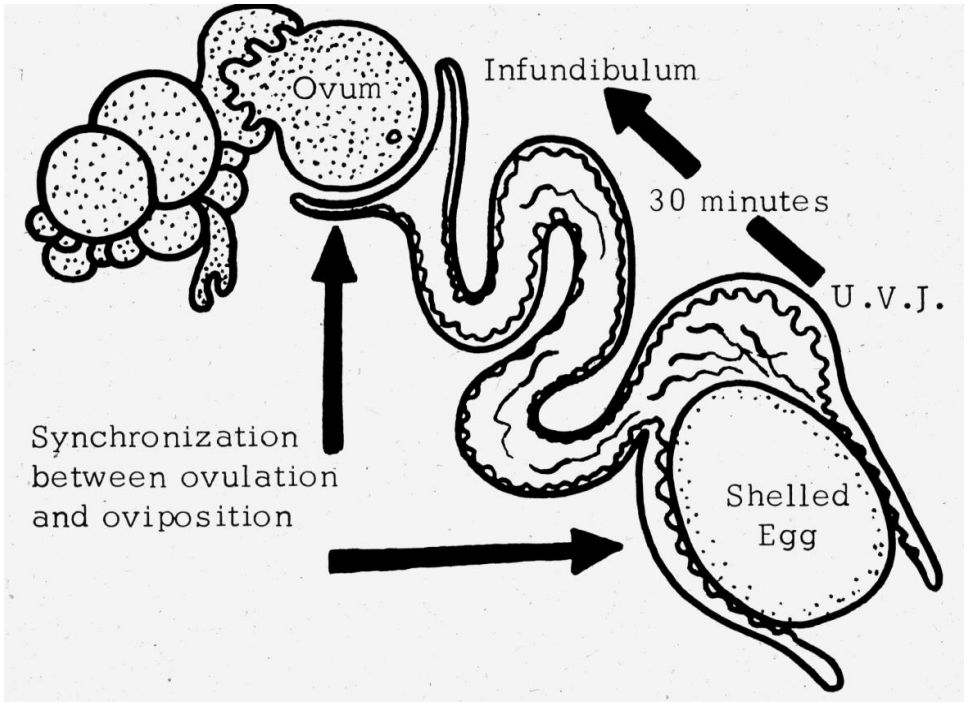
Fertilization

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



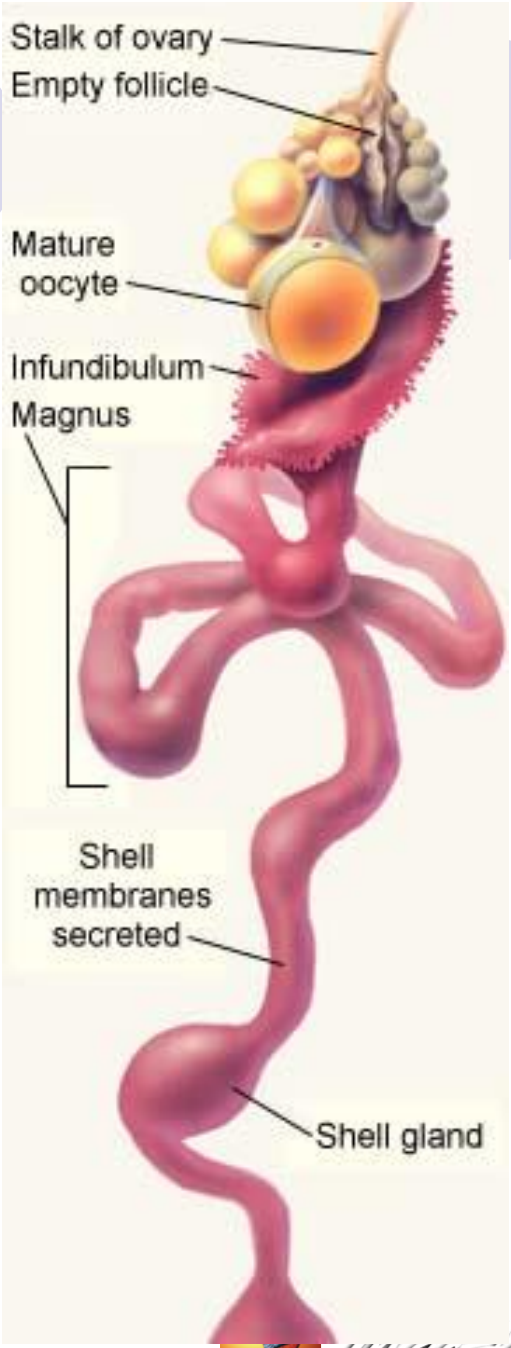
Sperm Cell Storage

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



Fertilization

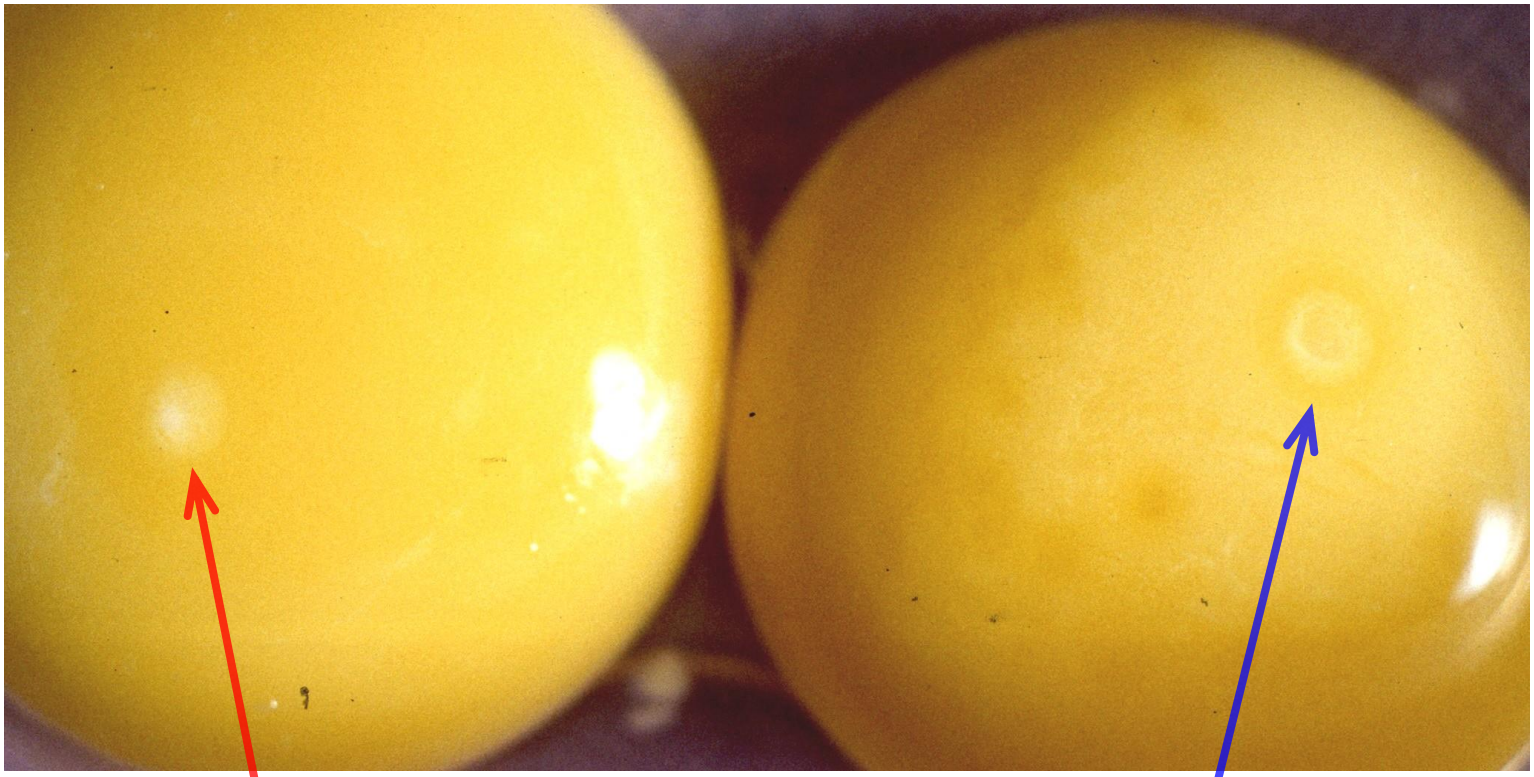
- Shell formation takes 24-26 hours to complete
- Hen's body temperature 104 - 106^{o} F



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)

Fertile and Infertile Eggs

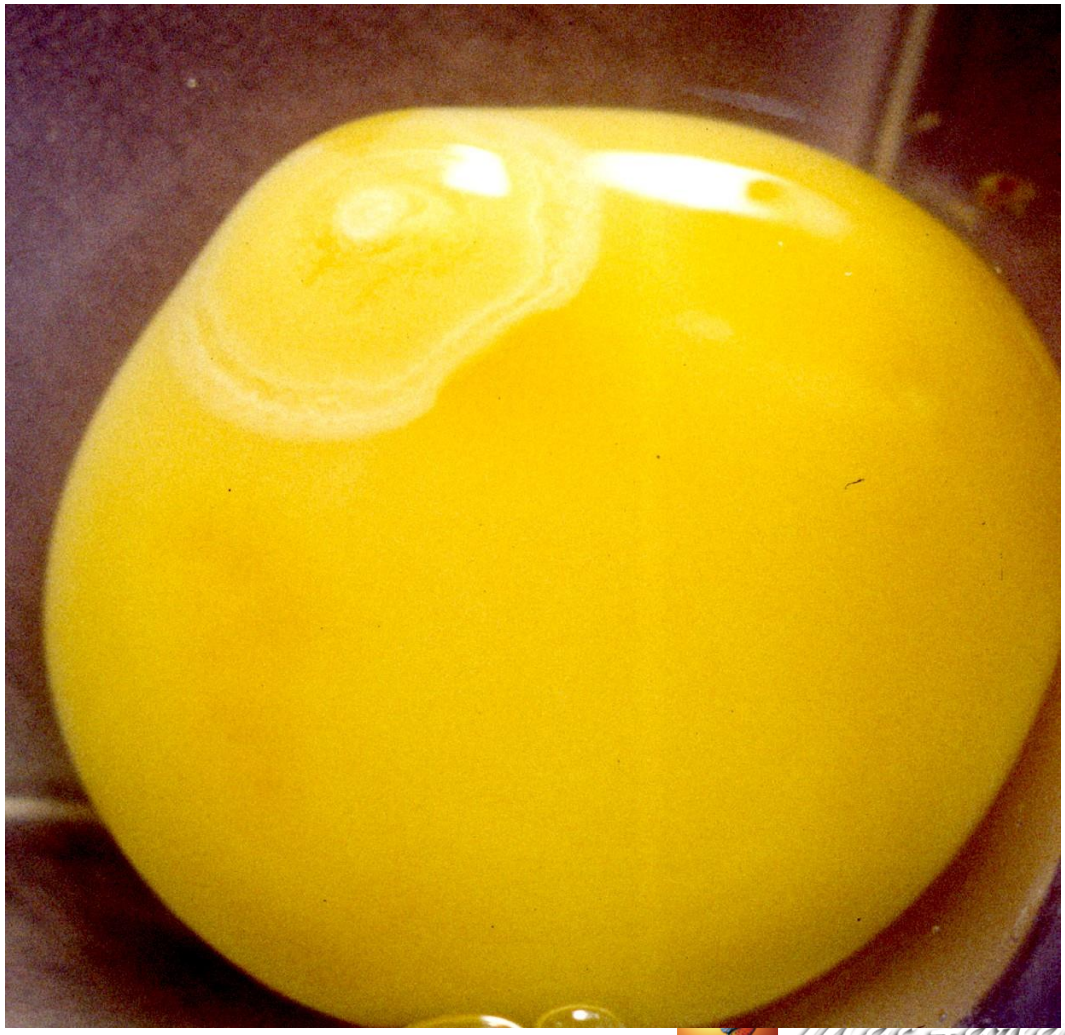


Fertile Eggs

- 12 hours of development

Fertile Eggs

- 24 hours of development

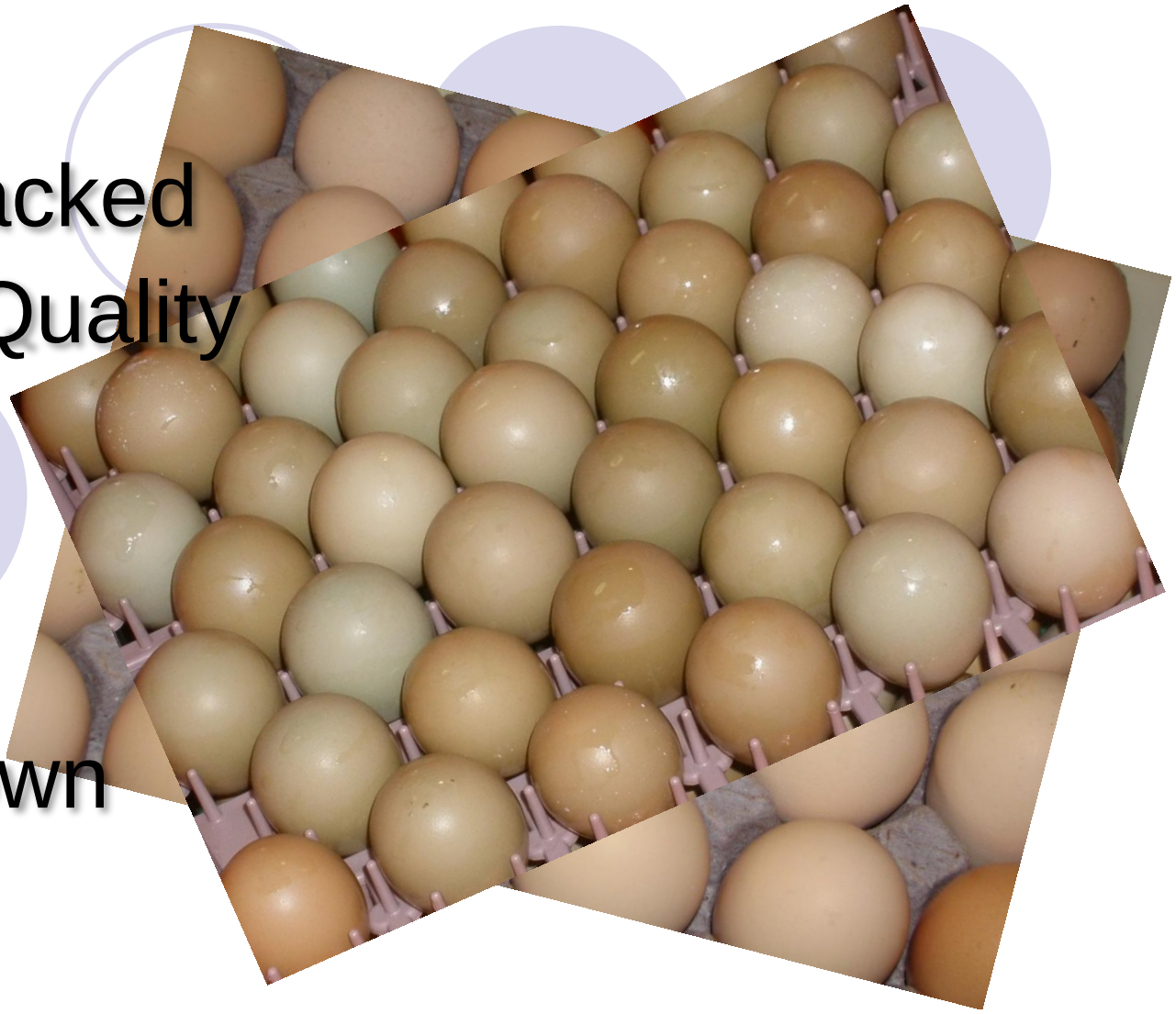


Egg Handling

- 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



Why Are Eggs Stored?

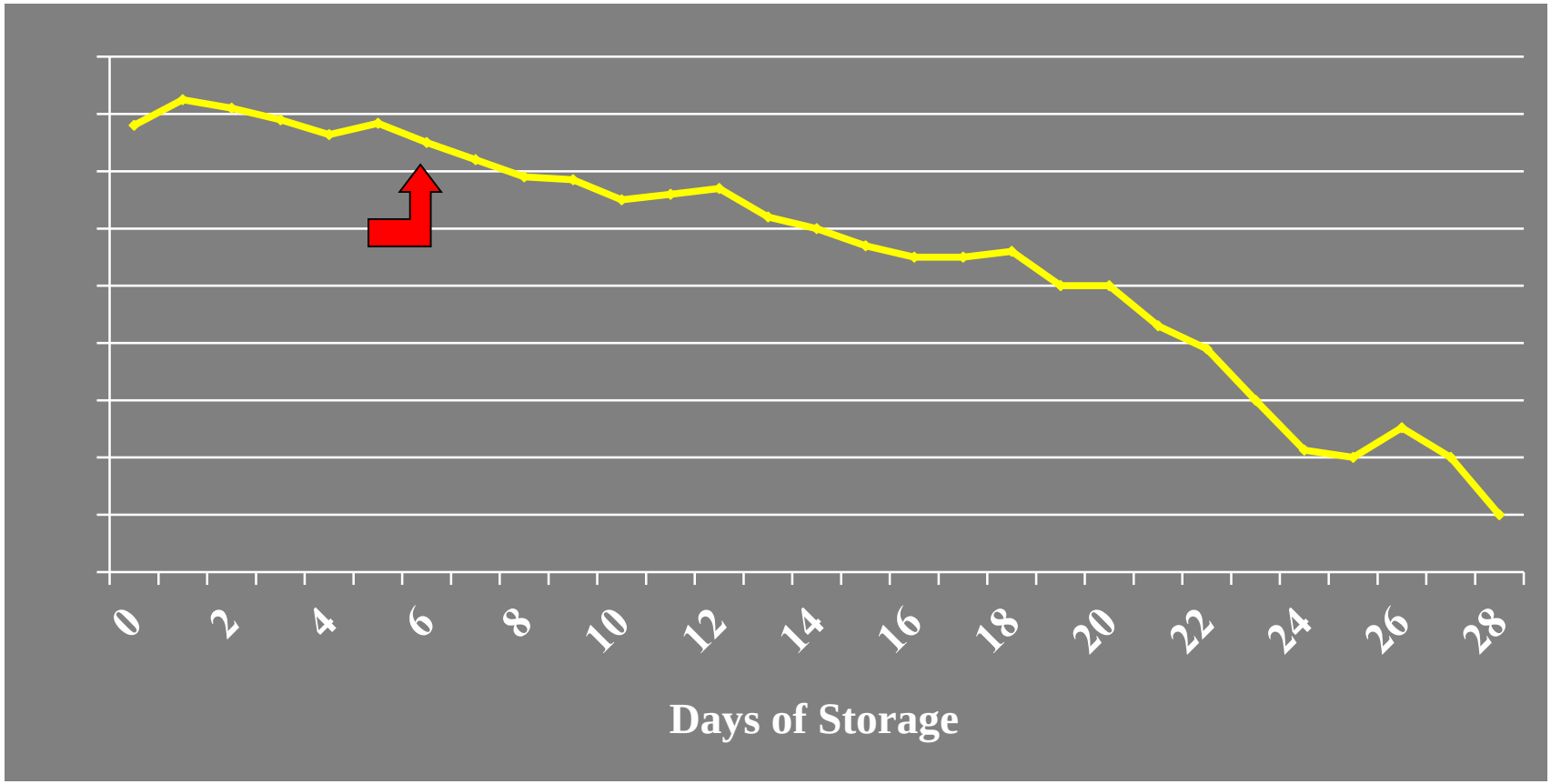
- Management perspective
  - To obtain sufficient egg numbers from each flock
  - Egg management, to fill machines/orders
- Physiological goals
  - Stop (or slow) embryo development

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

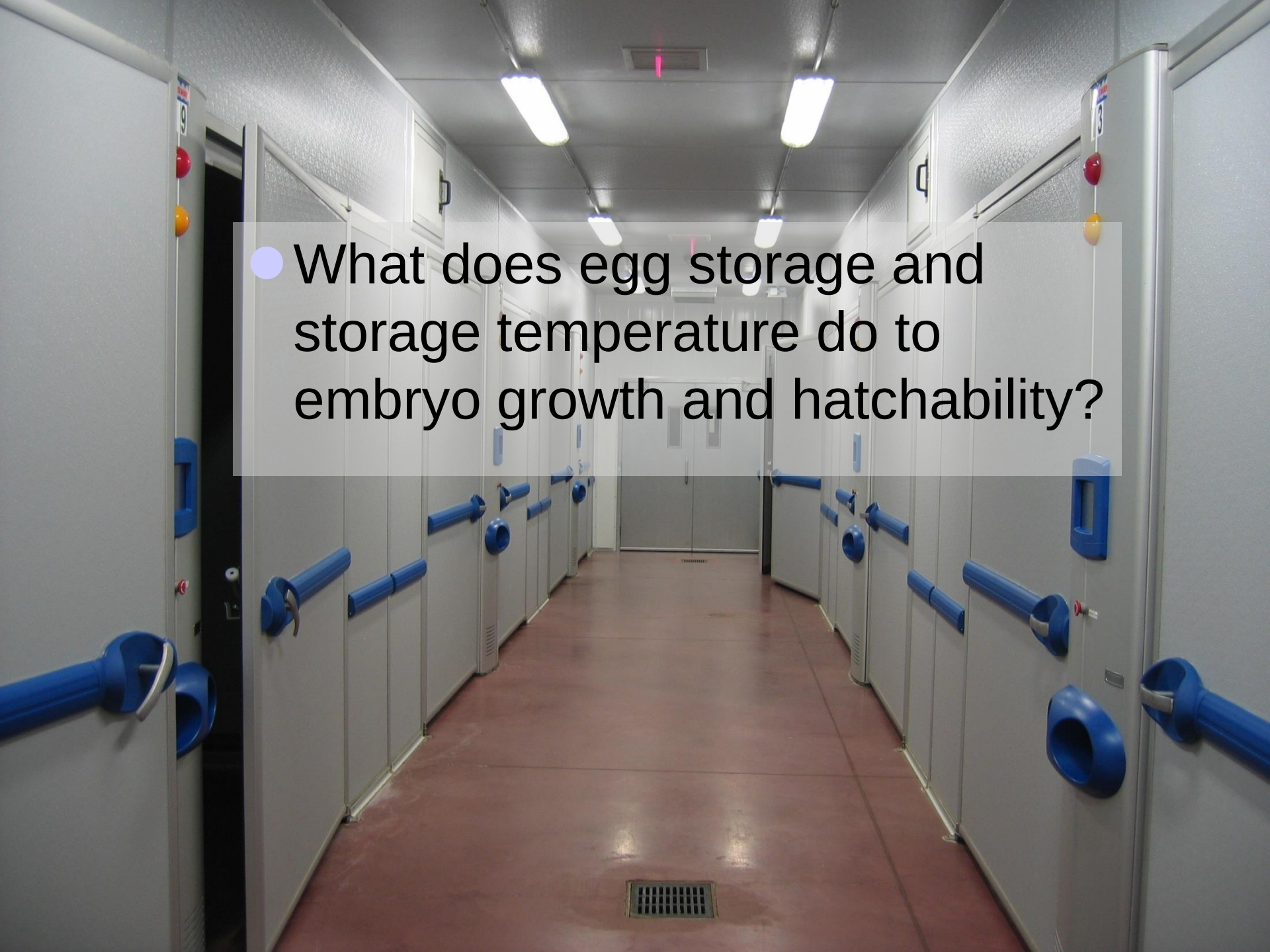
Embryo Development
(Germinal Disc Size in mm)

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)

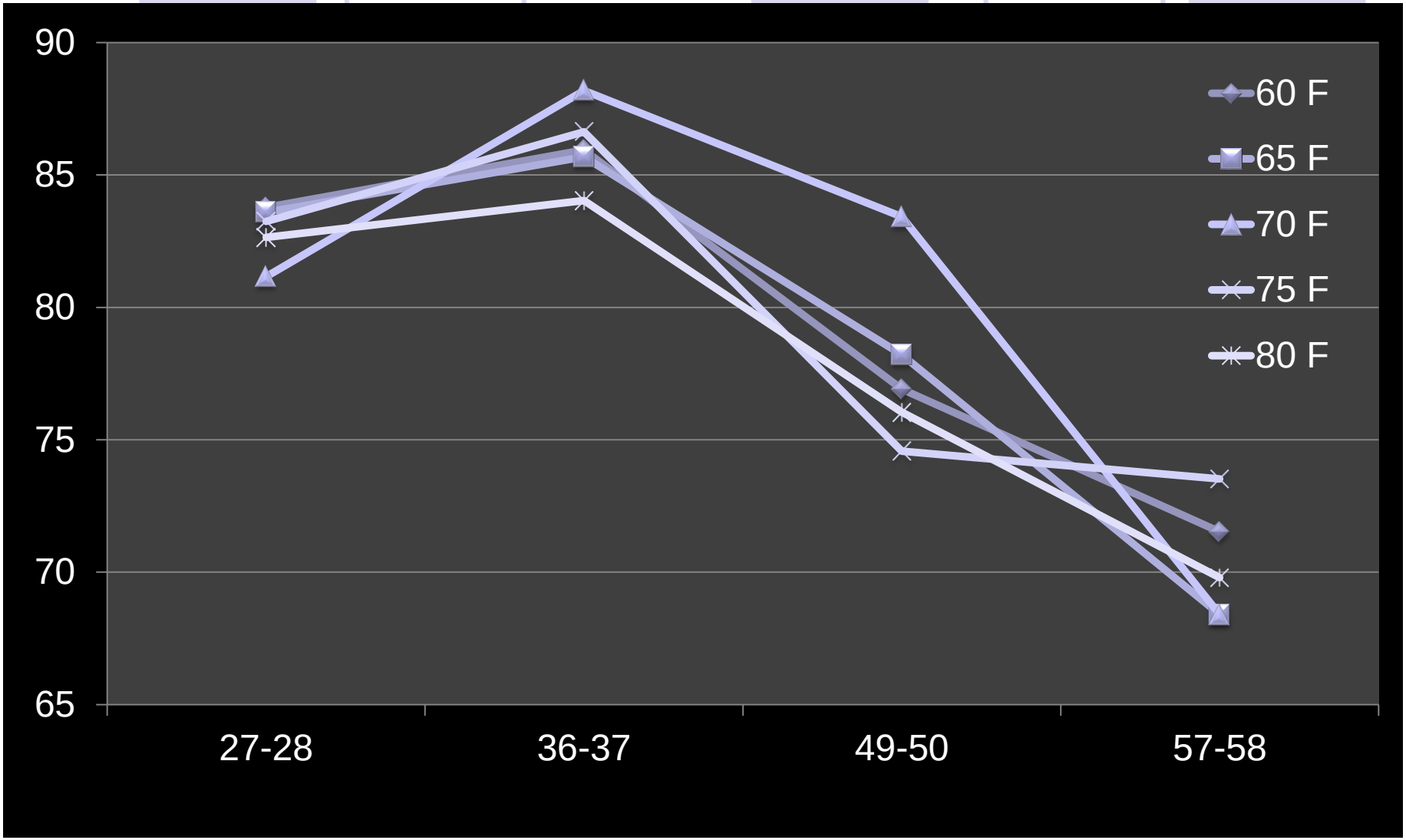
Sealed Egg Cases	Egg Cases with Holes in Side	Wire Baskets	Incubator Egg Trays
4-5 days	1-2 days	1 day	¾ day

Commercial Chicken Production Manual



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

Hatchability



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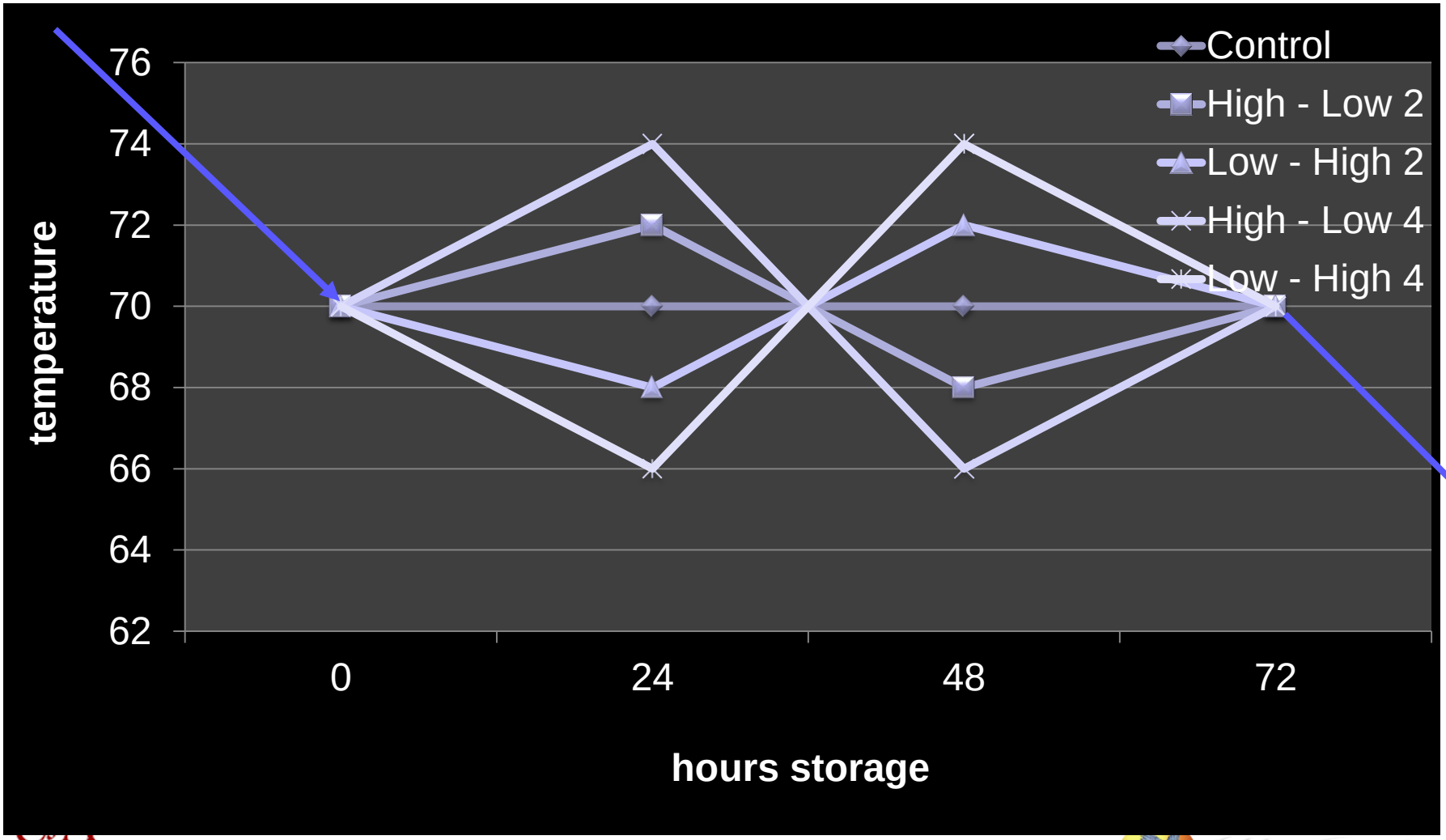
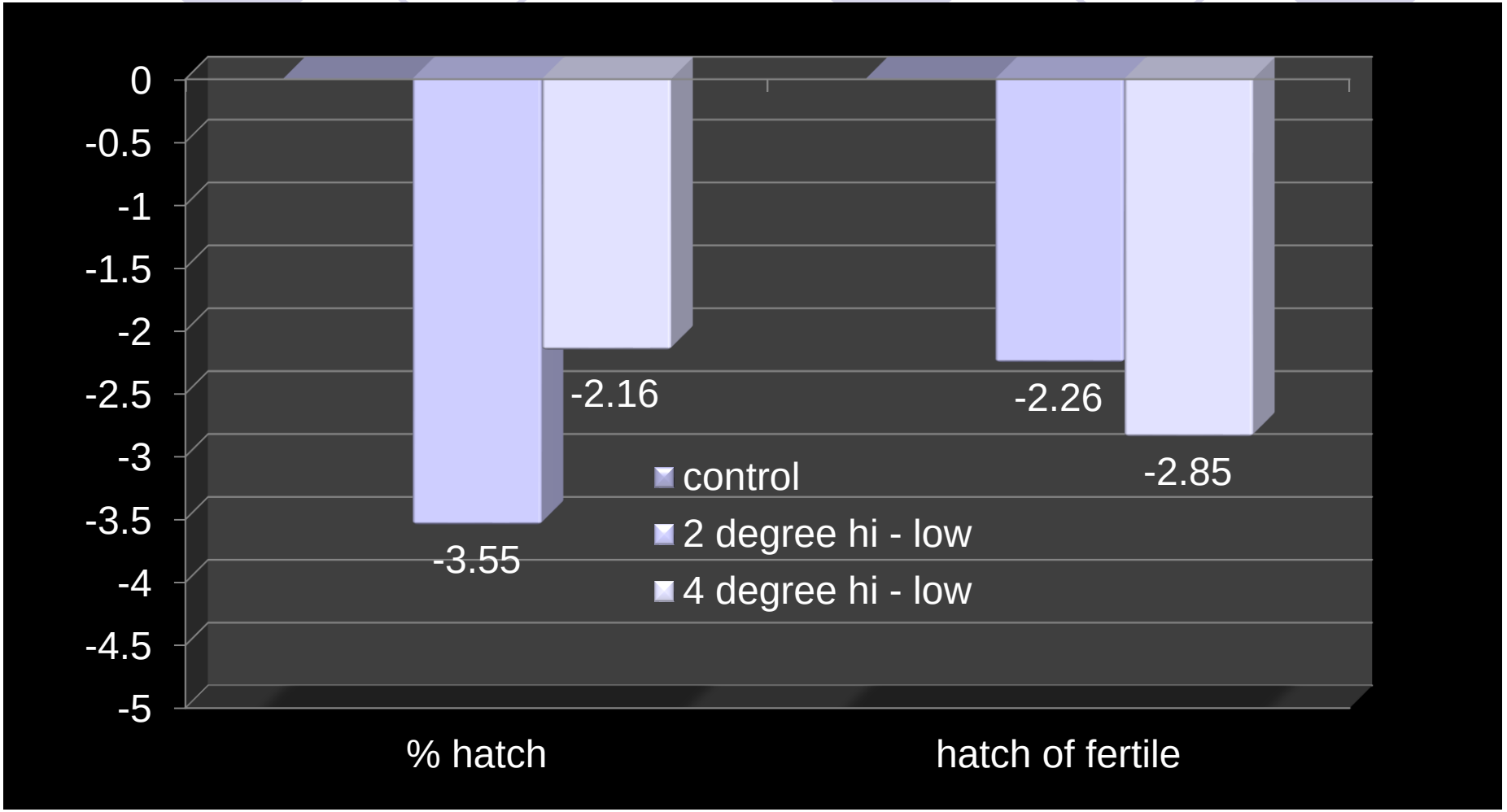
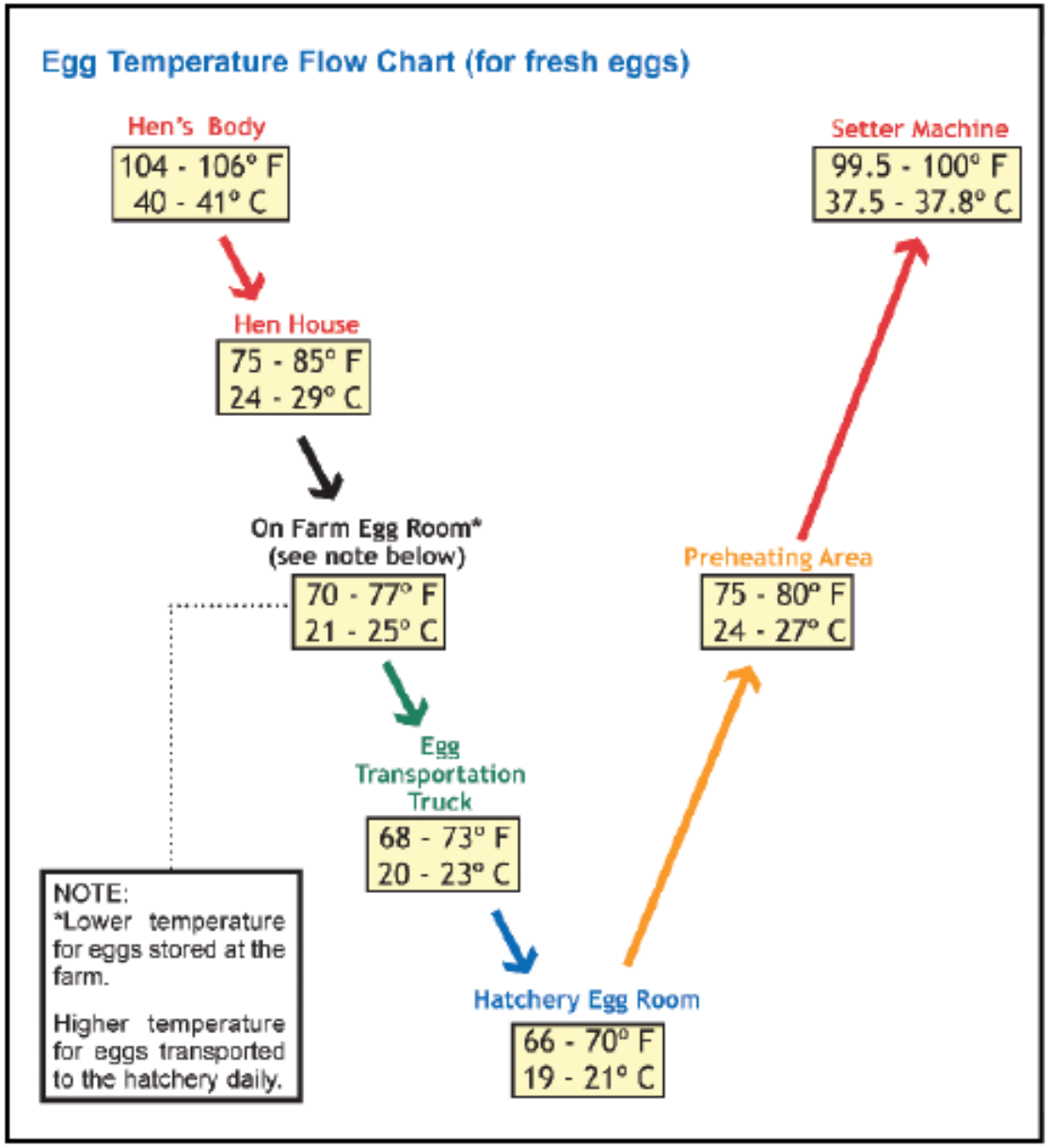
Fluctuating Egg Storage Temperature

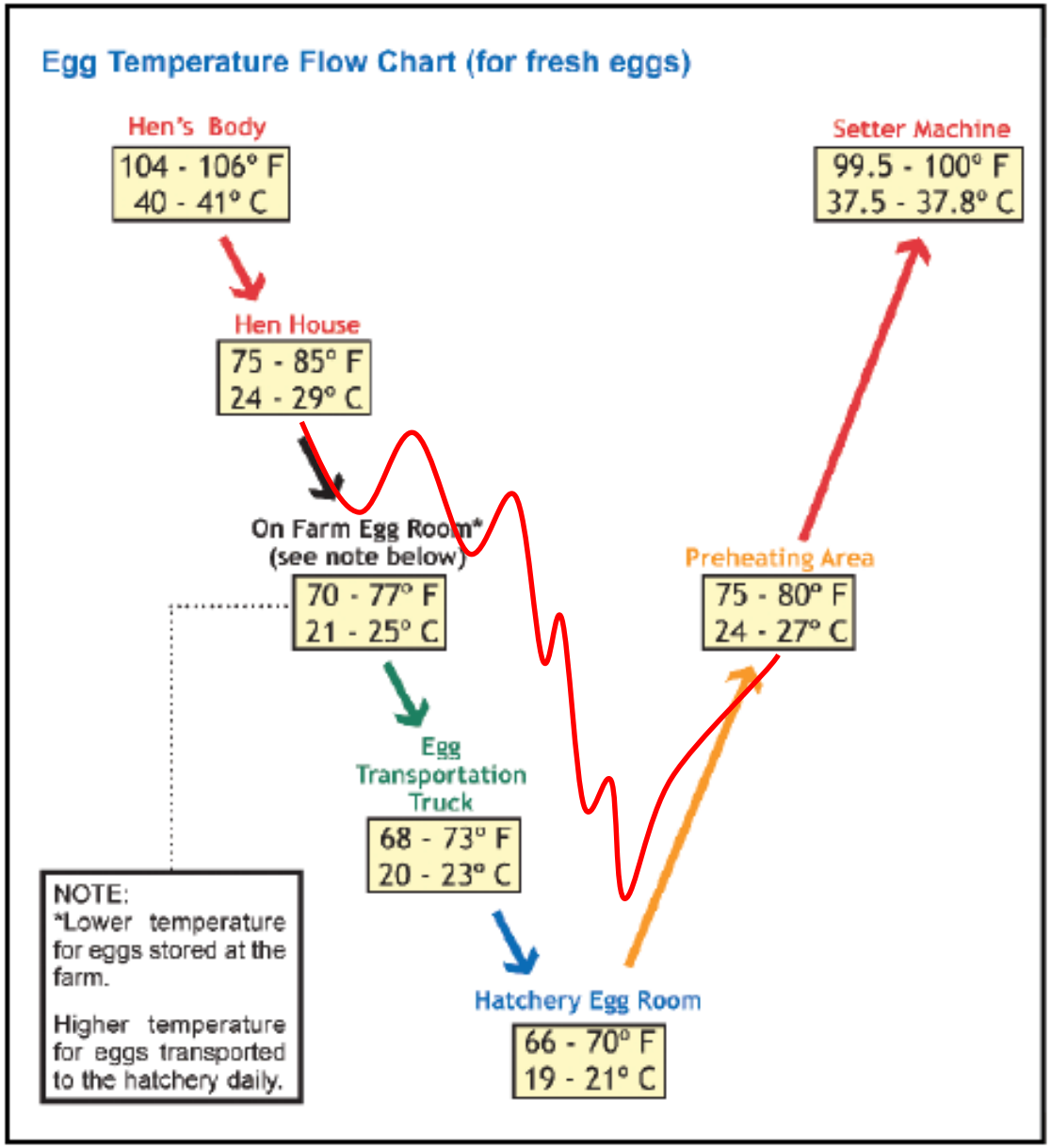


Hatch Loss Caused by Storage Temperature





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



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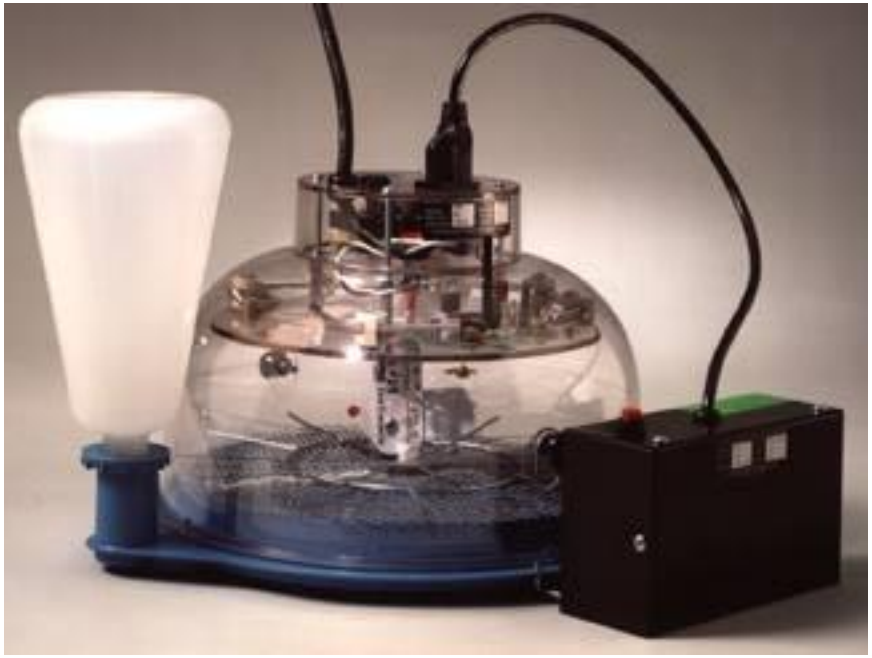
Data Loggers

- 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.

INCUBATORS

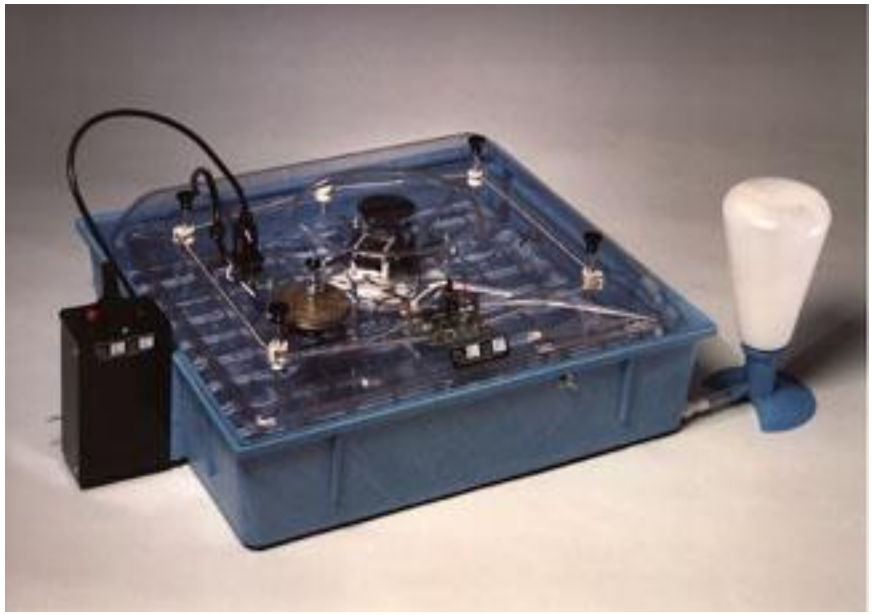
In the Beginning . . .
The Small

Small to Medium . . . The Dome Style

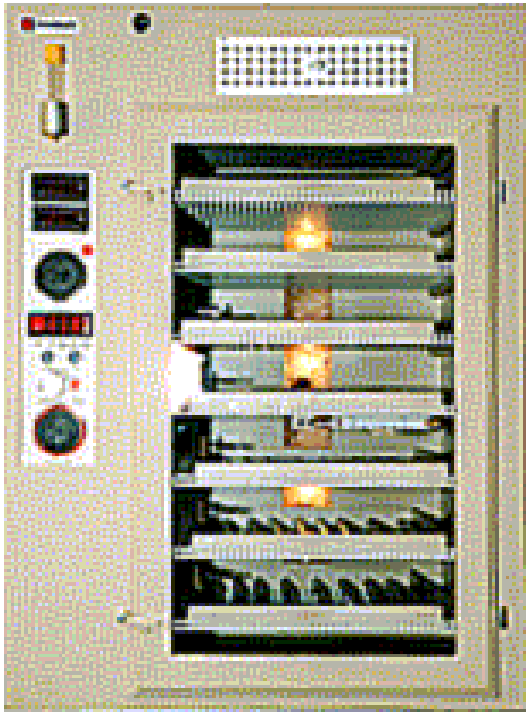


Medium Sized . . .
Table Top Style

Medium Sized . . .
Table Top Style



Large Sized . . . Cabinet Style



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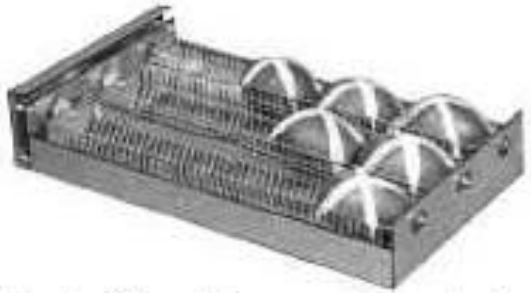
Large Sized . . . Cabinet Style



Rack with rotating emu egg baskets

Rack with rotating goose egg baskets
(can also be used for peafowl)


EGGS
EGGS
05.02.2006


2B
05.02.2006


05.02.2006


Natureform
2
Natureform
3
Natureform
4

At the End ? . . .
The Extra Large


EXIT


JAMESWAY

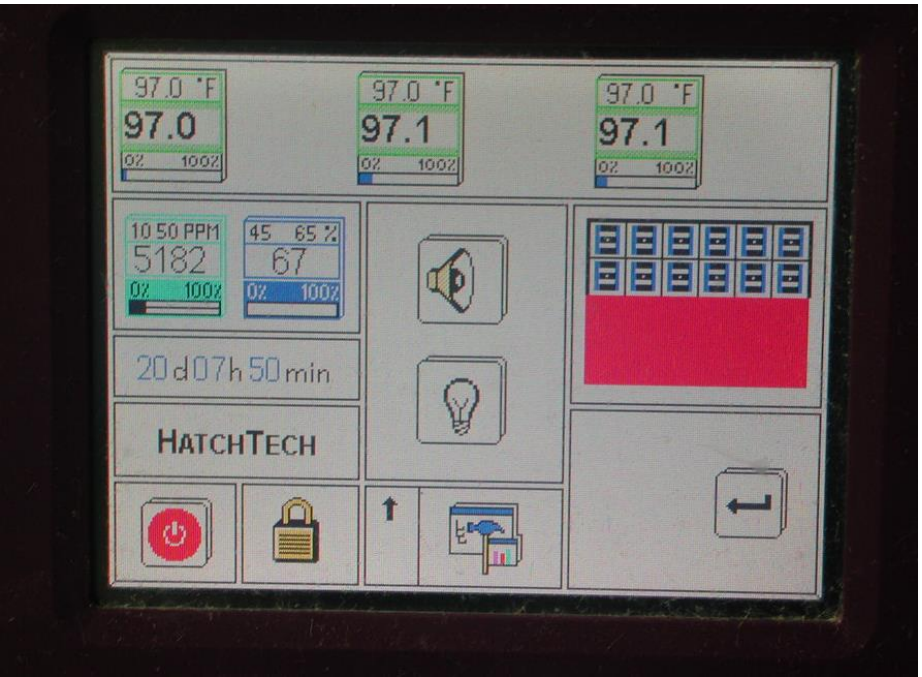

04


04/10/2008


04/10/2008

Introduction

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



Genetic Potential Growth

Phase #1

Hen Produces Egg

Egg Goes Into Incubator

Phase #2

#1 - Incubation

Fertile Egg

Embryo Fully Develops in the Incubator

18 Day Embryo

Developed Embryo Goes to Hatcher - Chick Matures and Hatches

Late19 - 20 Days

20thDay

504 Hrs. - 21 Days

Chicks at Farm

Phase #3

#2 - Hatching

Introduction

- However, the premise stays the same, create an environment similar to what the broody hen provided to her nest of eggs and her young

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

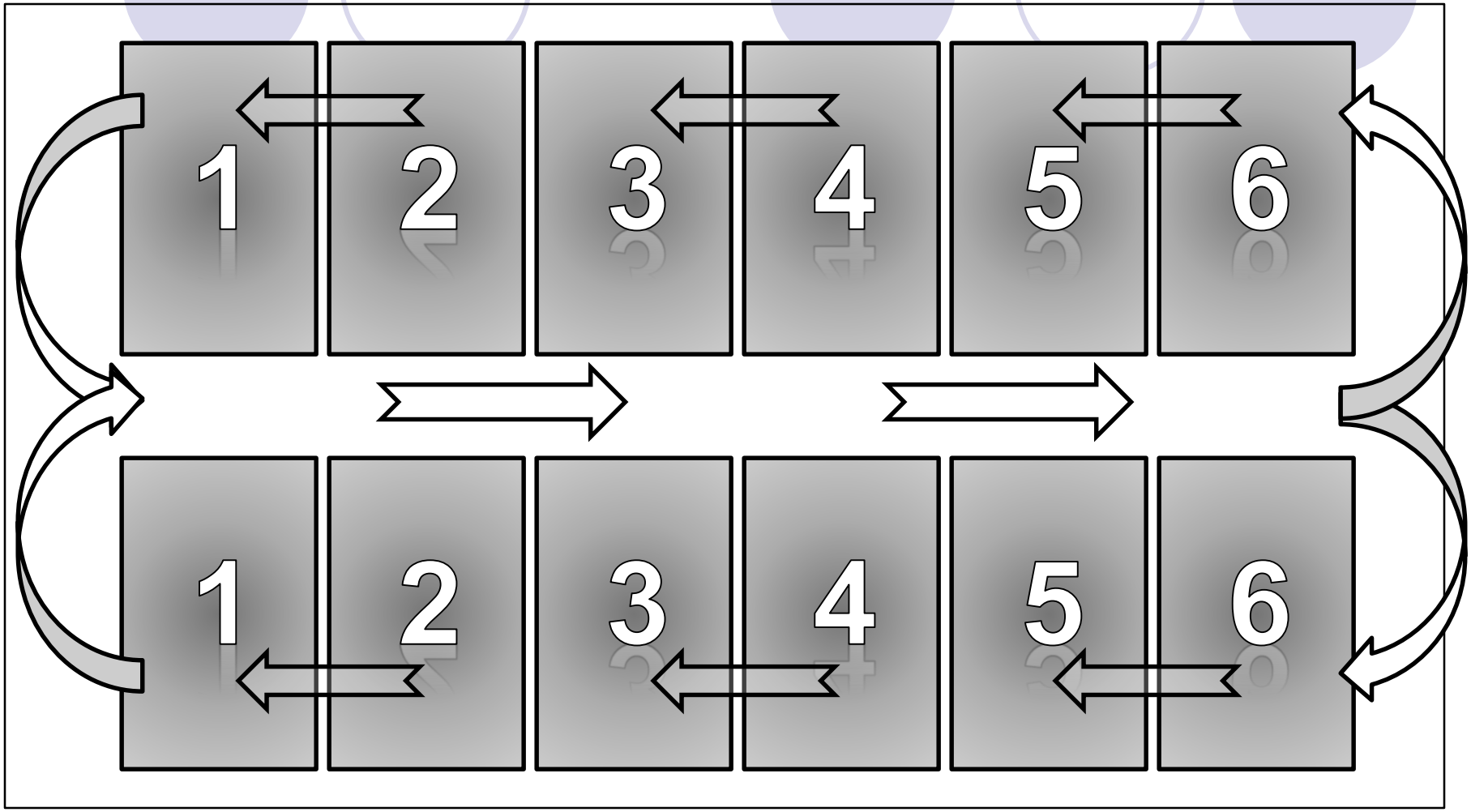
- Three main types of machines:
- 2 Multi-stage buggy loading
-

Incubation Types

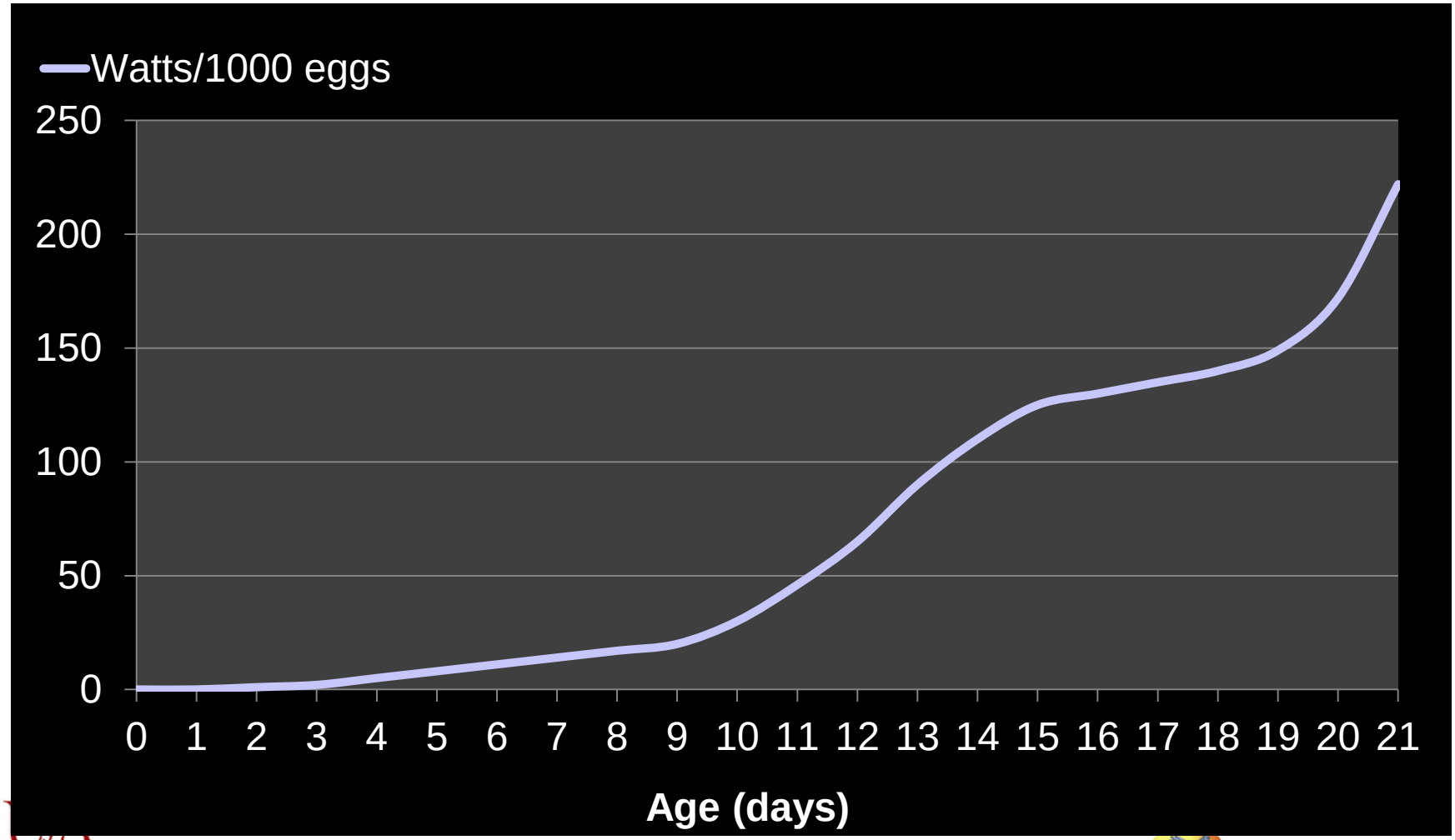
- Three main types of machines:
- 3 Single-stage buggy loading


4
5
2
1
6
3
6
4
5
4
1
2
3
6
5
4
1
2
3
5
6
1
4
2
Multi-stage
fixed rack

Multi-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

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

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

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
- 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

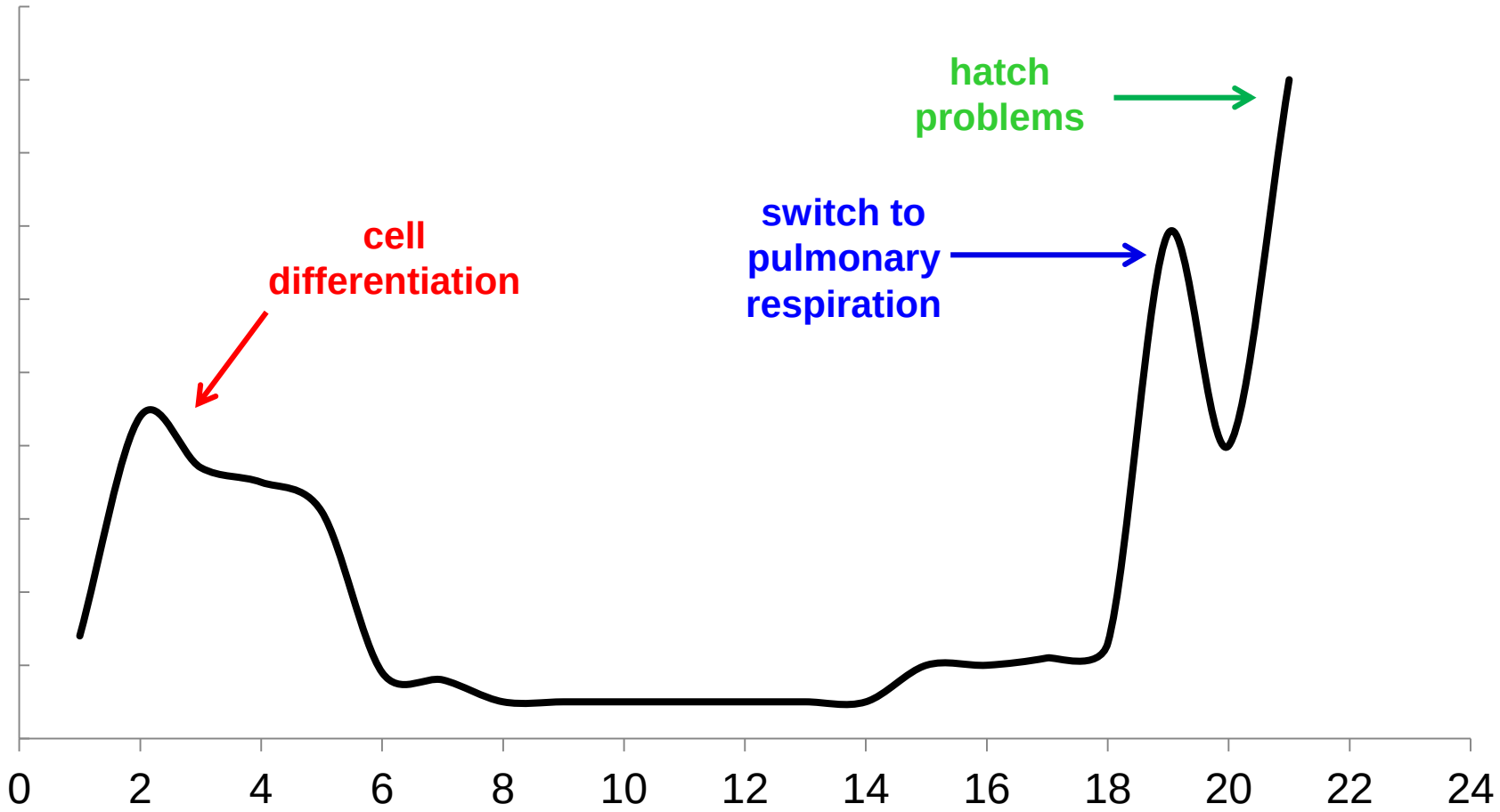
Operation of Hatchers

- 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

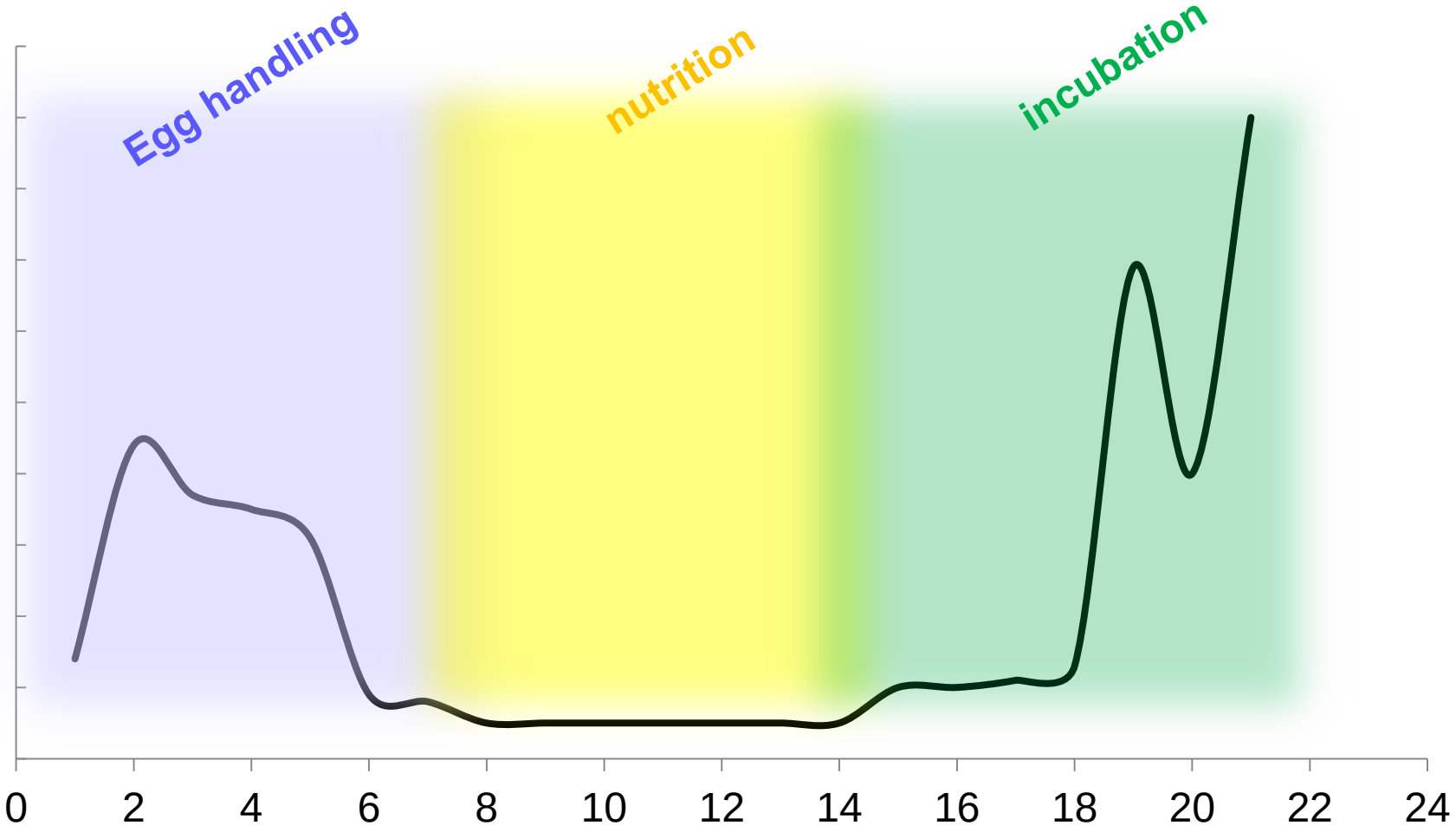
Operation of Hatchers

- 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

Percent Mortality of Fertile Eggs



Percent Mortality of Fertile Eggs



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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

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Embryodiagnosis

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

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

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

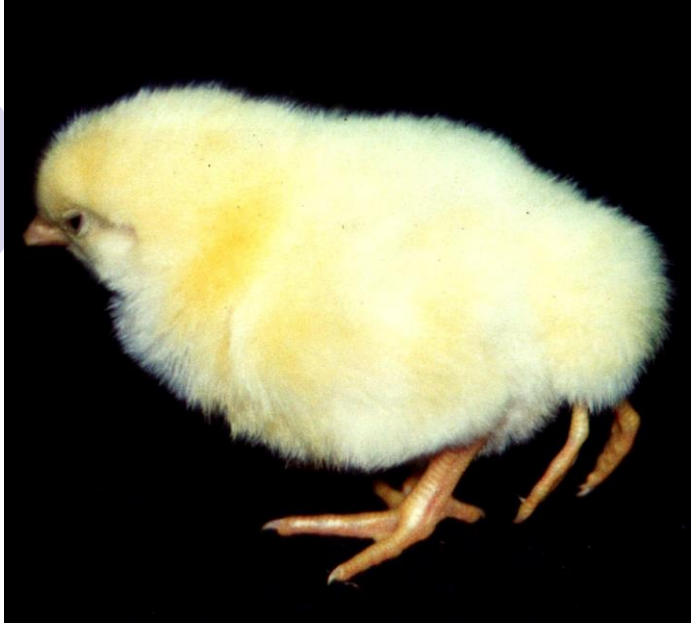
Red Hocks

- 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

Incubation & Embryology

10th Bi-Annual International
Pheasant Management Seminar
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MacFarlane PHEASANTS

R. Keith Bramwell, PhD
Extension Breeder/Hatchery Management
Department of Poultry Science
The University of Arkansas

Joshua R. Deines
PhD Graduate Student
Department of Poultry Science
The University of Arkansas

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