THE INCUBATOR COMPANY

JAMESWAY

Assessing Embryo Mortality to Improve Incubation

11th Bi-Annual International
Pheasant Management Seminar
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Presented by
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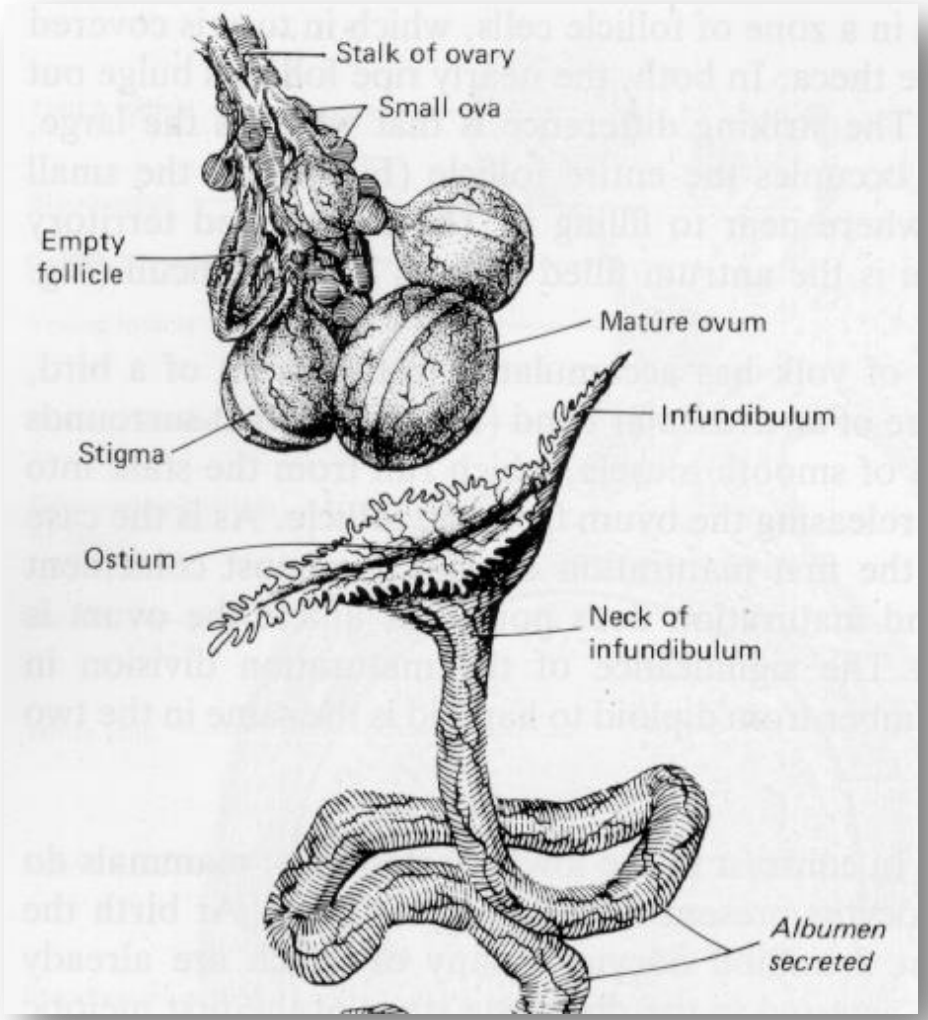
Jamesway Incubator Company

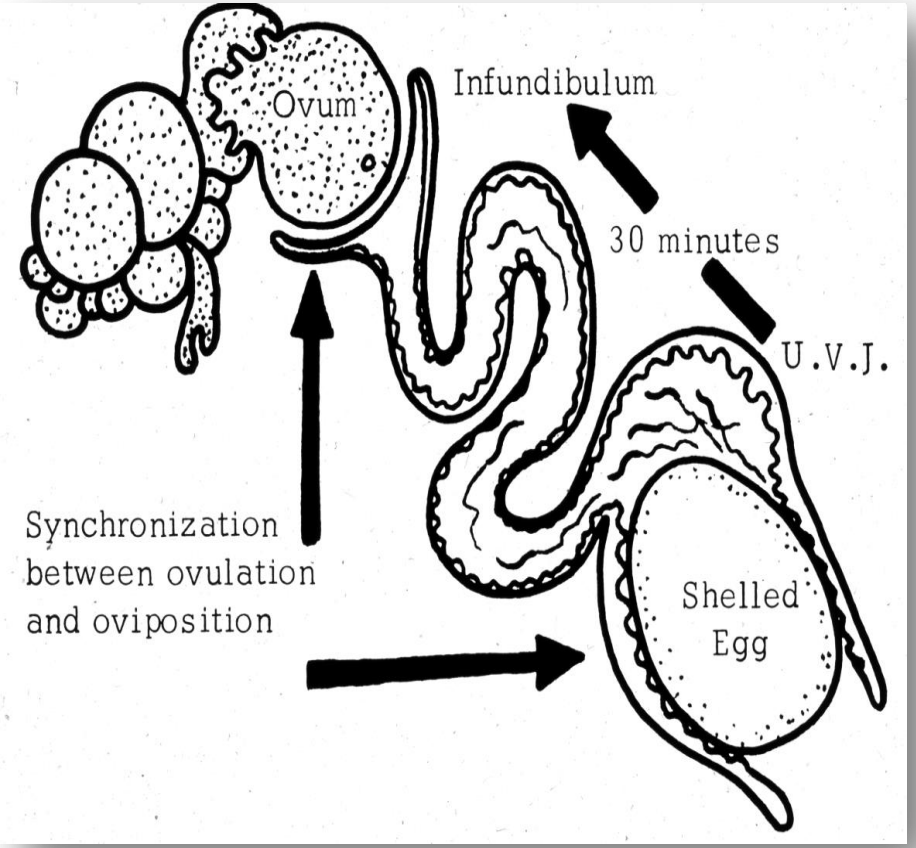
Fertilization Process

- Location - Infundibulum
- Funnel shaped – acts to engulf ovum



Fertilization Process

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



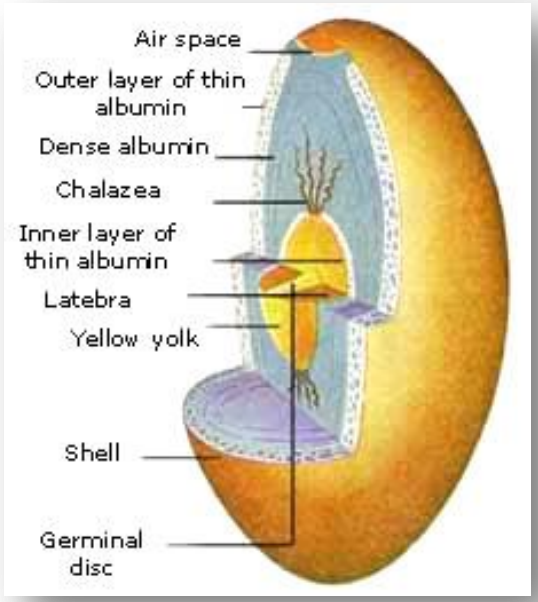
Fertilization Process

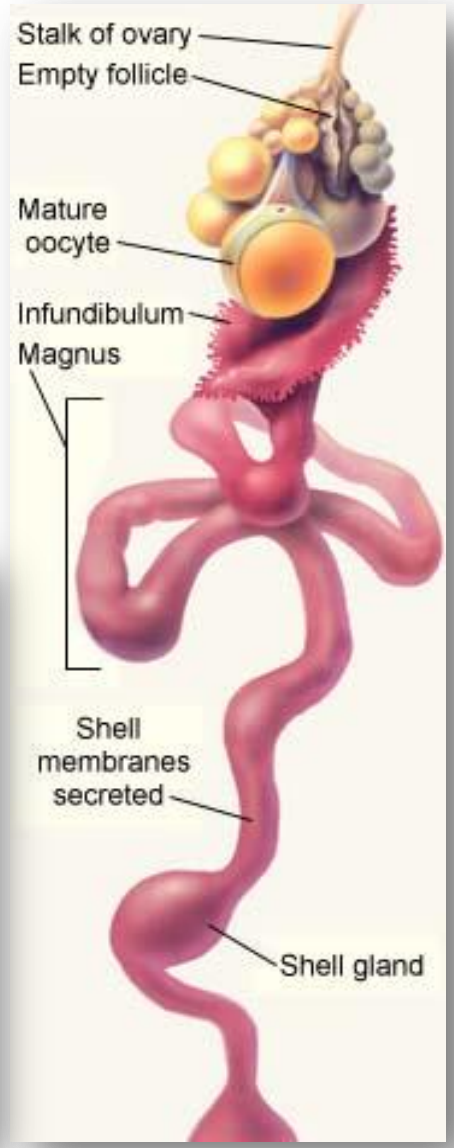
- Shell formation:

  24-26 hours to complete

- Hen's body temperature:

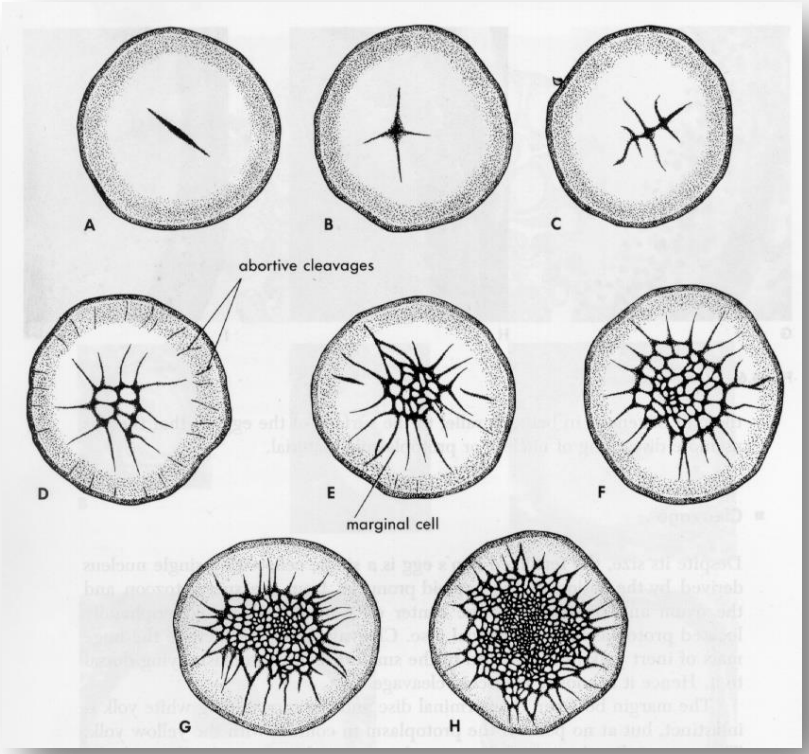
  40 - 41° C





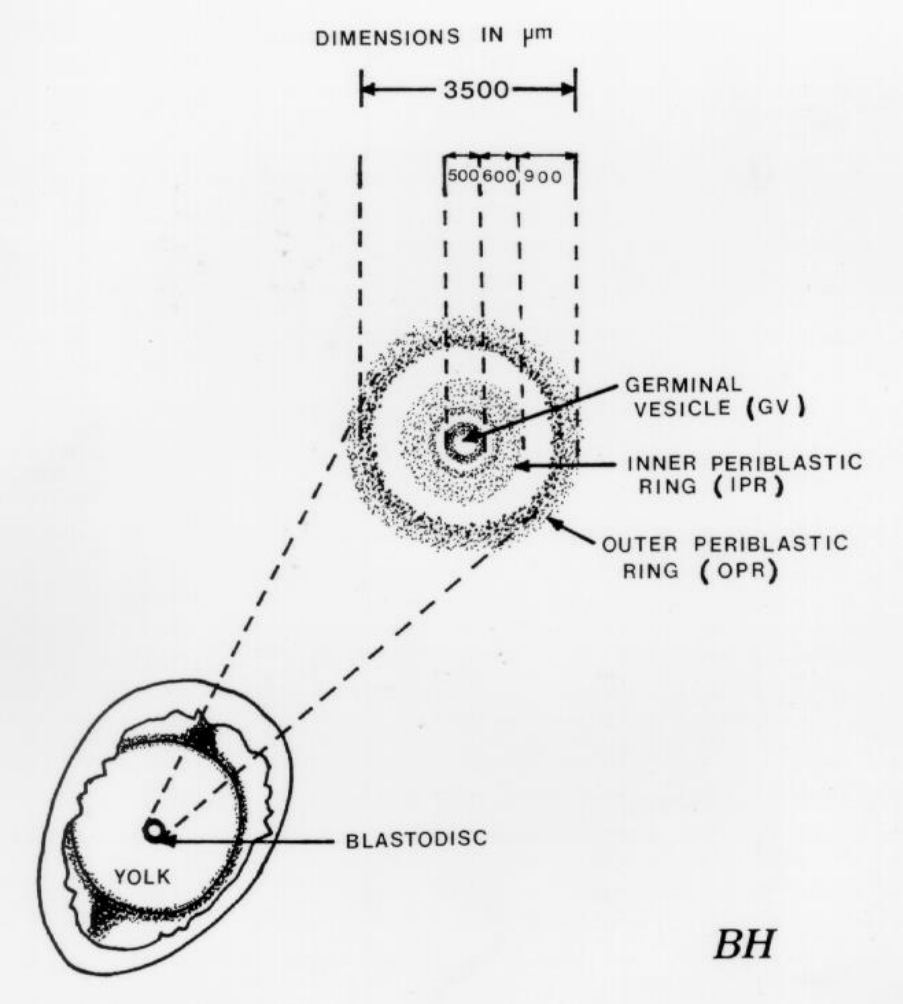
Fertilization Process

- Fertilization occurs within 5 minutes after ovulation
- Shell formation takes 24-26 hours to complete
- Hen's body temperature 40 - 41° C
- Laid egg represents 1 days embryonic growth (20,000 - 40,000 cells)

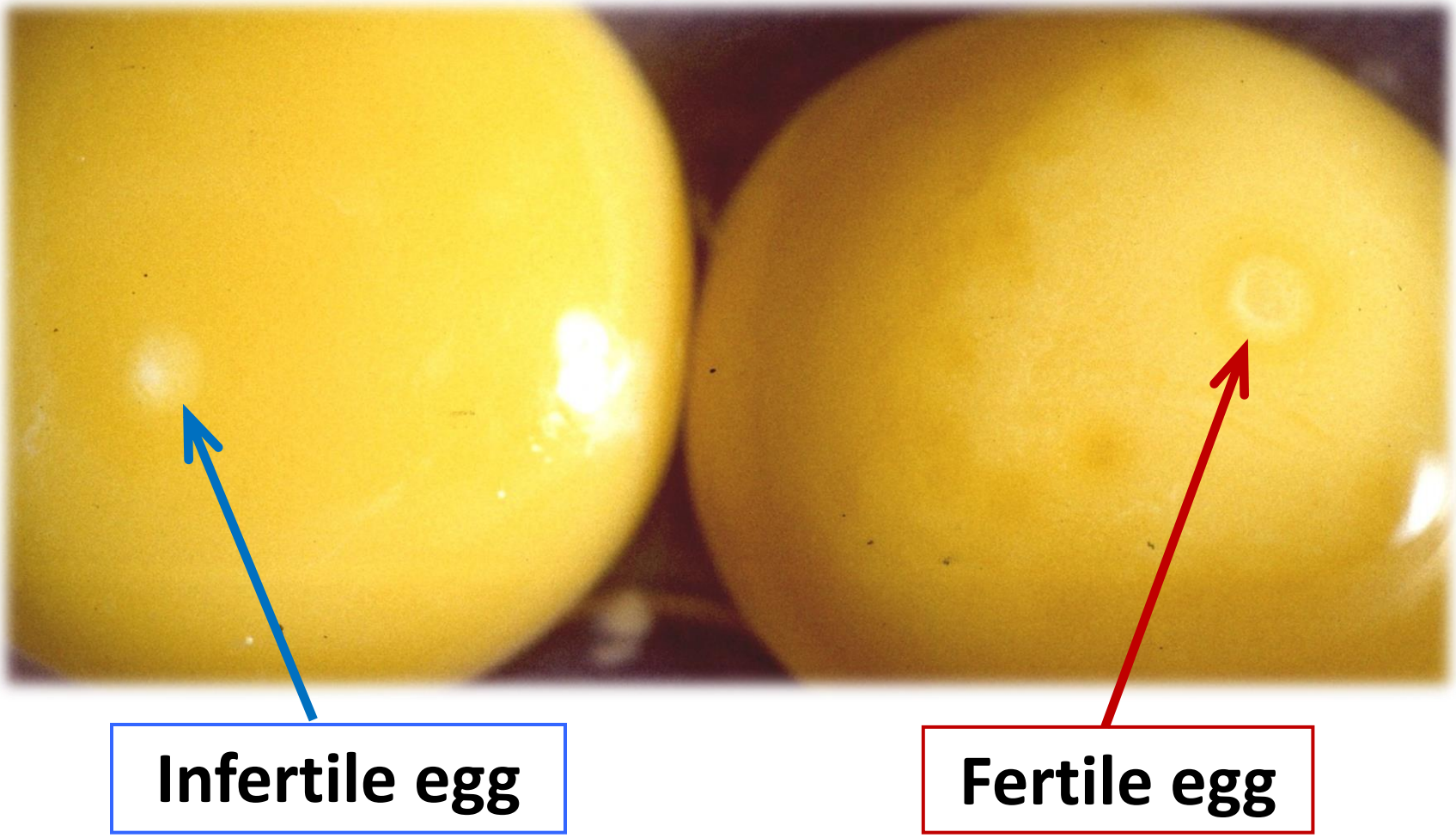


Germinal Disc (Blastodisc)

Site of fertilization and initial stages of embryo development

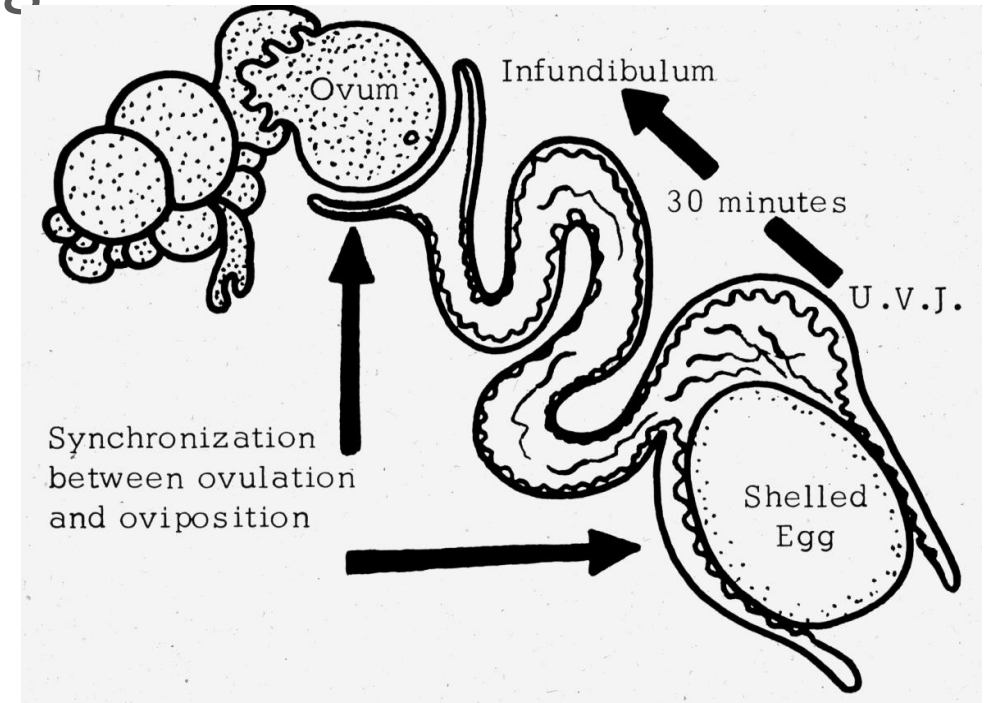


Infertile vs Fertile Eggs

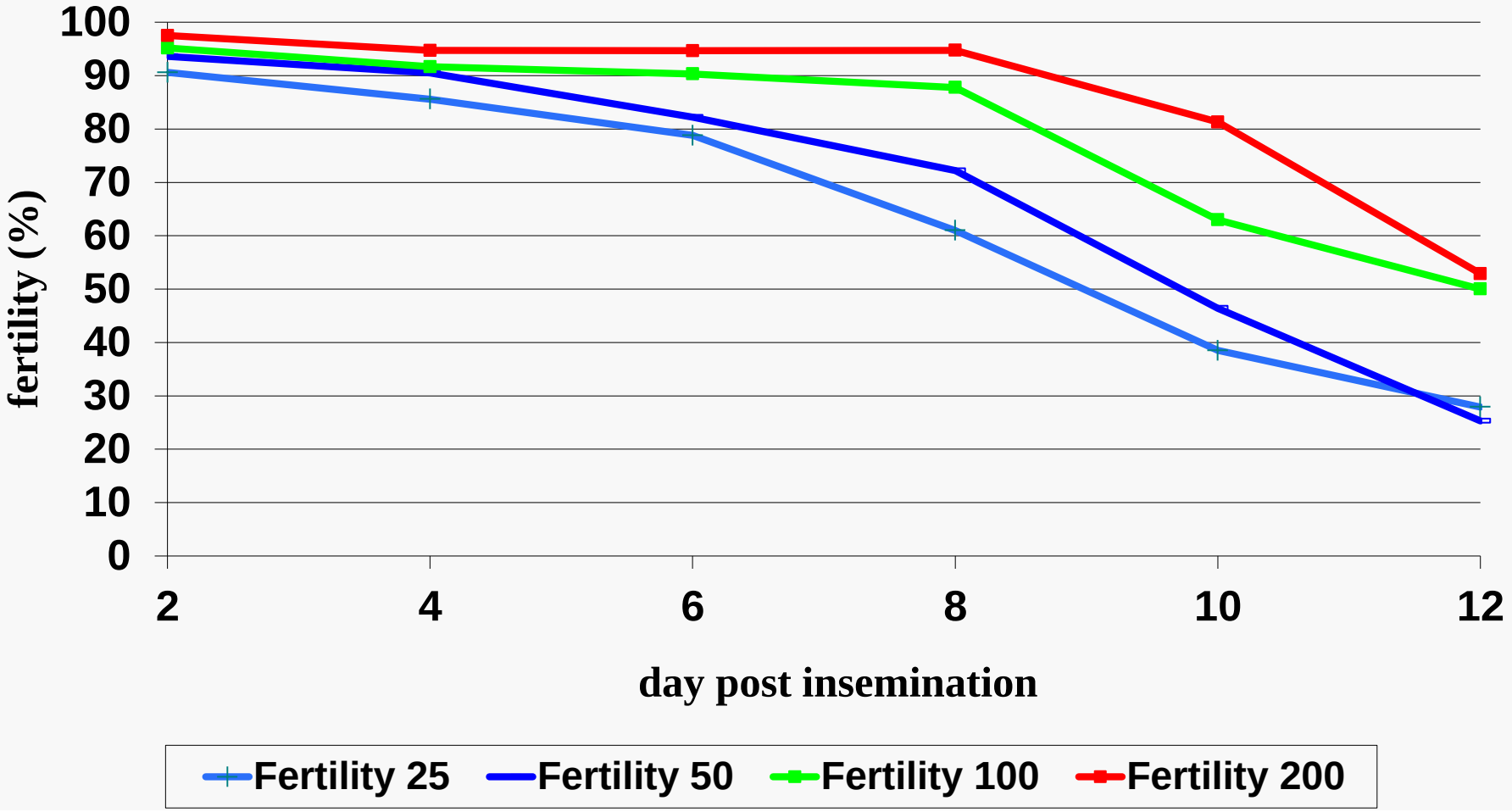


Sperm Cell Storage

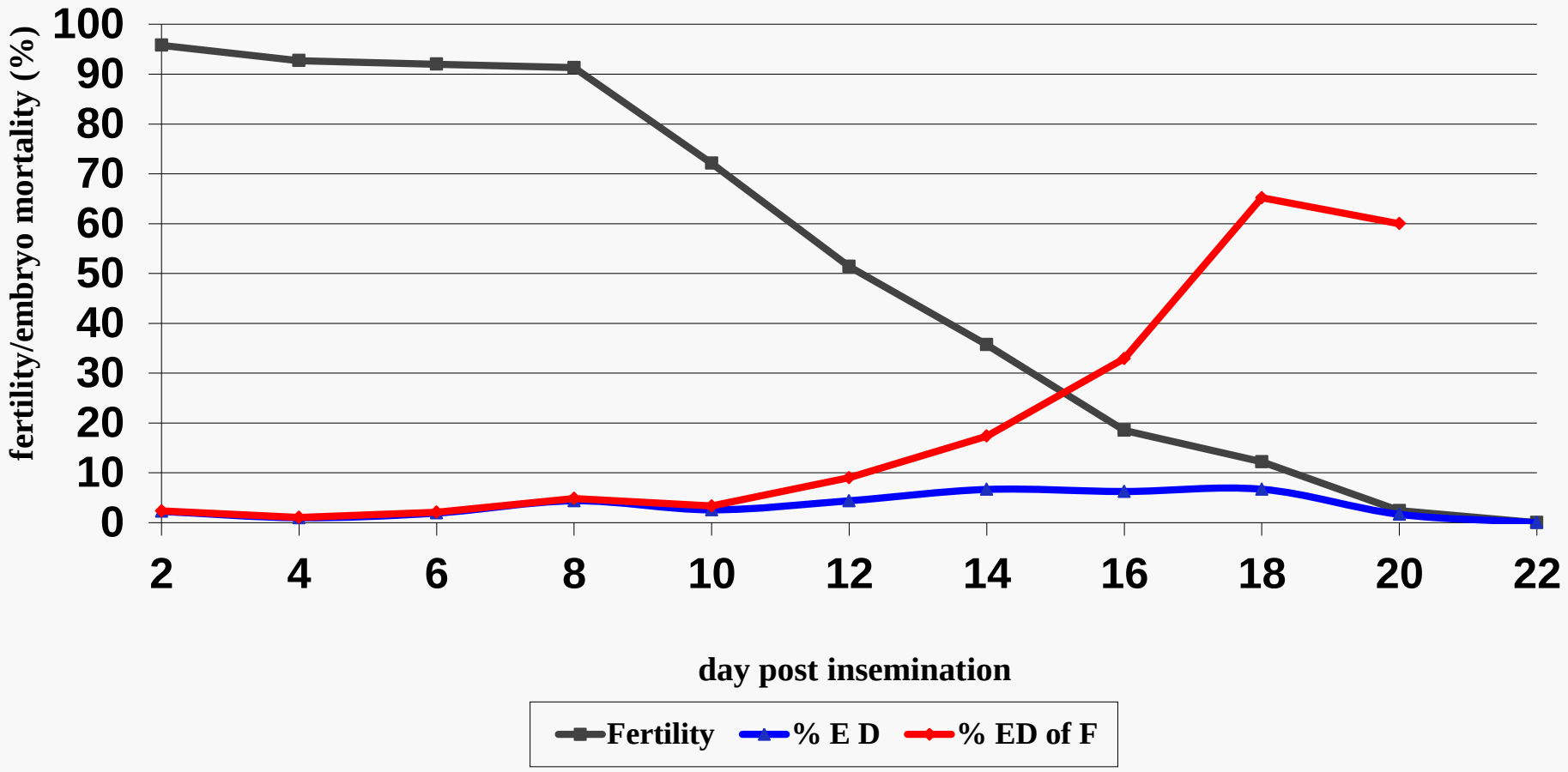
- A biological necessity to produce fertile eggs in the avian system



Fertility & Embryonic Mortality



Fertility & Embryonic Mortality



Methodology of Embryodiagnosis

- 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

Flock Examination & Record Keeping

- Breakout analysis of a sample of unhatched eggs and record incidences of:
  - Infertile eggs
  - Dead embryos in one of the 3 - 5 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?

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

Embryology Staging and Development

- A Series of Normal Stages in the Development of the Chick Embryo.
  - **V. Hamburger & H.L. Hamilton,** *Journal of Morphology,* (1951)

- The Avian Embryo. Structural and Functional Development.
  - A.L. Romanoff, New York (& London), (1960)

Embryology Staging and Development

- Vertebrate Embryology: The Dynamics of Development.
  - R. Pugh, Harcourt, Brace & World, (1964)

- Avian Growth and Development: Evolution Within-Altricial-Precocial Spectrum.
  - J.M. Starck and R.E. Ricklefs, Oxford Press, (1998)

Hatch Residue Breakout Sheet (Pheasant)

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Hatchery: _____	Incubator: _____	Hatch % : _____	Flock ID: _____	Set Time:_____
Break-out date: _____	Hatcher: _____	HOF % : _____	Flock age: _____	Transfer Time: _____
Set Date: _____	Setter Type: _____	Fertility %: _____	# Eggs set: _____	Transfer Age:_____

Egg age: _____
Moisture Loss:_____

Tray #	eggs/tray	infertile	0 - 3 d	4 - 7 d	Total early	8 - 17 d	18 - 21 d	22 - 24 d	Total Late	Anomally	Mal-position	Misc.

Tray #	Pip in air cell	Live Pip into egg	Live pip, yolk not absorbed	Dead pip	Transfer crack	Other crack	Mold	Early Cont.	Late Cont.	Small end up	Cull egg	Cull Chick

Hatch Residue Breakout Sheet (Pheasant)

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Hatchery: _____	Incubator: _____	Hatch % : _____	Flock ID: _____	Set Time:_____
Break-out date: _____	Hatcher: _____	HOF % : _____	Flock age: _____	Transfer Time: _____
Set Date: _____	Setter Type: _____	Fertility %: _____	# Eggs set: _____	Transfer Age:_____

Egg age: _____
Moisture Loss:_____

Tray #	eggs/tray	infertile	0 - 3 d	4 - 7 d	Total early	8 - 17 d	18 - 21 d	22 - 24 d	Total Late	Anomally	Mal-position	Misc.

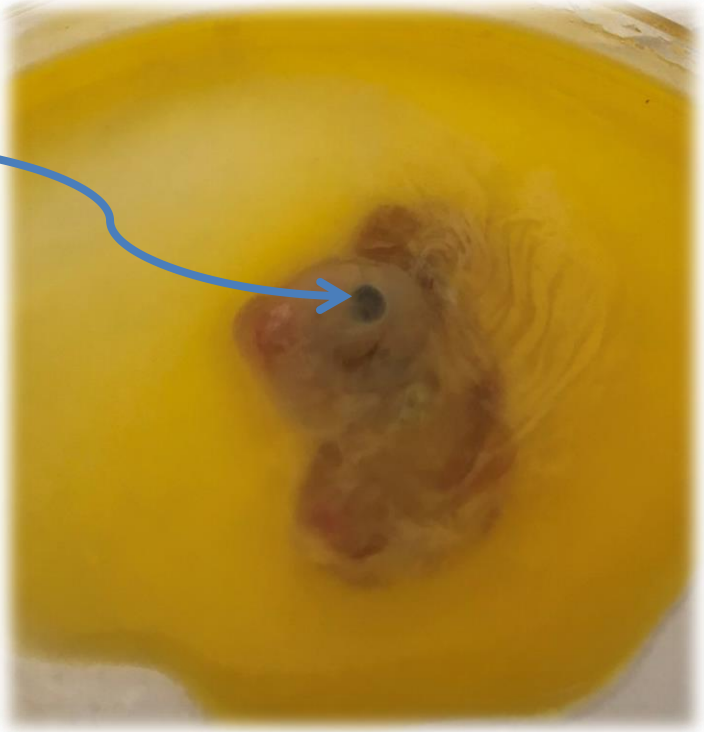
Tray #	Pip in air cell	Live Pip into egg	Live pip, yolk not absorbed	Dead pip	Transfer crack	Other crack	Mold	Early Cont.	Late Cont.	Small end up	Cull egg	Cull Chick

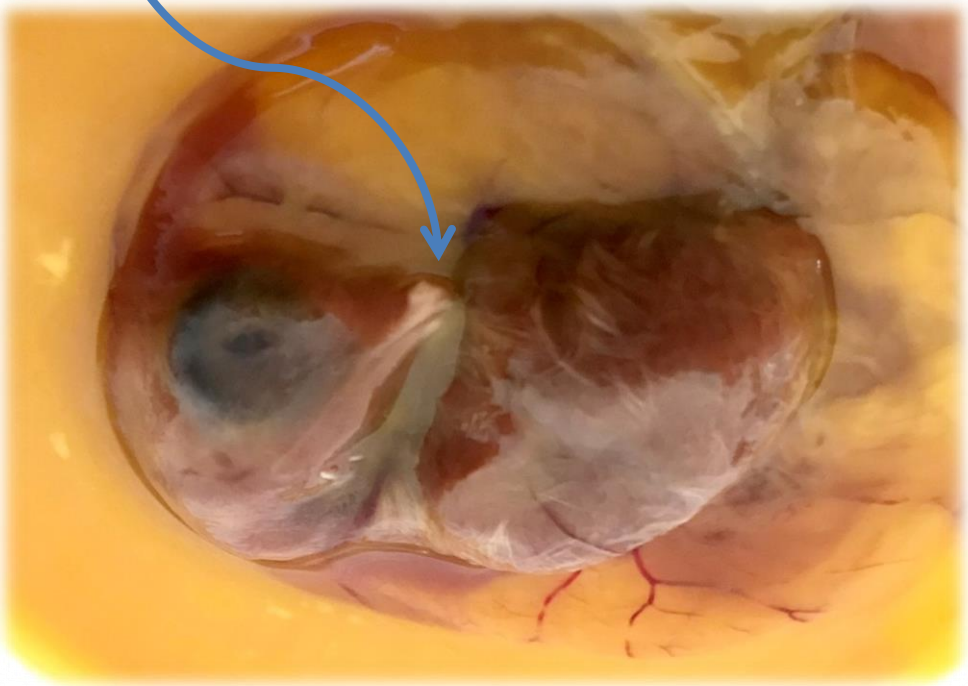
Key Factors in Embryo Development

- Fertile egg – Donut shaped germinal disc
- Day 4 – Eye pigmentation ***Prominent***
- Day 8 – Egg tooth present and ***Prominent***

Pigmented Eye

Egg Tooth





Key Factors in Embryo Development

- Fertile egg – Donut shaped germinal disc
- Day 4 – Eye pigmentation ***Prominent***
- Day 8 – Egg tooth present and ***Prominent***
- Day 18 – Chick down ***Prominent***
- Day 22 – Yolk sac withdrawn into body

What is Acceptable or 'Normal'?

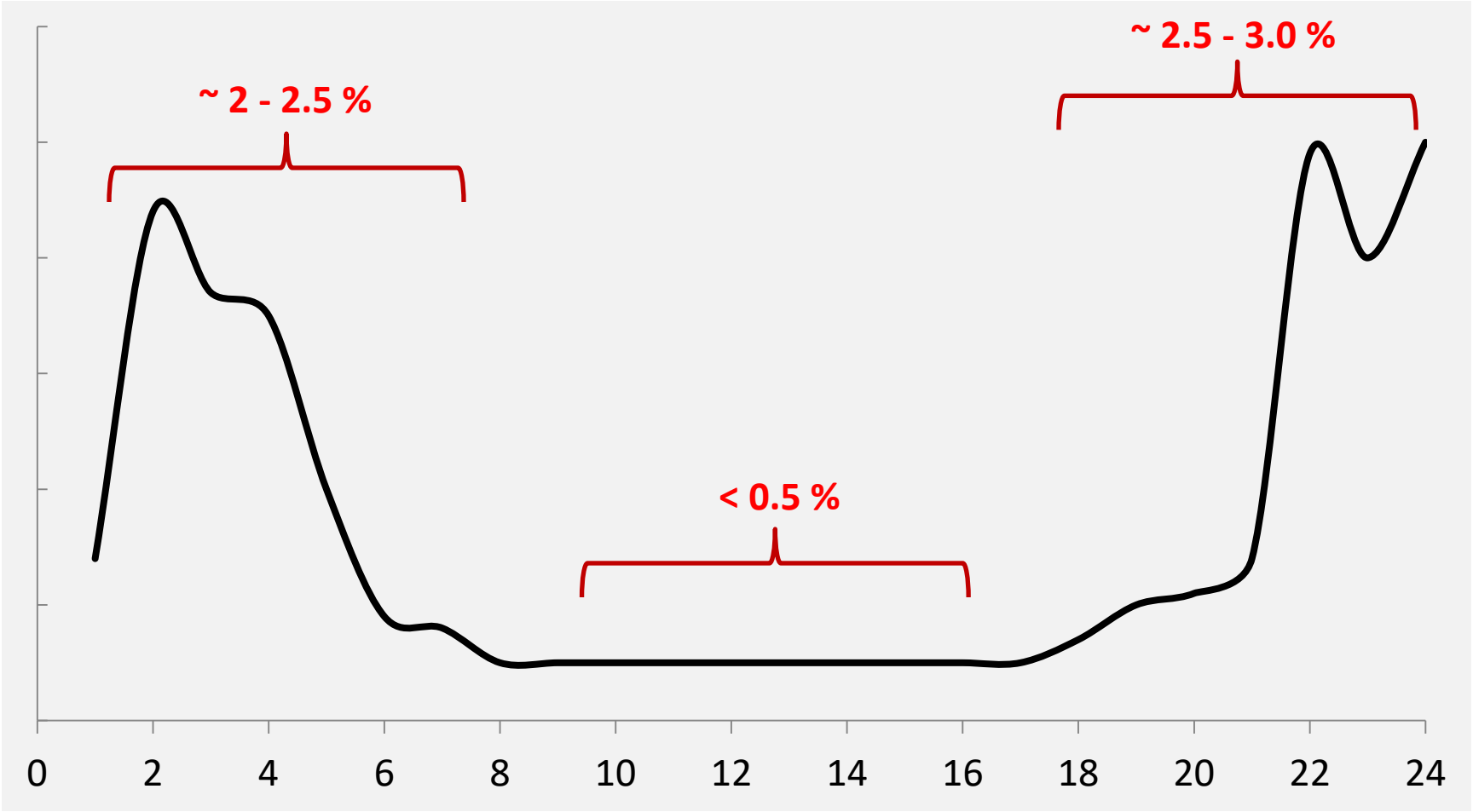
- This is a ***biological system***, therefore:

- Fertility? 100% is NOT possible!
- Hatch of Fertile? 100% is NOT possible!
- Hatchability? 100% is NOT possible!
- Chick Quality? 100% perfect is NOT possible!

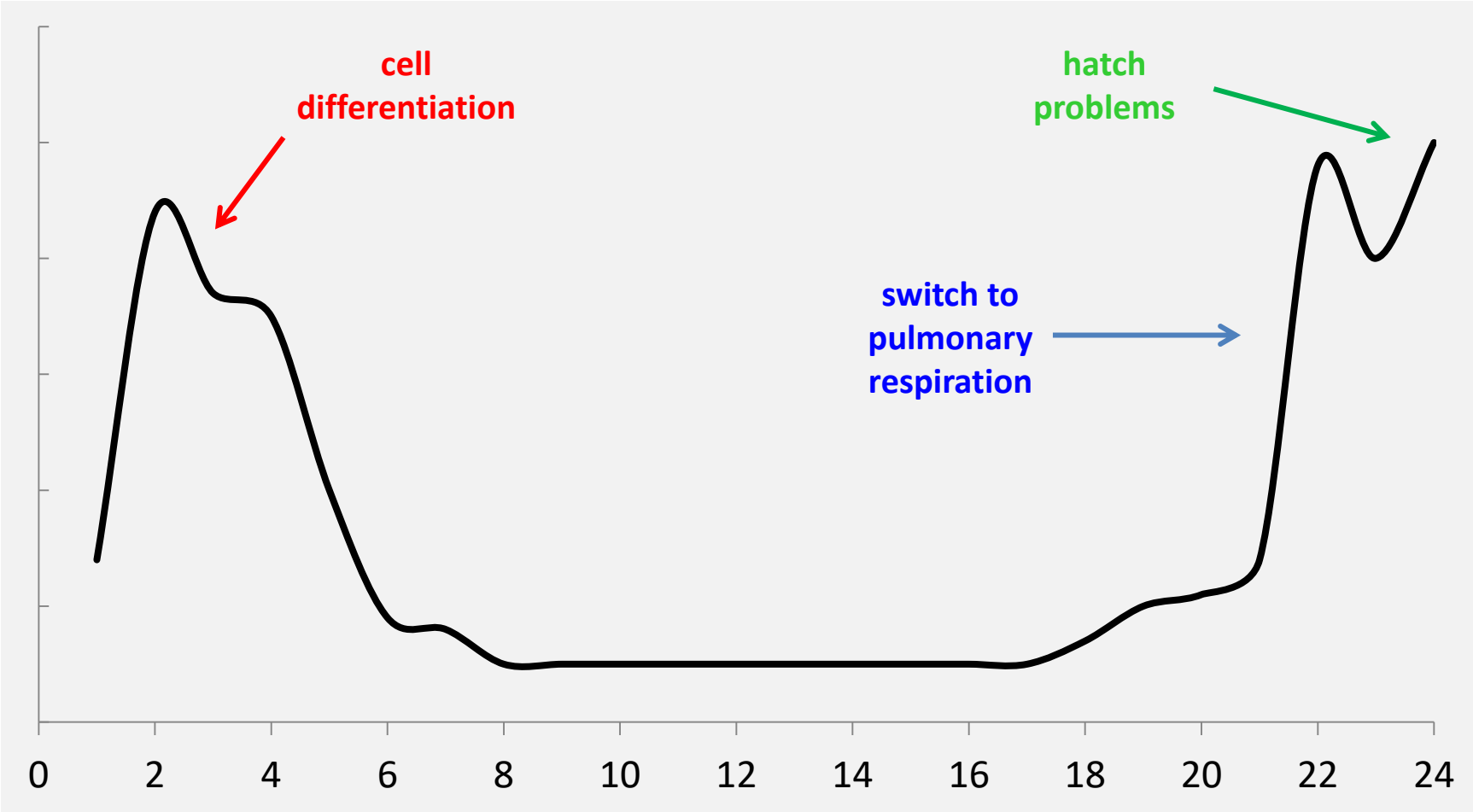
What is Acceptable or 'Normal'?

- This is a ***biological system***, therefore:
- Expect mortality, losses are unavoidable
- Fertility? 1-2% infertile
  - Dependant on breed (strain), age of flock, health status of breeders, etc.
- Embryo mortality? 4-5% **total** embryo loss
  - Dependant on breed (strain), age of flock, fertility, egg age, egg storage conditions (transport), *and* of course incubation conditions

Percent Mortality of Fertile Eggs



Percent Mortality of Fertile Eggs



Embryonic Mortality Pattern

- 1-7 days (1 - 3 days)
  - ~ 2.5 %
  - Blood & circulation system developing

    Cell differentiation
- Potential causes
  - Poor egg handling (gathering & storage)
  - Aged flocks (infrequent mating)
  - Incubator problems?

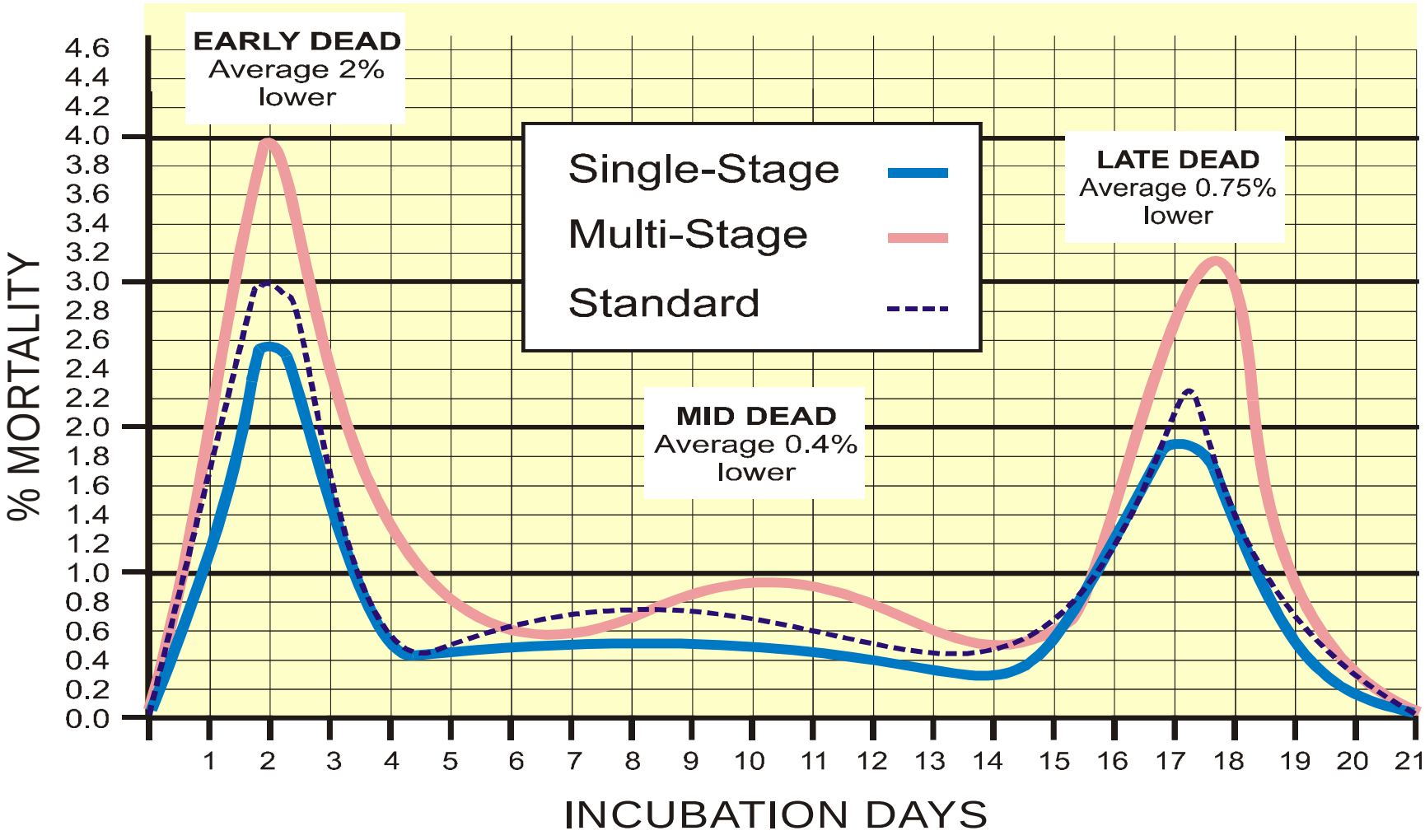
Embryonic Mortality Pattern

- 8 -17 days
  - ~ 0.5%
- Potential causes
  - Breeder nutrition
    - Riboflavin
    - Vitamin B12
    - Manganese
    - Pantothenic acid
  - Incubator problems

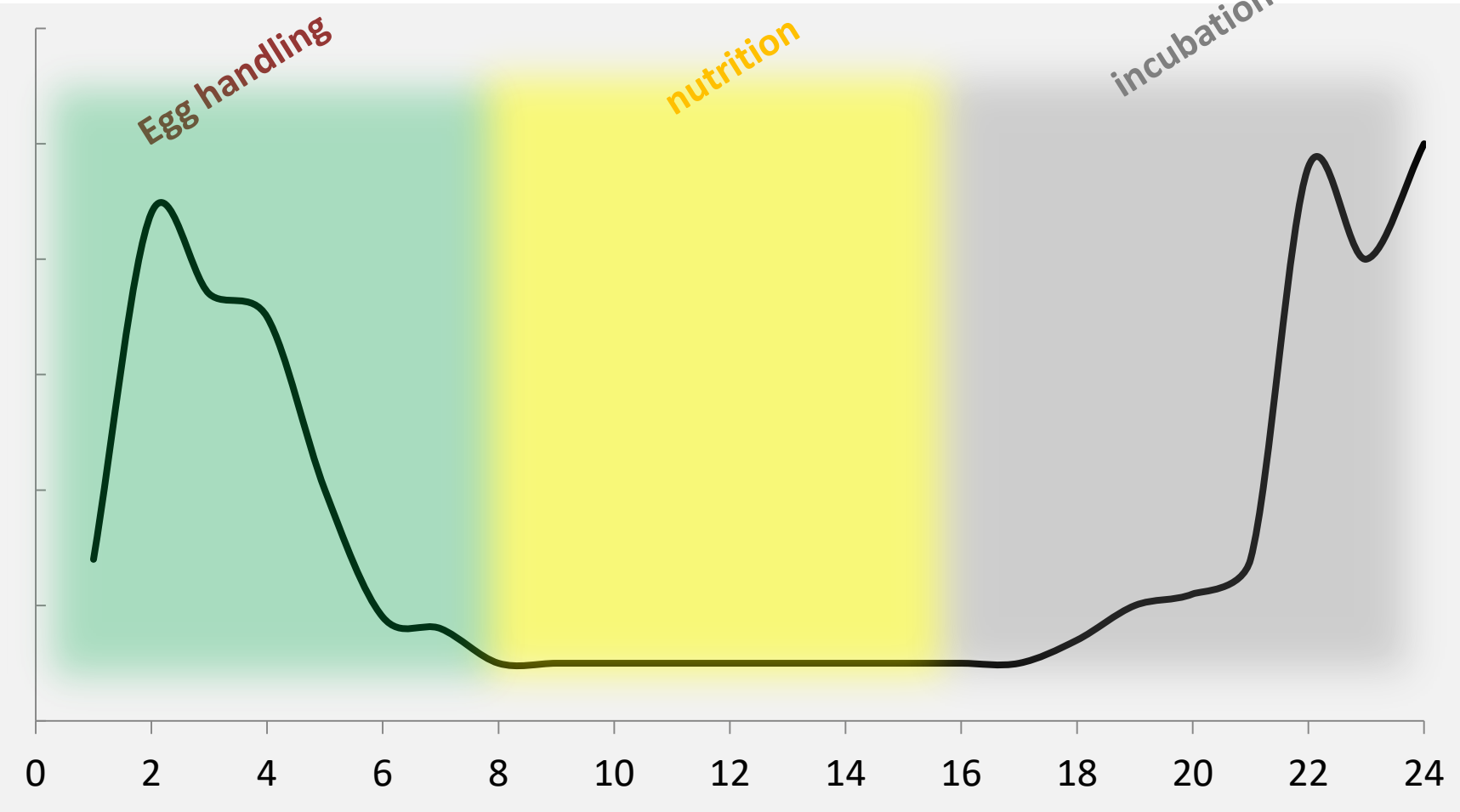
Embryonic Mortality Pattern

- 18-24 days
  - ~ 2.5 %
  - **Switch to pulmonary respiration**
- Potential causes
  - Incubation problems
    - Temperature, humidity, turning, pull time
  - Aged flocks (shell quality, etc)
  - Contamination
  - Egg orientation

Typical Embryo Mortality Trend



Percent Mortality of Fertile Eggs



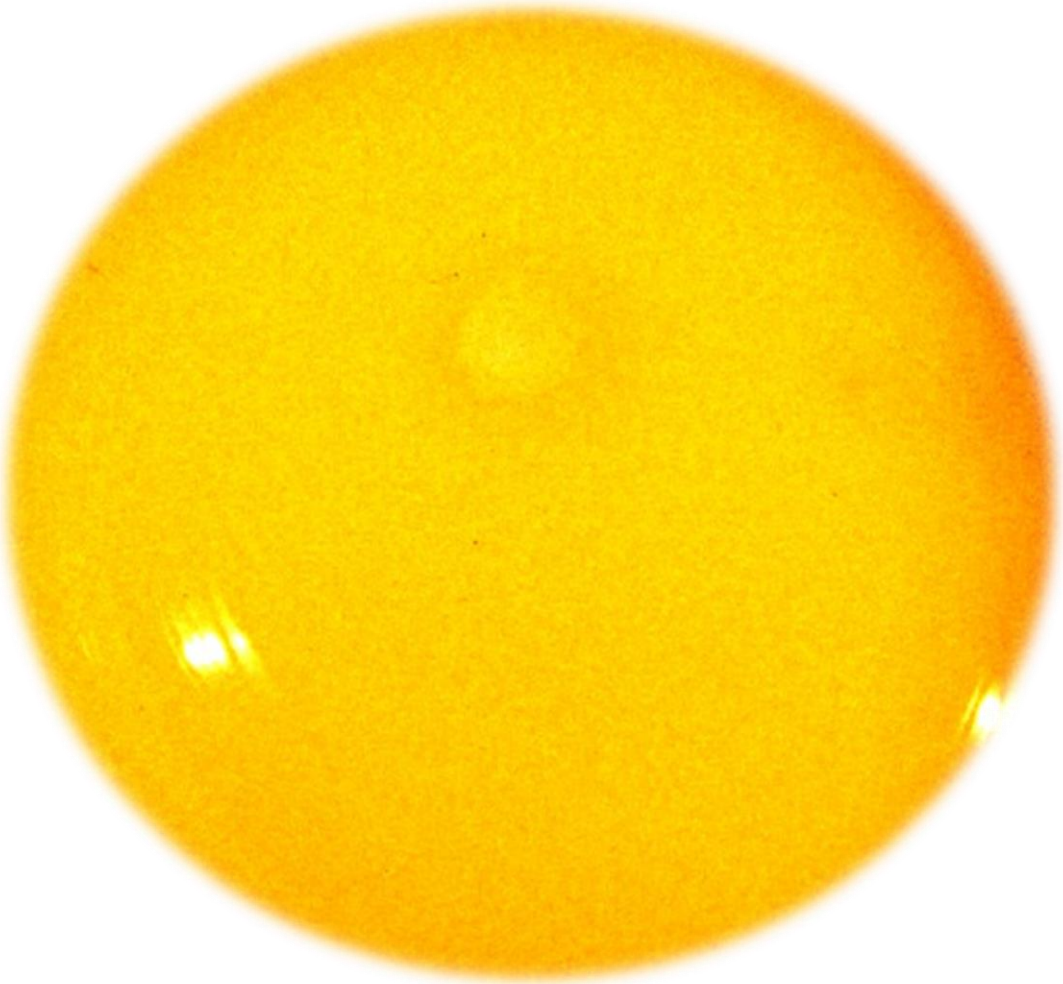
Fertile vs. Infertile

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

Infertile vs Fertile Eggs

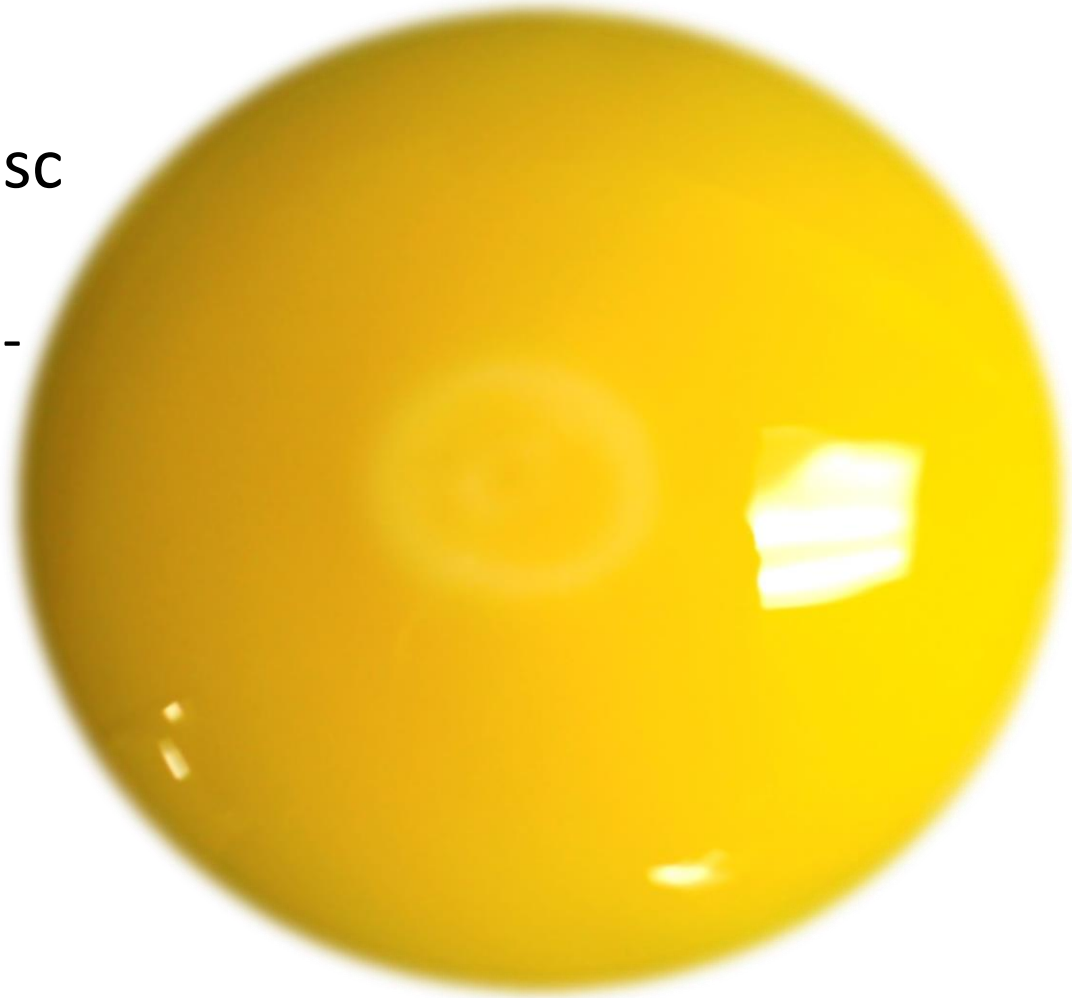
Fertile Eggs

- Fertile germinal disc



Fertile Eggs

- Fertile germinal disc
  - Shows some pre-incubation, or pre-development
- 12 hours of development



Fertile Eggs

- 24 hours of development

Infertile Eggs

Embryonic Development

- No development

Troubleshooting Guide

- **DECREASED MATING FREQUENCY**
- Males and females with abnormal sperm or egg
  - Both occur in young or old
- Nutritional deficiencies, excesses
  - Severe feed restriction
- Certain drugs, pesticides, chemicals, toxins, mycotoxins

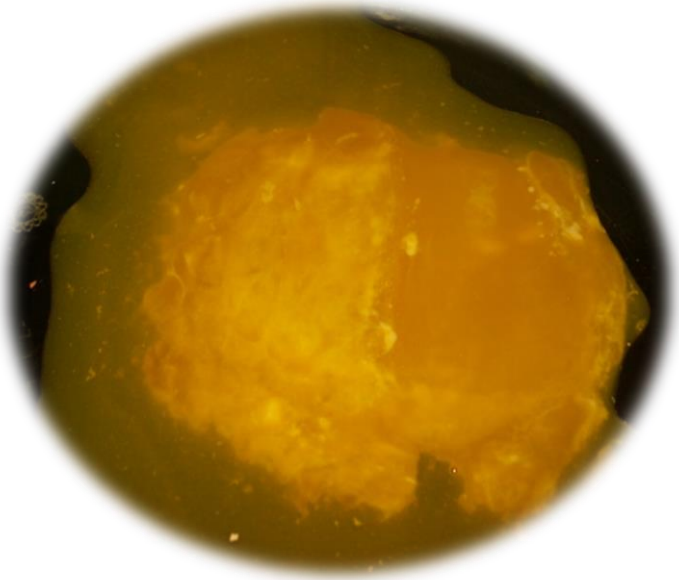
Day 1

Embryonic Development

- Appearance of tissue development

Troubleshooting Guide

- Low fertility
- Pre-incubation, poor egg storage
- Improper egg holding time
- Rough egg handling



Day 2

Embryonic Development

- Tissue development very visible
- Appearance of blood vessels

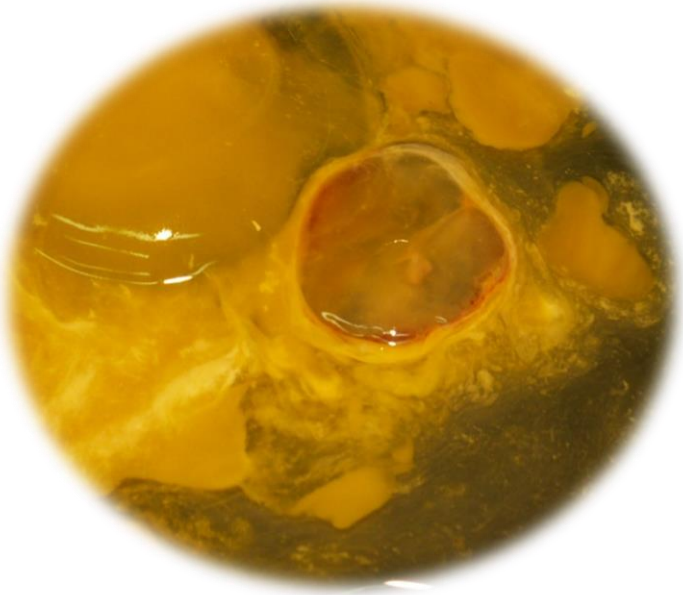
Troubleshooting Guide

- Low fertility
- Pre-incubation, poor egg storage
- Improper egg holding time
- Rough egg handling

Day 3

Embryonic Development

- Heart beats
- Blood vessels very visible



Troubleshooting Guide

- Low fertility
- Pre-incubation, poor egg storage
- Improper egg holding time
- Rough setting of eggs

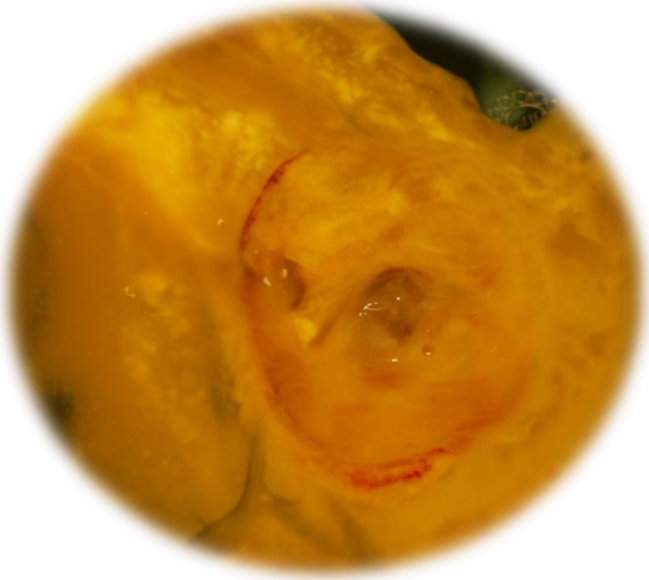
Day 4

Embryonic Development

- **Eye pigmentation easily visible**

Troubleshooting Guide

- Pre-incubation, poor egg storage
- Improper egg holding time
- Rough setting of eggs
- Contaminated eggs
- Drugs-toxins



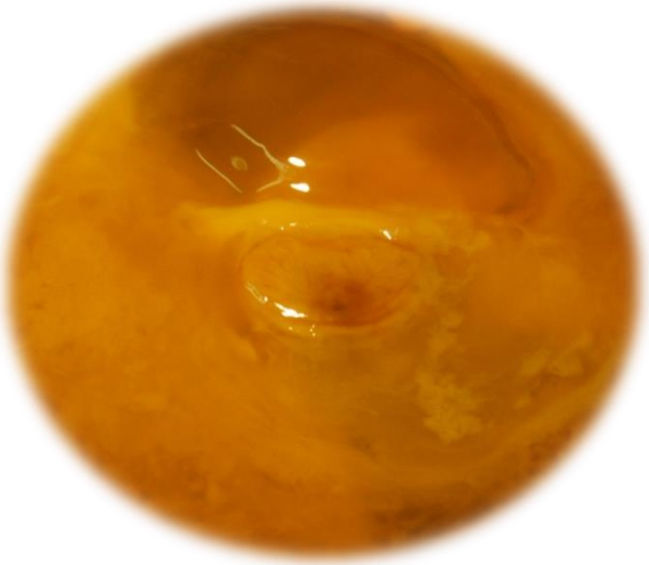
Day 5

Embryonic Development

- Appearance of elbows and knees

Troubleshooting Guide

- Pre-incubation, poor egg storage
- Improper egg holding time
- Rough setting of eggs
- Contaminated eggs
- Drugs-toxins



Day 6

Embryonic Development

- Appearance of beak
- Voluntary movement begins

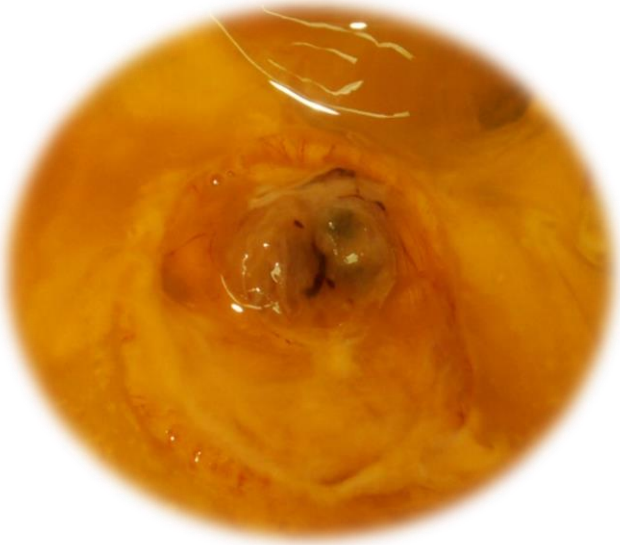
Troubleshooting Guide

- Pre-incubation, poor egg storage
- Improper egg holding time
- Improper turning
- Rough setting of eggs
- Contaminated eggs
- Drugs-toxins

Day 7

Embryonic Development

- Comb growth begins
- Egg tooth begins to appear



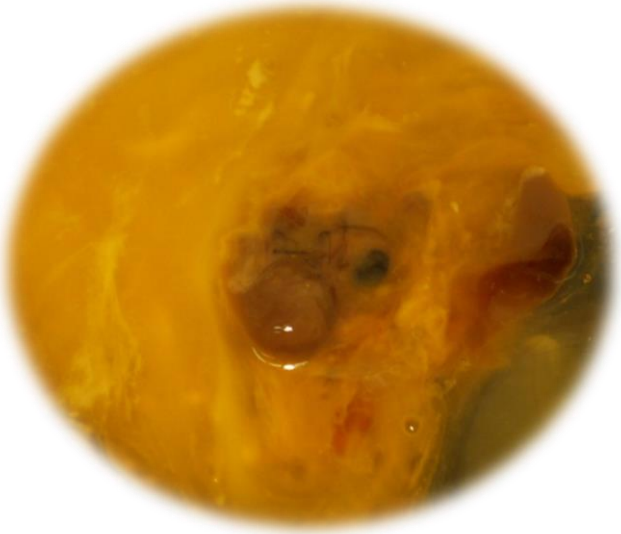
Troubleshooting Guide

- Improper temperature
- Rough setting of eggs
- Contaminated eggs
- Nutritional
  - Vitamin E, riboflavin, biotin, pantothenic acid, linoleic acid
- Drugs-toxins

Day 8

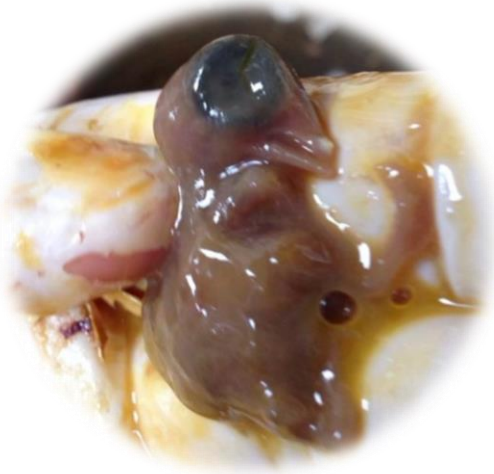
Embryonic Development

- Feather tracts seen
- Upper & lower beak equal in length
- **Egg tooth easily visible**



Troubleshooting Guide

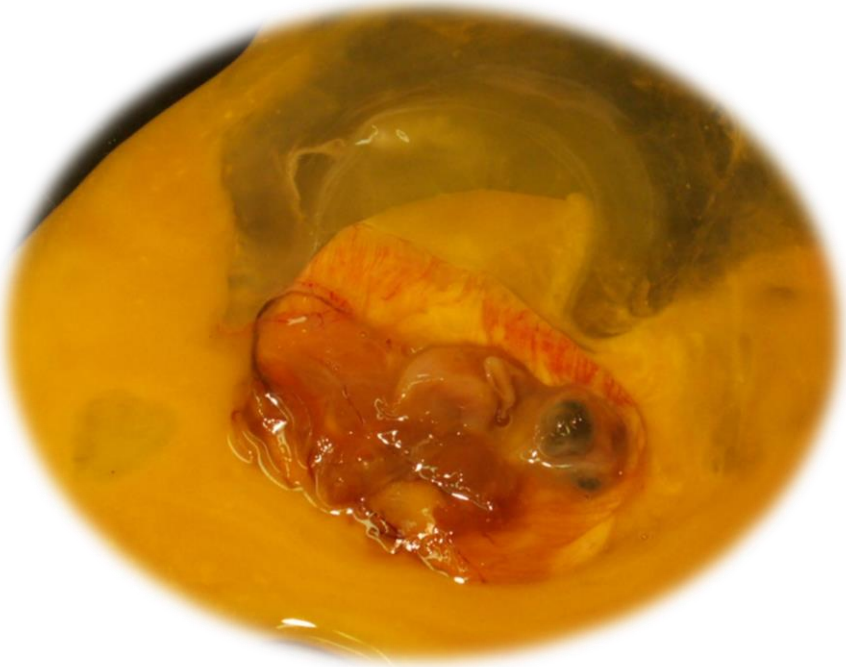
- Improper temperature
- Insufficient egg holding time
- Rough setting of eggs
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid



Day 9

Embryonic Development

- Embryo starts to look bird like
- Mouth opening appears



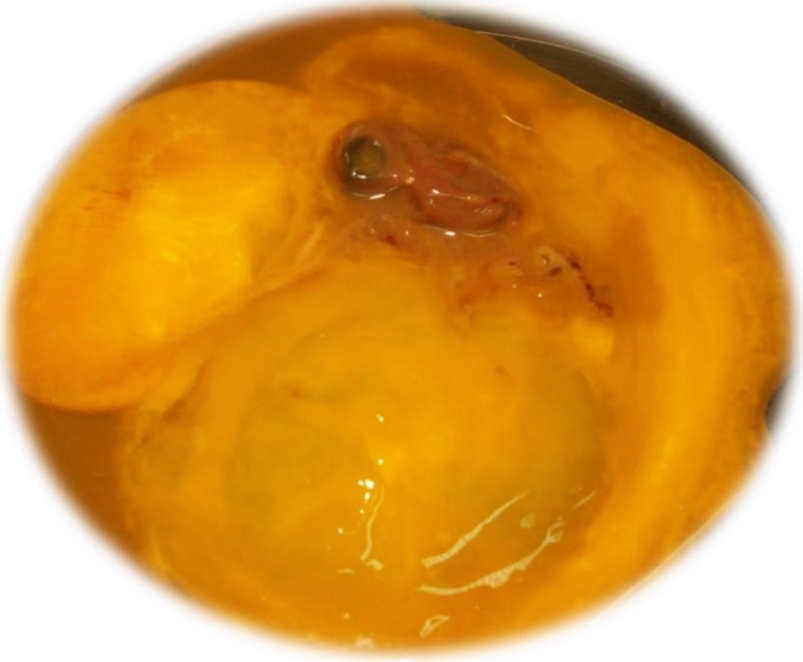
Troubleshooting Guide

- Improper temperature
- Insufficient egg holding time
- Rough setting of eggs
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 10

Embryonic Development

- Egg tooth prominent
- Toe nails



Troubleshooting Guide

- Improper turning
- Improper temperature
- Improper ventilation
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 11

Embryonic Development

- Comb serrated
- Tail feathers apparent

Troubleshooting Guide

- Improper turning
- Improper temperature
- Improper ventilation
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 12

Embryonic Development

- Toes fully formed
- First few visible feathers

Troubleshooting Guide

- Improper turning
- Improper temperature
- Improper ventilation
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 13

Embryonic Development

- Appearance of scales
- Body covered lightly with feathers

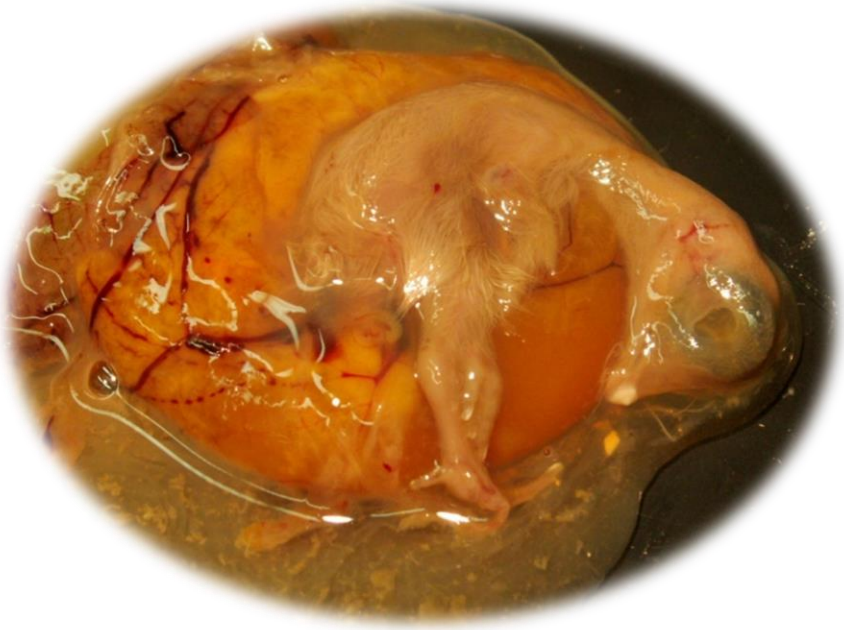
Troubleshooting Guide

- Improper turning
- Improper temperature
- Improper ventilation
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 14

Embryonic Development

- Embryo turns head towards large end of egg



Troubleshooting Guide

- Improper turning
- Improper temperature
- Improper ventilation
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 15

Embryonic Development

- Gut is drawn into abdominal cavity

Troubleshooting Guide

- Improper turning
- Improper temperature
- Improper ventilation
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 16

Embryonic Development

- Feathers cover complete body
- Albumen nearly gone

Troubleshooting Guide

- Improper turning
- Improper temperature
- Inverted eggs
- Contaminated
- Nutritional
  - Riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorous, boron, linoleic acid

Day 17

Embryonic Development

- Amniotic fluid decreases
- Head is between legs

Troubleshooting Guide

- Improper turning
- Improper temperature
- Improper humidity
- Improper ventilation
- Inverted eggs
- Contaminated

Day 18

Embryonic Development

- Growth of embryo nearly complete
- Yolk sac is still on outside of embryo
- Head is under the right wing

Troubleshooting Guide

- Rough transfer
  - Transfer cracks, delays
- Vaccination
- Wet trays and hatchers
- Inconsistent transfer
- Improper turning
- Improper temperature
- Improper humidity
- Improper ventilation
- Inverted eggs

Day 19

Embryonic Development

- Yolk sac draws into body cavity
- Amniotic fluid gone
- Embryo occupies most of space within egg(not in the air cell)

Troubleshooting Guide

- Rough transfer
  - Transfer cracks, delays
- Vaccination
- Wet trays and hatchers
- Inconsistent transfer
- Improper turning
- Improper temperature
- Improper humidity
- Improper ventilation
- Inverted eggs

Day 20

Embryonic Development

- Yolk sac drawn completely into body
- Embryo becomes a chick(breathing in air cell)
- Internal & external pip

Troubleshooting Guide

- Hatcher ventilation
- Hatcher temperature
- Rough transfer
- Wet trays and hatchers
- Improper turning
- Improper temperature
- Improper humidity
- Improper ventilation
- Inverted eggs

Day 20

Embryonic Development

- Yolk sac drawn completely into body
- Embryo becomes a chick(breathing in air cell)
- Internal & external pip

Troubleshooting Guide

- Breeder disease
- Poor shell quality
- Hatcher temperature
- Hatcher ventilation
- Time of transfer

Pipped

- Signs
  - Dead in shell
  - Full-term embryo

- Causes
  - **Low humidity or temperature for long periods**
  - **Hatcher humidity low**
  - **High temperatures during hatching**
  - 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
  - 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

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`

Skeletal Malformations

- Signs
  - Posterior duplication
  - Any multiple truncated development
- Causes
  - Poor egg storage and handling
  - Inadequate turning
  - Improper egg orientation (small end up)
  - Setter temperature too high or too low
  - Breeder disease
  - Poor ventilation or poor conductivity of eggs

Cross Beak & Missing Eye

- Temperature too high
- Egg turning problems

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

Brain Hernia (Exposed Brain)

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

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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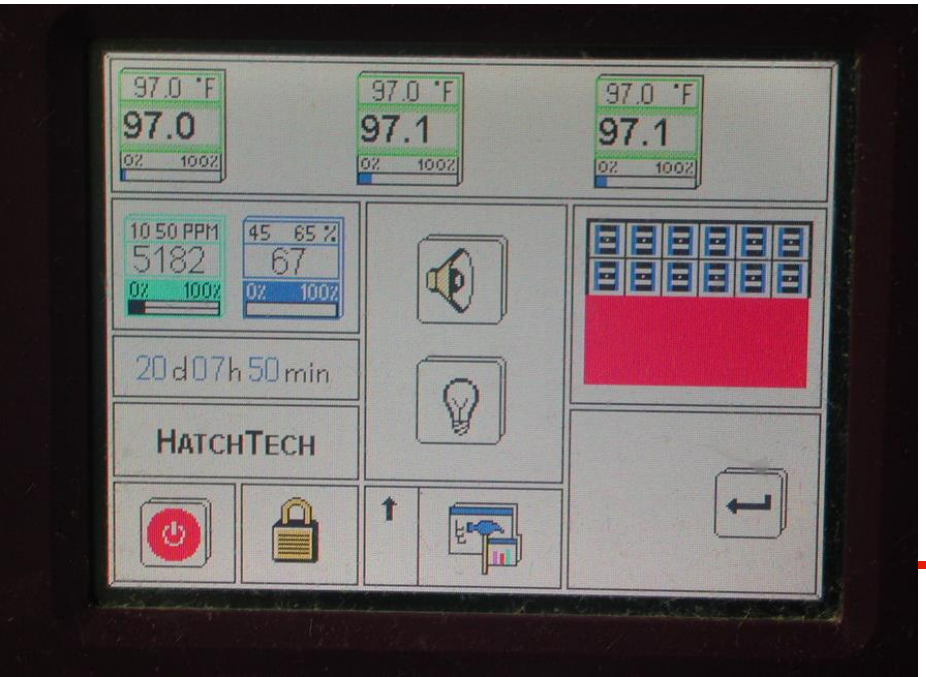
YOUR PARTNER
FOR A WORRY FREE HATCHERY

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:

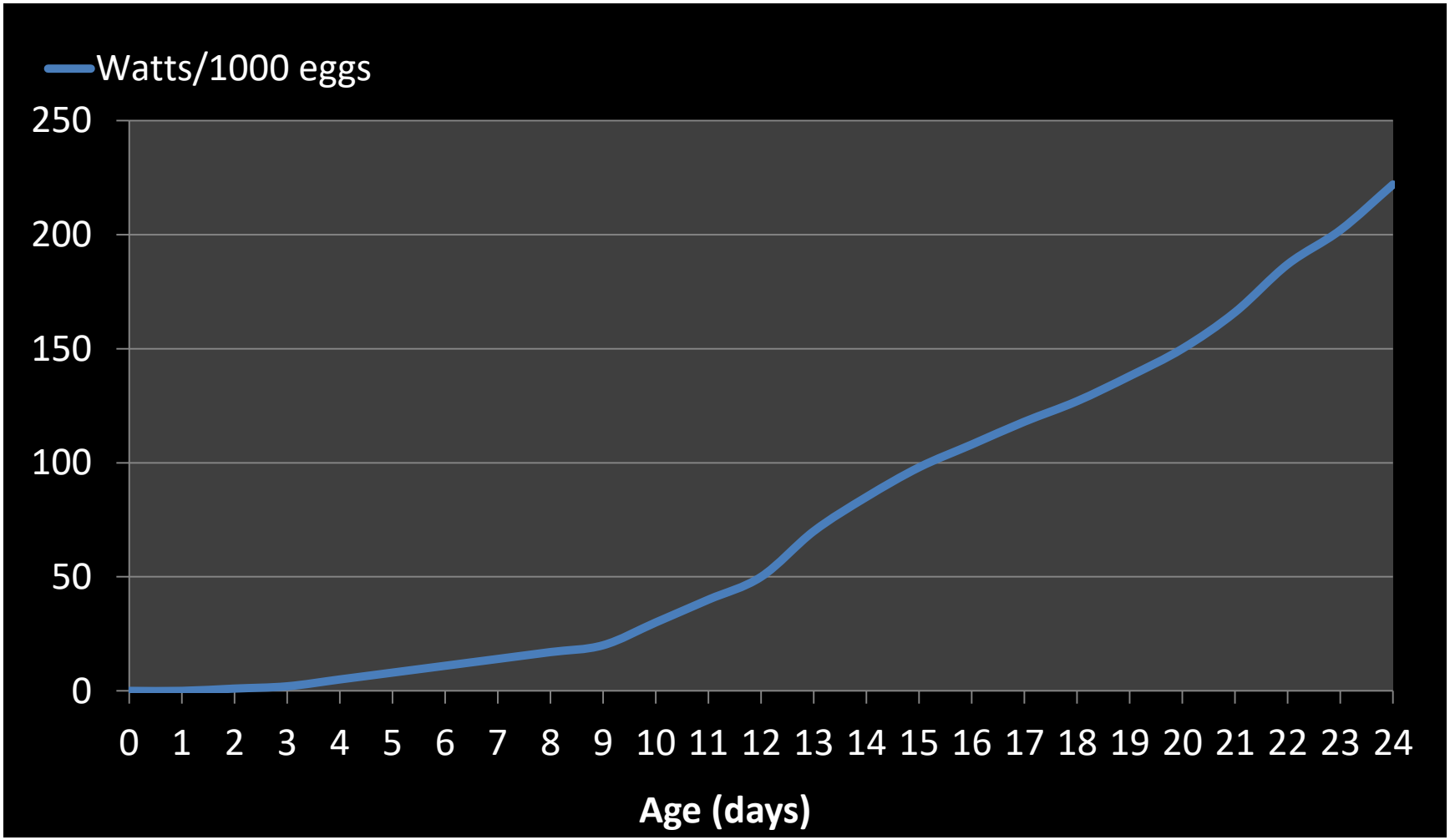
- 2 Multi-stage buggy loading

Incubation Types

- Three main types of machines:

- 3 Single-stage buggy loading

Heat Production of Developing Embryos




4
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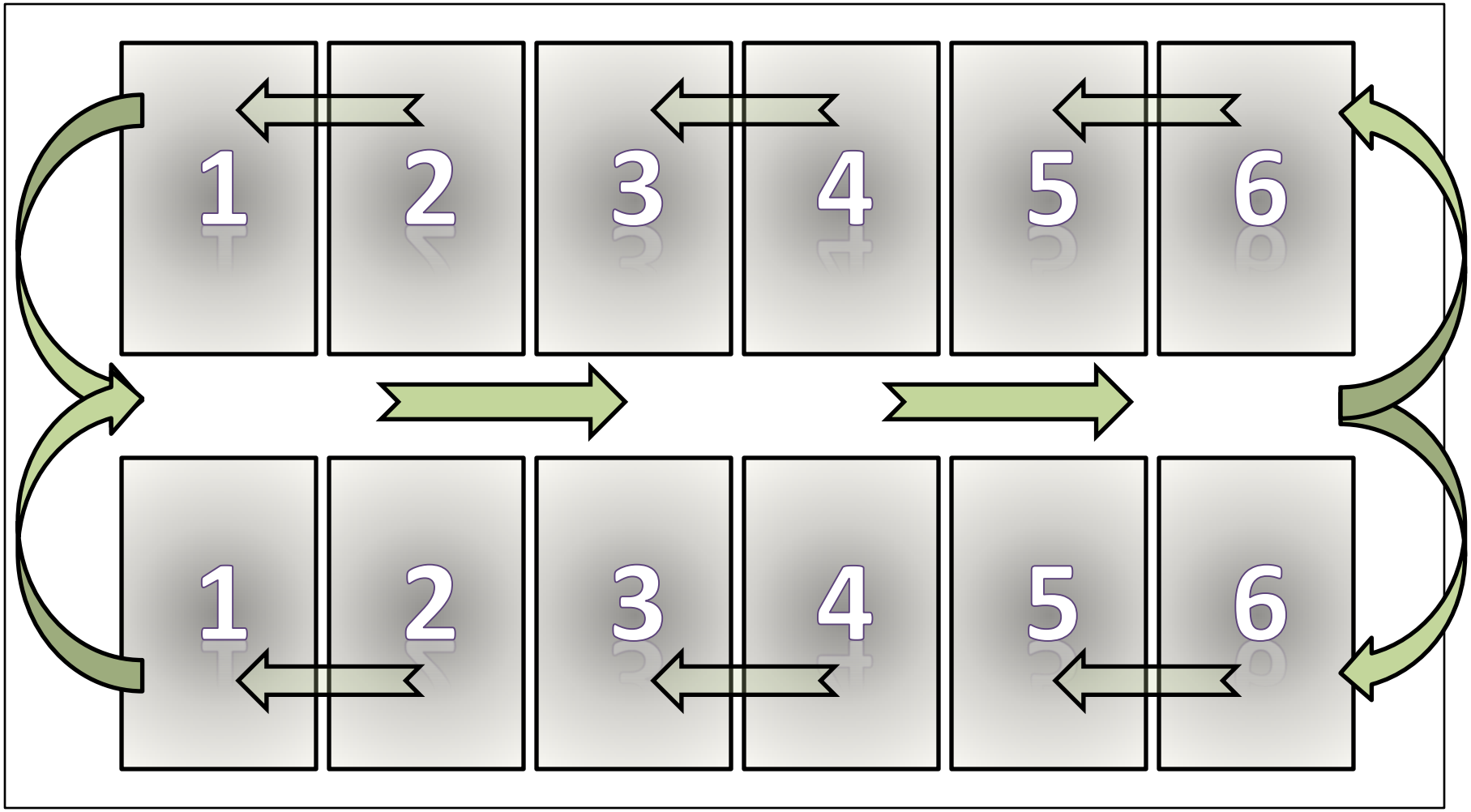
2
Multi-stage
fixed rack

Multi-stage Buggy Loading



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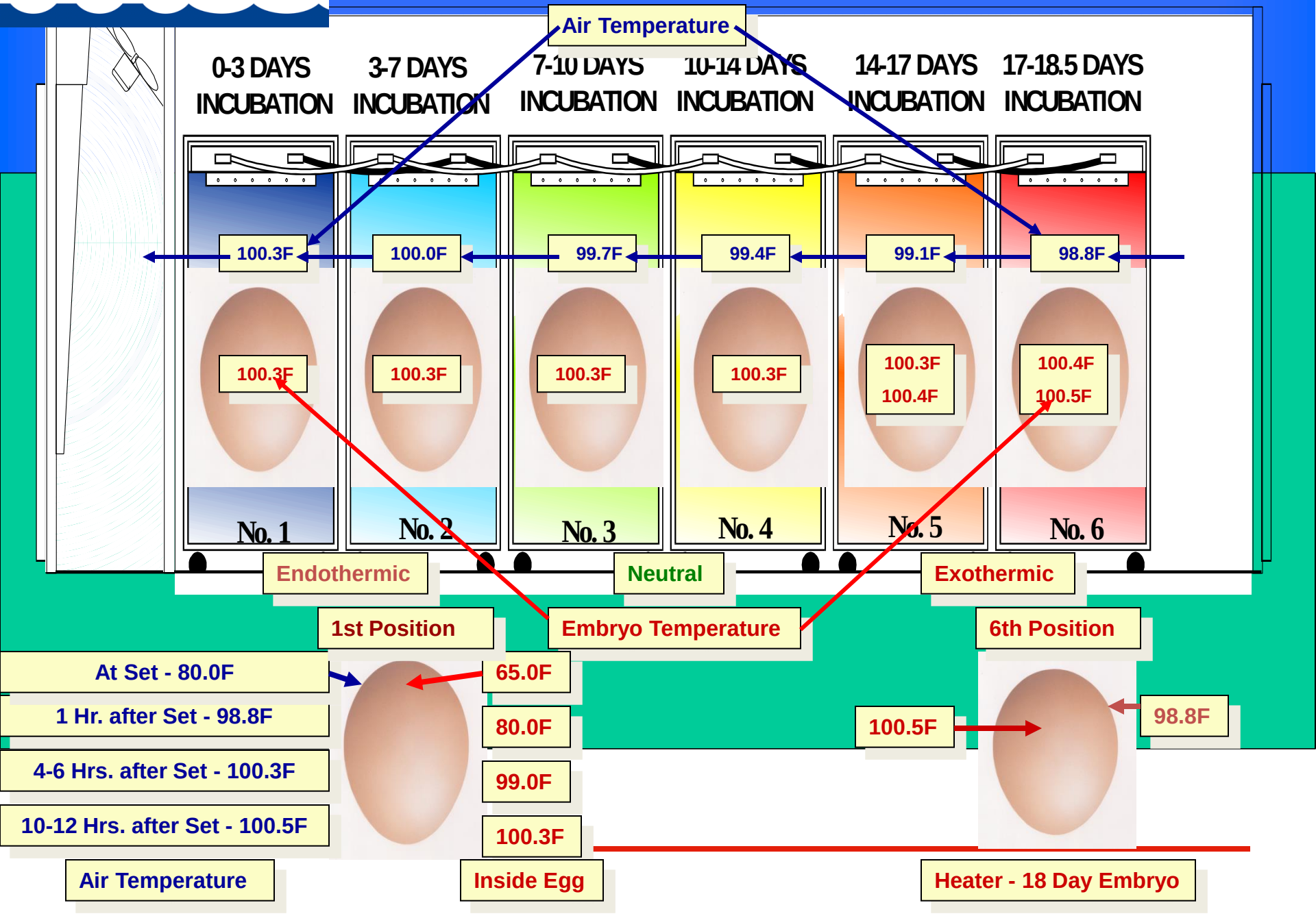
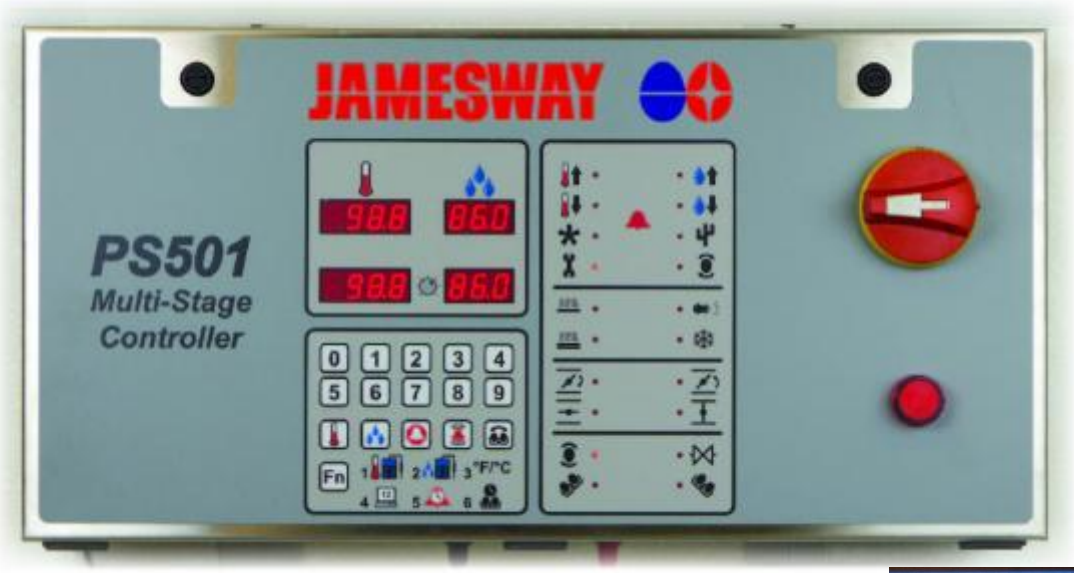
Multi Stage Achieving Average




Single-stage
Buggy loading


JAMESWAY
PS501
Multi-Stage
Controller
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0 1 2 3 4
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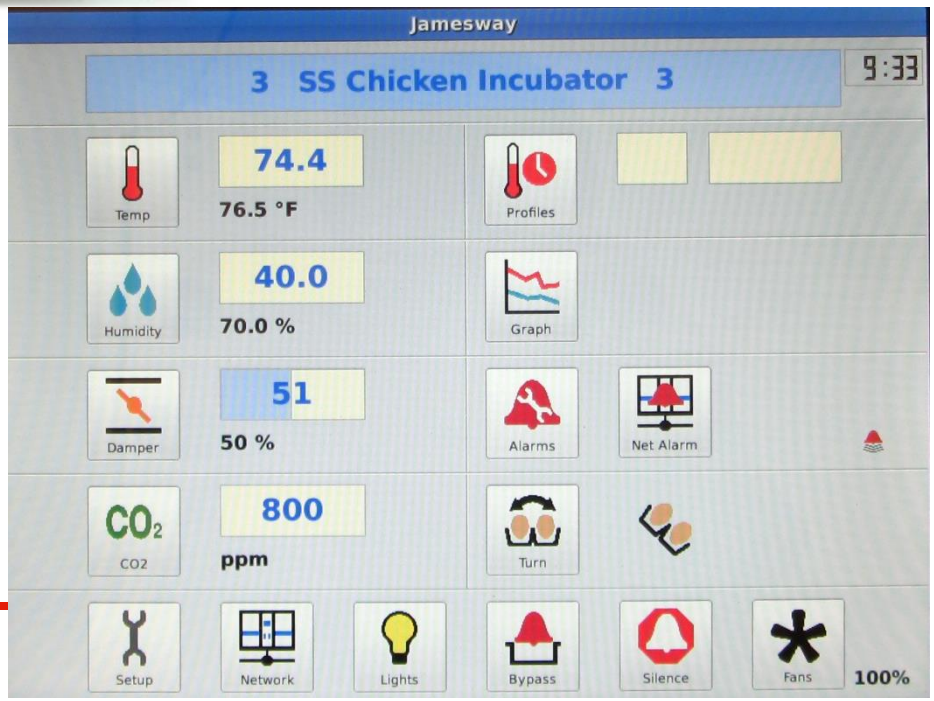
Jamesway
3 SS Chicken Incubator 3
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ppm
CO2
Turn
Setup
Network
Lights
Bypass
Silence
Fans
100%

Incubation Systems Available in Today's Industry

- 1. Multi Stage Incubation
- a. Still by far the most common (varying stages of embryonic development in each incubator)
- b. One way system to achieve averages for all
- c. Interdependent (Each group of embryos supports and are dependant on the other)
- 2. Single Stage Incubation
- a. All in - All out
- b. Flexibility
- c. Biosecurity
- STATEMENT: Industry Trend Is Toward Single Stage

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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

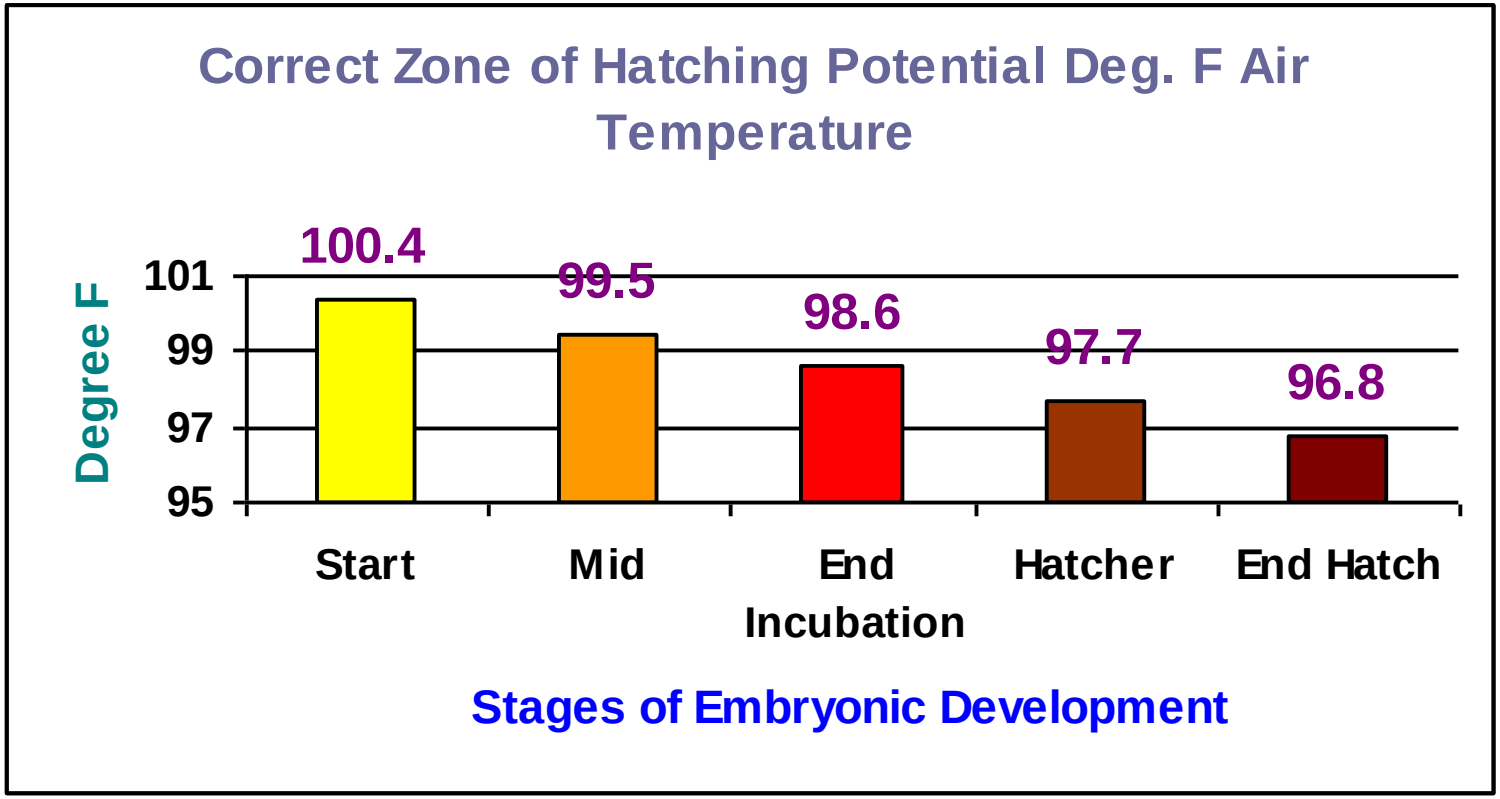
- Temperature determines the metabolic rate and development of the embryo
  - Multi-stage incubation - temperature remains constant
  - Single-stage incubation – temperature can be altered to best stimulate growth. Starting with a higher temperature then reduced thereafter. (incubation profiling)
  -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

Example Setter Profile

Incubator 129 Profile 510 - 512 Total Incubation Time

			Day/Hr	Pilot Temperature	Air Temperature	Humidity	Damper CO2 PPM %	Damper CO2 PPM	Damper % Opening
PreWarm		1	-6		80.0	75%		5	5
		2	-3		85.0	75%		5	5
Endothermic	Developmental	3	0.00	100.4	100.4	75%	0	0	0
		4	1.00	100.3	100.3	75%	0	0	0
		5	2.00	100.2	100.2	75%	0	0	0
		6	3.12	100.1	100.1	75%	4000 PPM	4000 PPM	0
		7	4.12	100.1	100.0	75%	5000 PPM	5000 PPM	0
		8	5.12	100.1	99.9	75%	6000 PPM	6000 PPM	0
		9	6.00	100.1	99.8	75%	7000 PPM	7000 PPM	0
Neutral	Maintenance	10	7.00	100.0	99.7	75%	8000 PPM	8000 PPM	0
		11	8.00	100.0	99.6	75%	9000 PPM	9000 PPM	0
		12	9.00	100.0	99.5	70%	10000 PPM	10000 PPM	0
		13	9.12	100.0	99.4	62%	15%	6000 PPM	15%
		14	10.00	100.0	99.3	55%	20%	4000 PPM	20%
		15	10.06	100.0	99.2	50%	25%	4000 PPM	25%
		16	11.00	100.0	99.0	48%	30%	4000 PPM	30%
		17	11.12	100.0	98.8	45%	35%	4000 PPM	35%
		18	12.00	100.0	98.6	44%	40%	4000 PPM	40%
		19	12.06	100.0	98.4	43%	45%	4000 PPM	45%
		20	12.12	100.0	98.2	42%	50%	4000 PPM	50%
		21	13.00	100.0	98.1	40%	55%	4000 PPM	55%
		22	13.12	100.0	98.0	39%	60%	4000 PPM	60%
Exothermic	Maturity	23	14.12	100.1	97.8	35%	70%	3800 PPM	70%
		24	15.00	100.1	97.6	32%	75%	3500 PPM	75%
		25	15.12	100.2	97.4	30%	80%	3200 PPM	80%
		26	16.00	100.2	97.2	30%	85%	3000 PPM	85%
		27	16.12	100.2	97.2	30%	90%	3000 PPM	90%
		28	17.00	100.2	97.2	30%	95%	2800 PPM	95%
		29	18.00	100.2	97.3	30%	100%	100%	100%
		30	18.12	100.2	97.4	30%	100%	100%	100%

Air Temperature Zones vs Stages of Development



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

Summary

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