

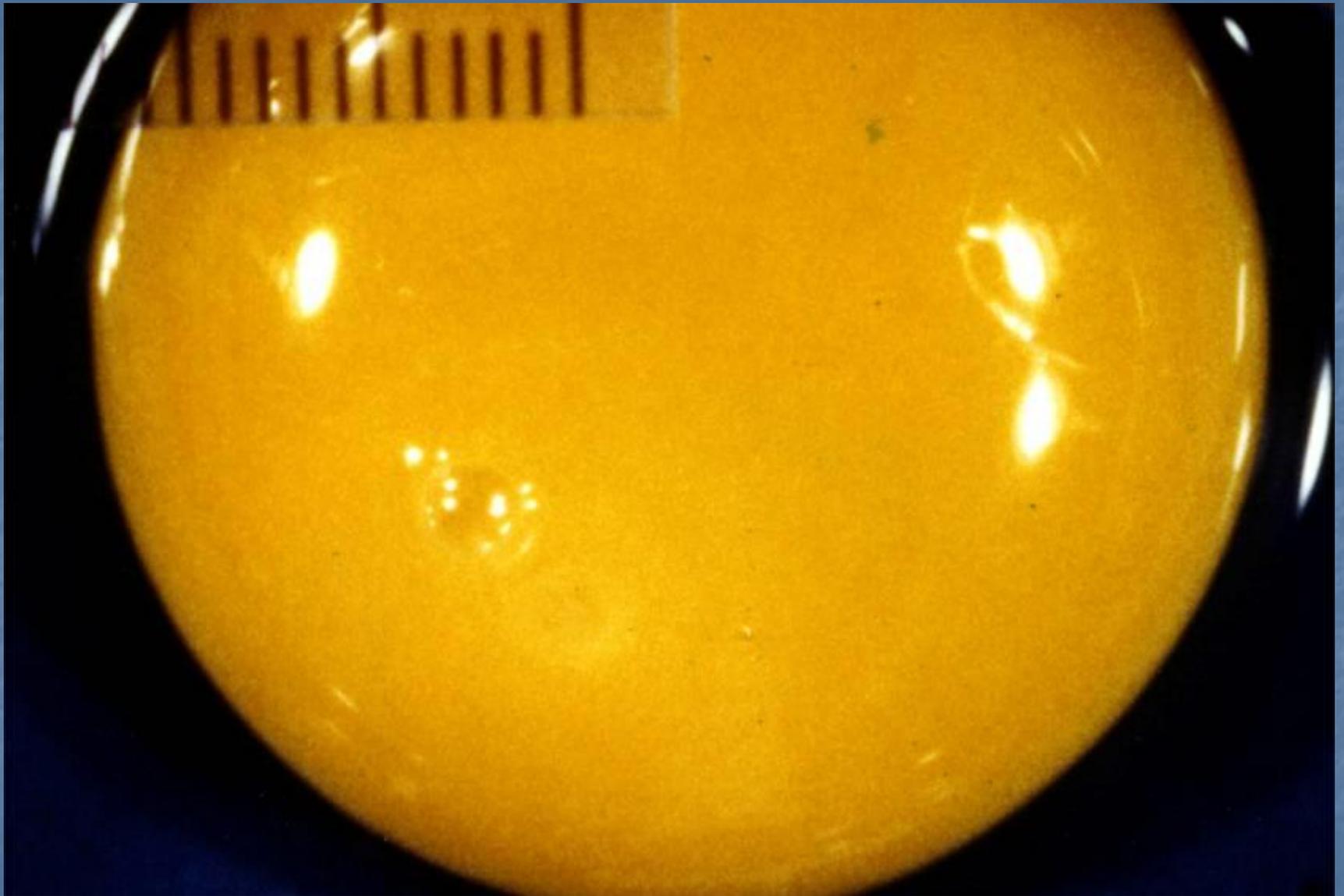
Basic Concepts of Embryology

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Artificial Incubation of Eggs

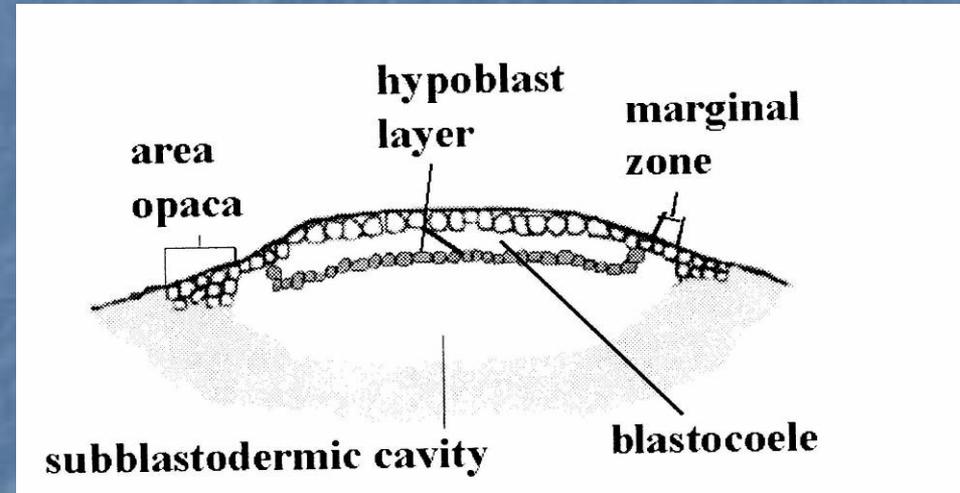
- Five Basic Principles of Incubation
 - Temperature
 - Humidity
 - Turning
 - Ventilation
 - Light and Sound

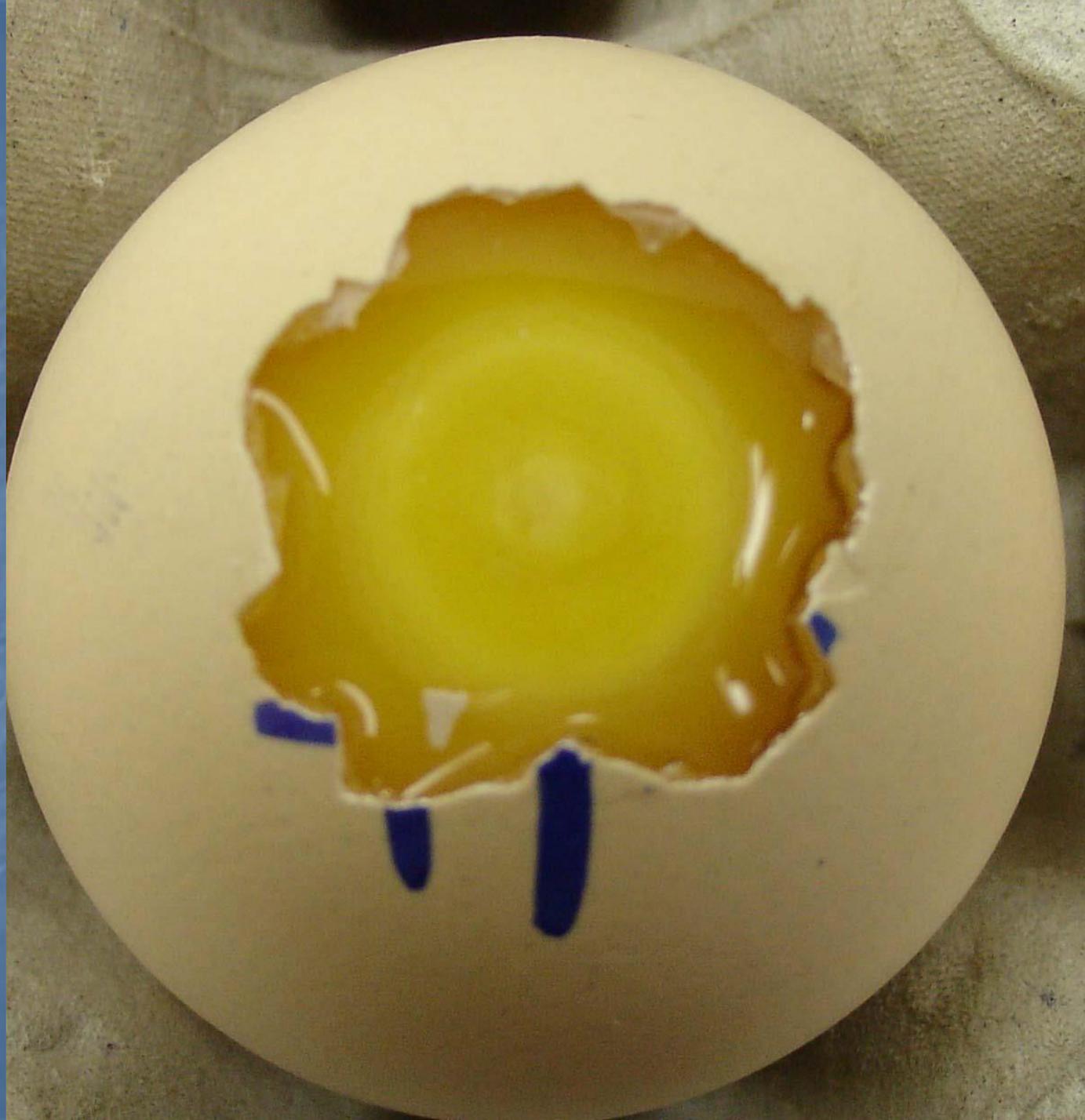


- **Blastoderm**
comprised of 2
layers

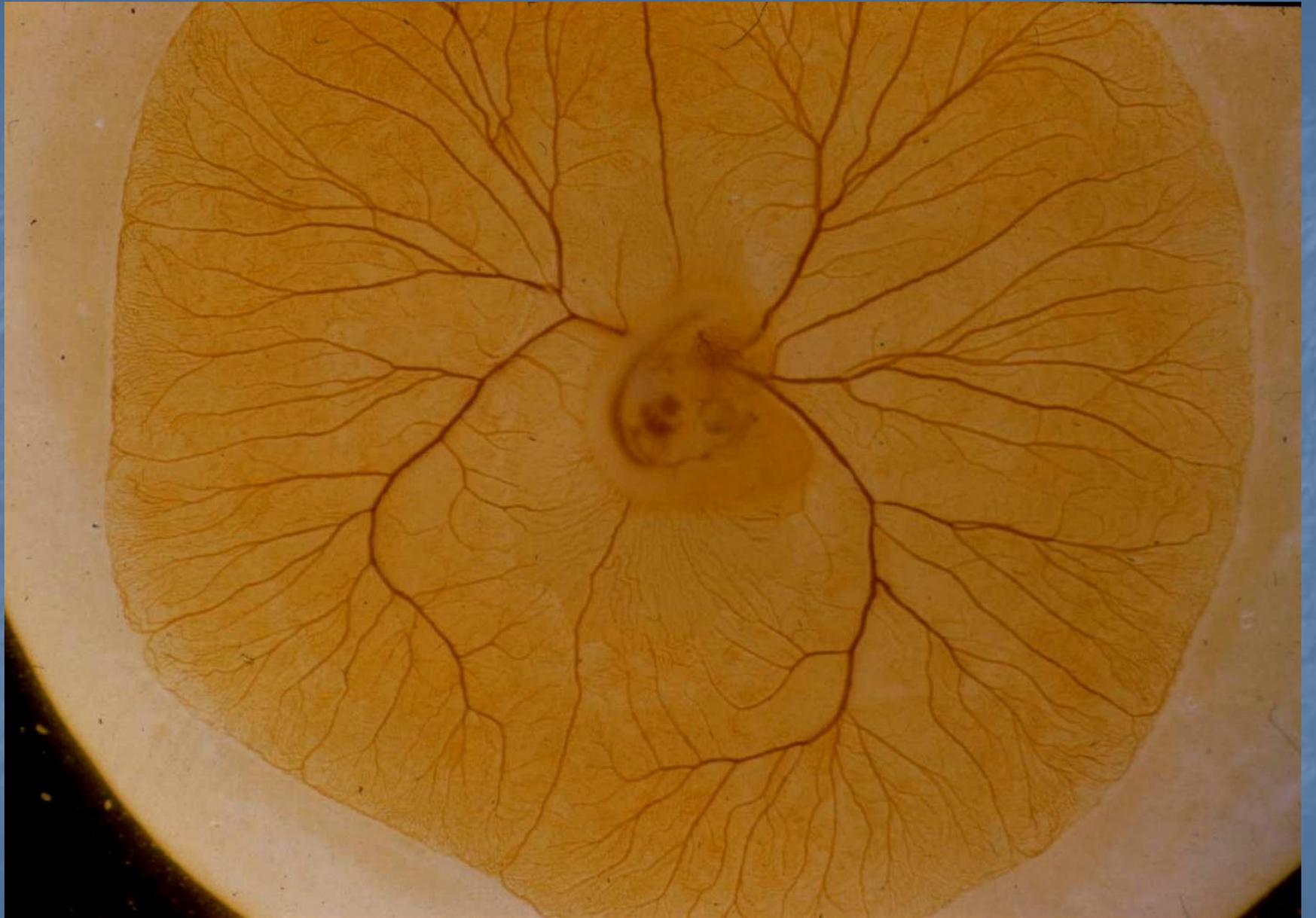
- **Epiblast**
(ectoderm)

- **Hypoblast**
(endoderm)





- **Gastrulation begins with formation of middle layer (mesoderm)**
 - **Somites arise from mesoderm**



Growth of Pheasant Embryos Compared to other Species

- Most embryos are at EG Stage 10 at time egg is laid.

Pheasant embryos are at EG Stage 8 to 10

- Pheasant embryos growth slower than all other species through the initial period (Bakst et al., 2007).

Sub-embryonic fluid

- Water does not move directly from albumen to embryonic tissue
- Endoderm cells of area vasculosa are specialized for transport of water and sodium from albumen to yolk sac

Sub-embryonic fluid

- A fluid which appears in the yolk sac beneath the embryo
- Noticeable at 2-3 days of incubation reaches maximum at day 6
- Is assumed that water from SEF is distributed to growing tissue (embryonic and extra-embryonic) by vascular system

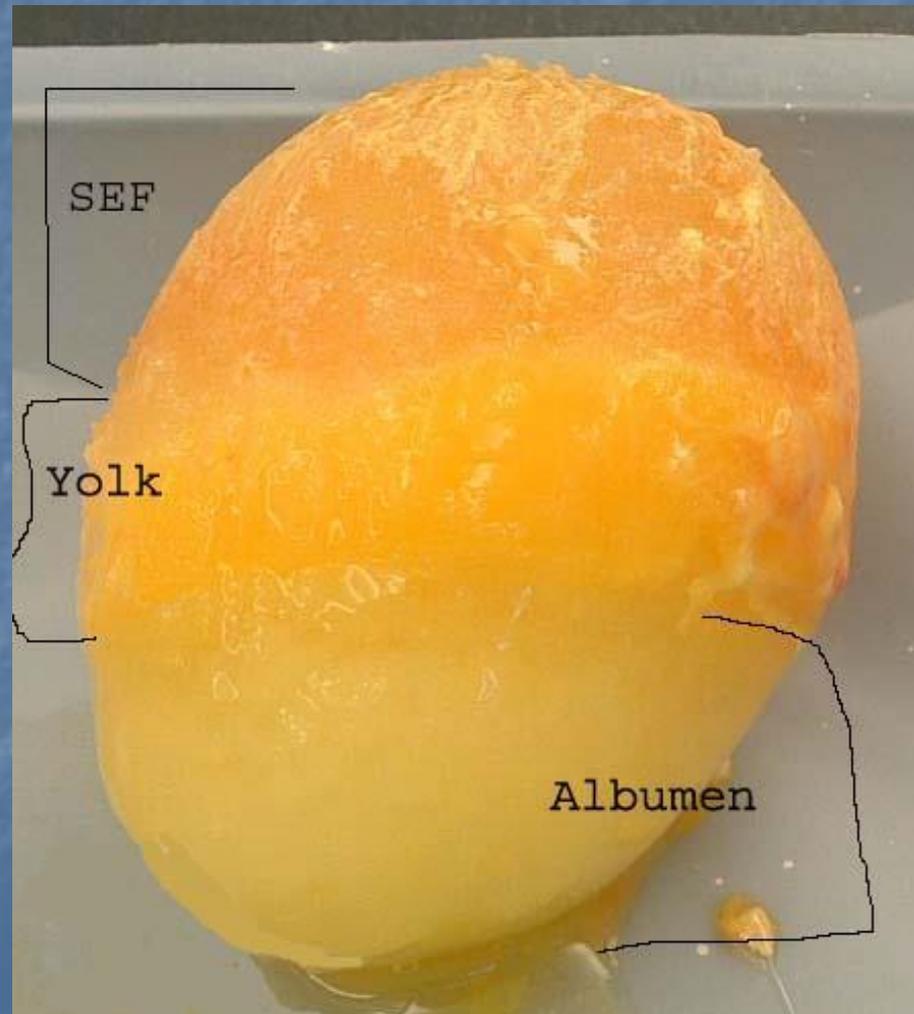
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- Critical period for production of SEF
 - 3-7 days
 - Turning: Absence of turning reduces growth of area vasculosa over yolk sac and causes reduced SEF

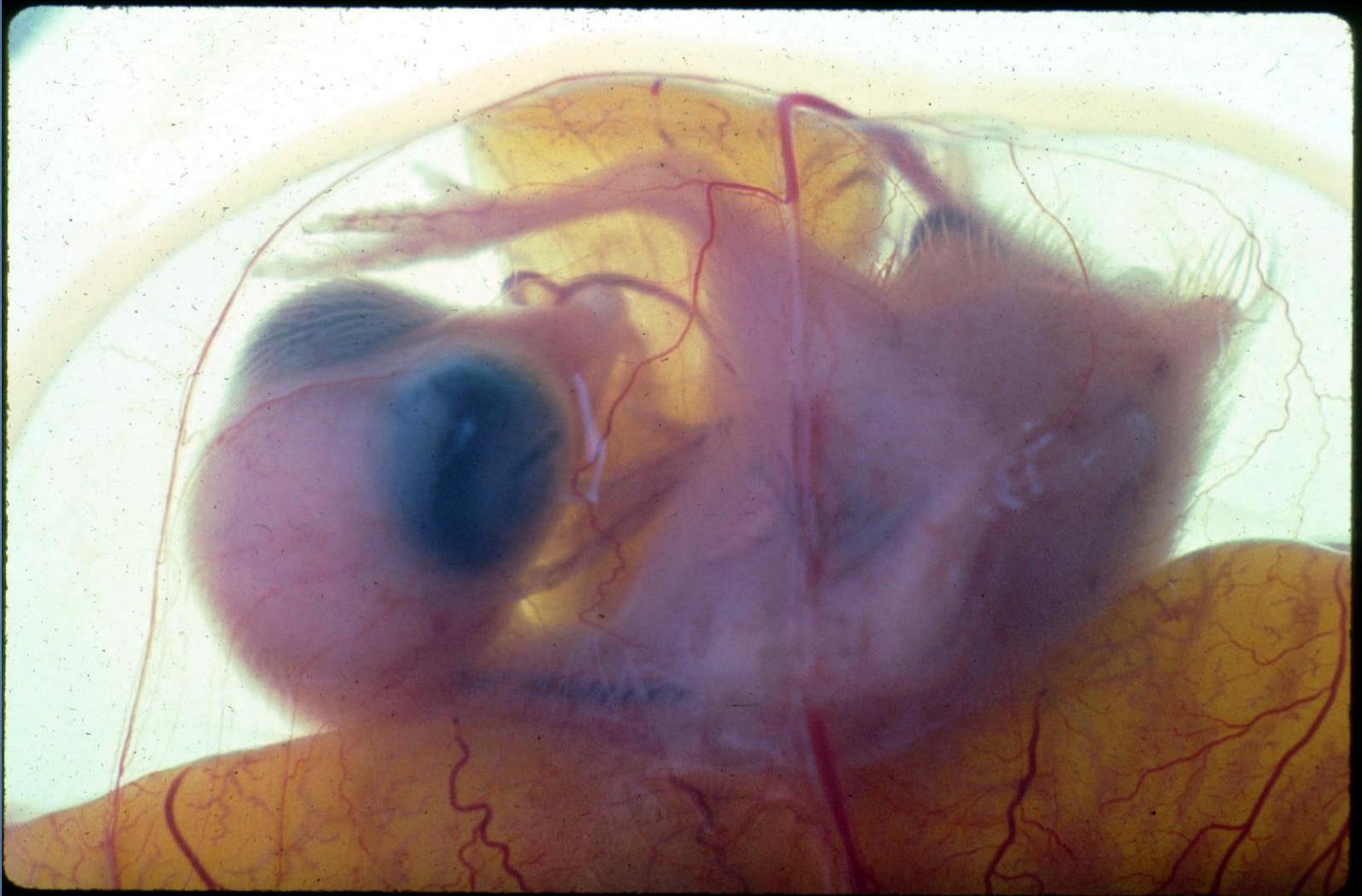
Sub embryonic fluid



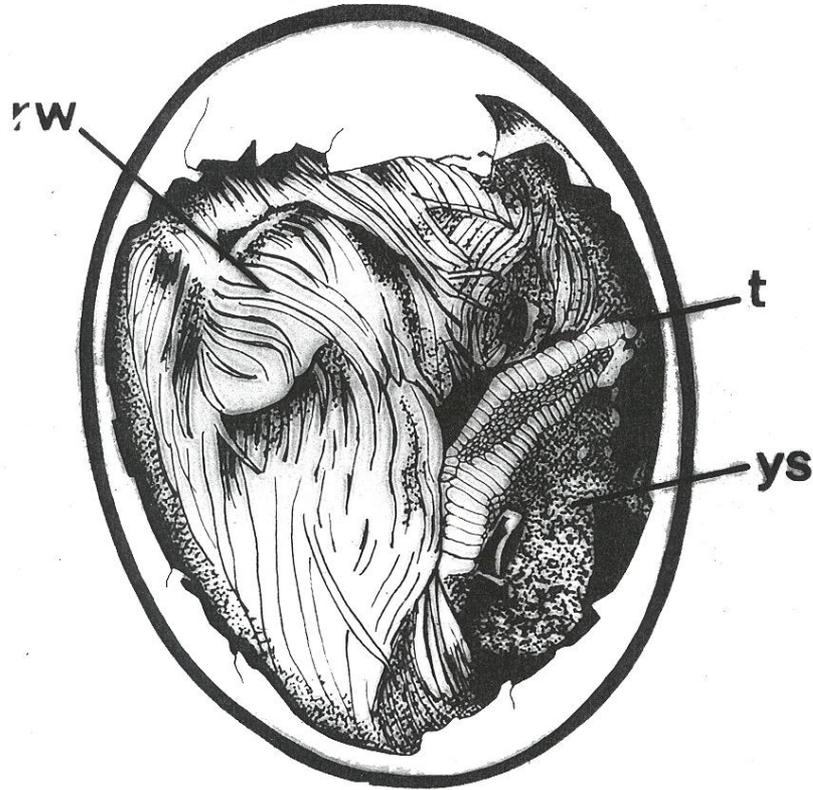


9d embryo, 2 week stored
Frozen



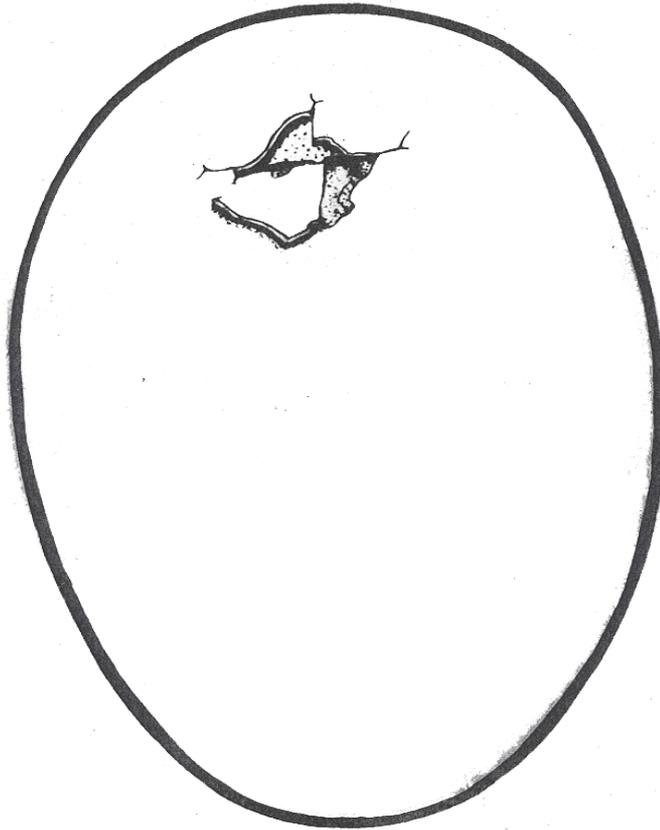


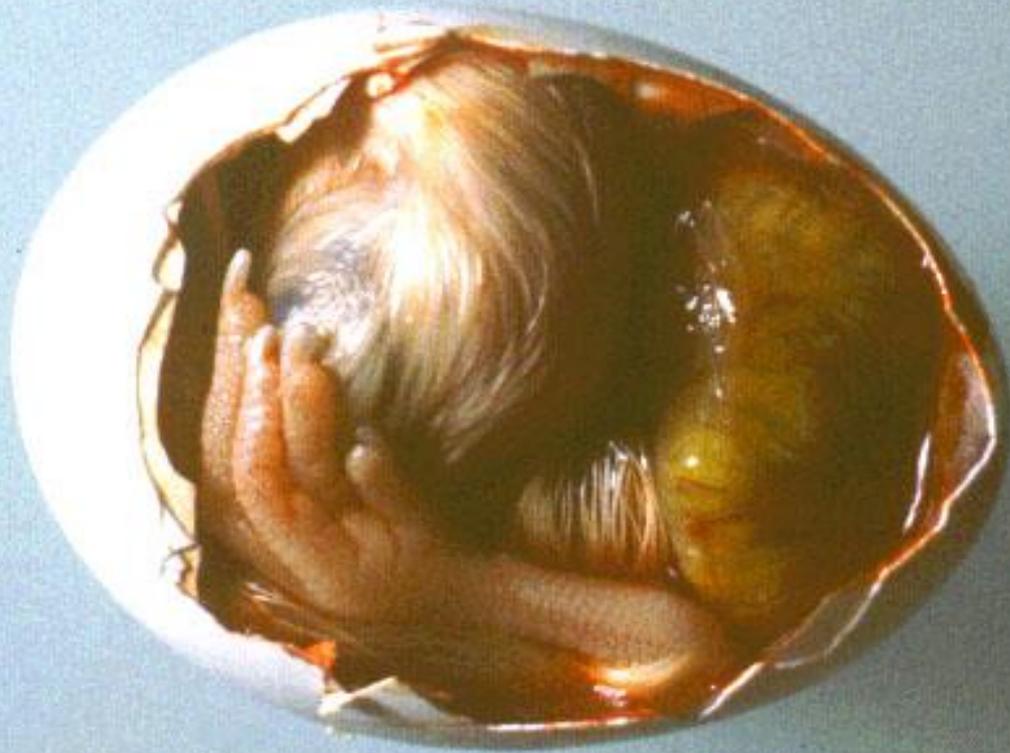
24 Days of Incubation



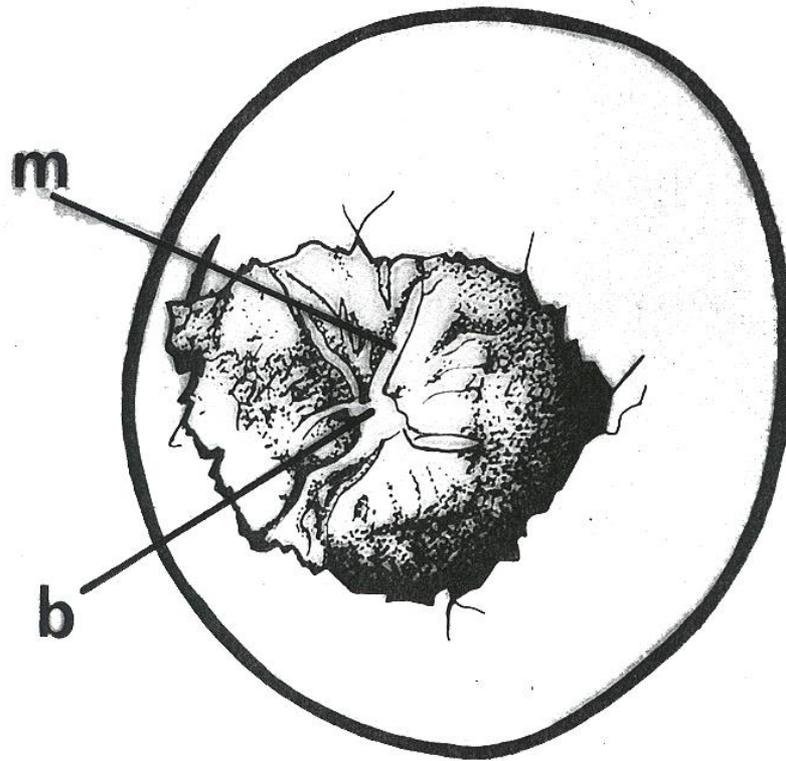
b - beak lw - left wing tl - tail
c - snood m - membrane ts - tarsal joint
k - knee rw - right wing ys - yolk sac

External Pipping





INTERNAL PIPPING





20d internal pipping

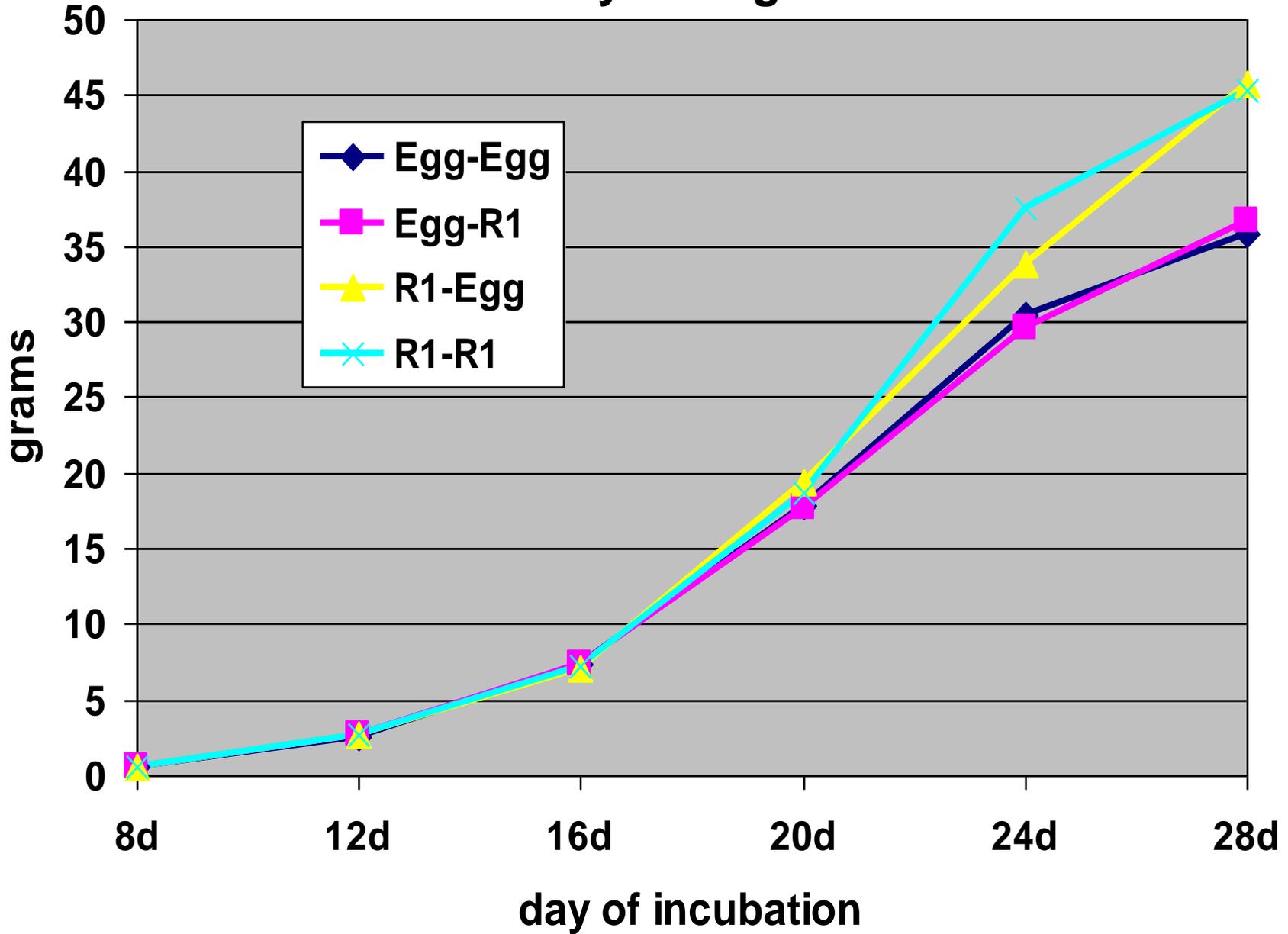




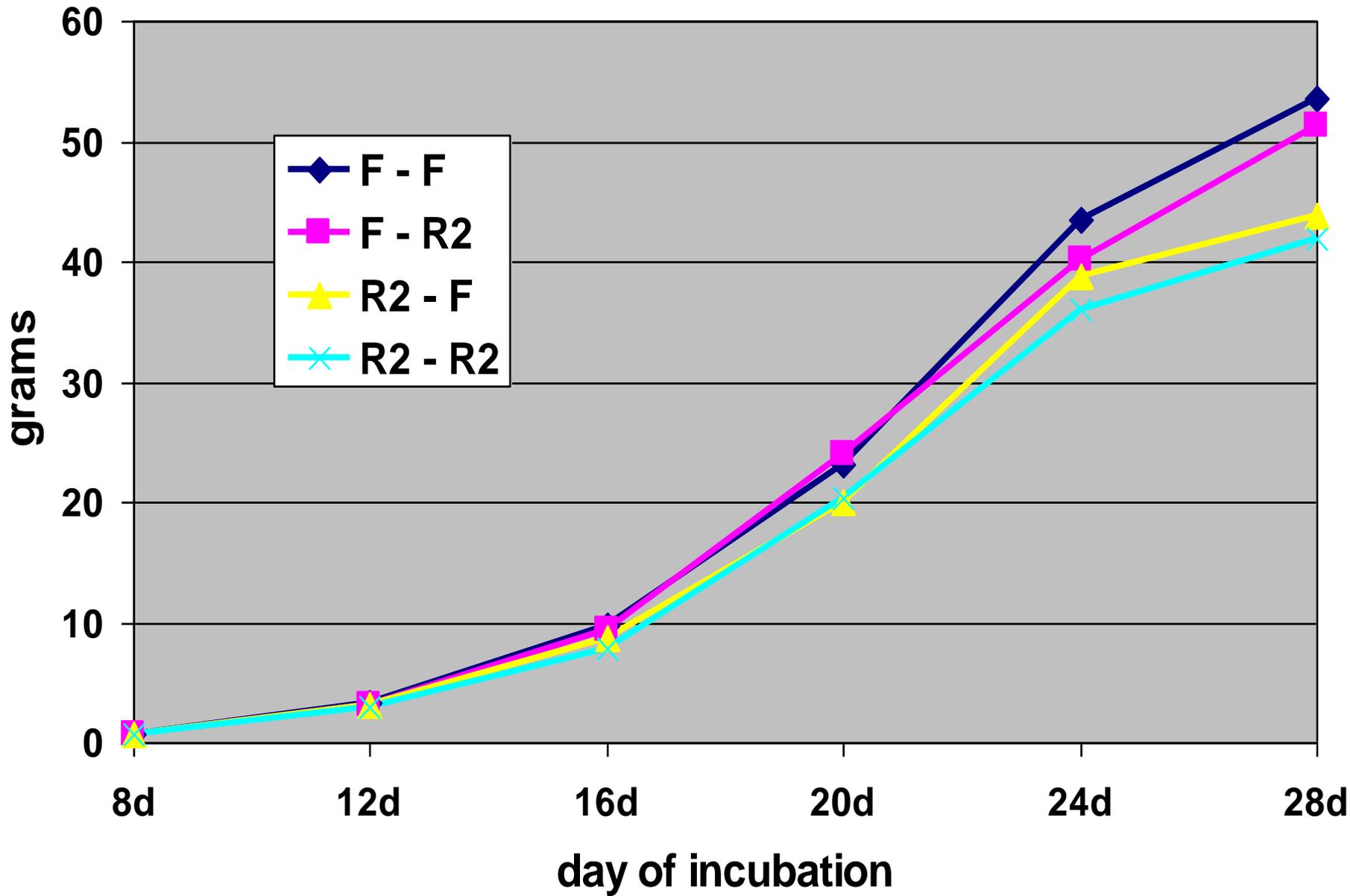
Embryo Growth

- The *Growth* of an embryo is driven by oxygen
- The *Rate of Growth* of an embryo is driven by temperature
- Why not use growth to judge incubation rather than “staging”?

Embryo Weights

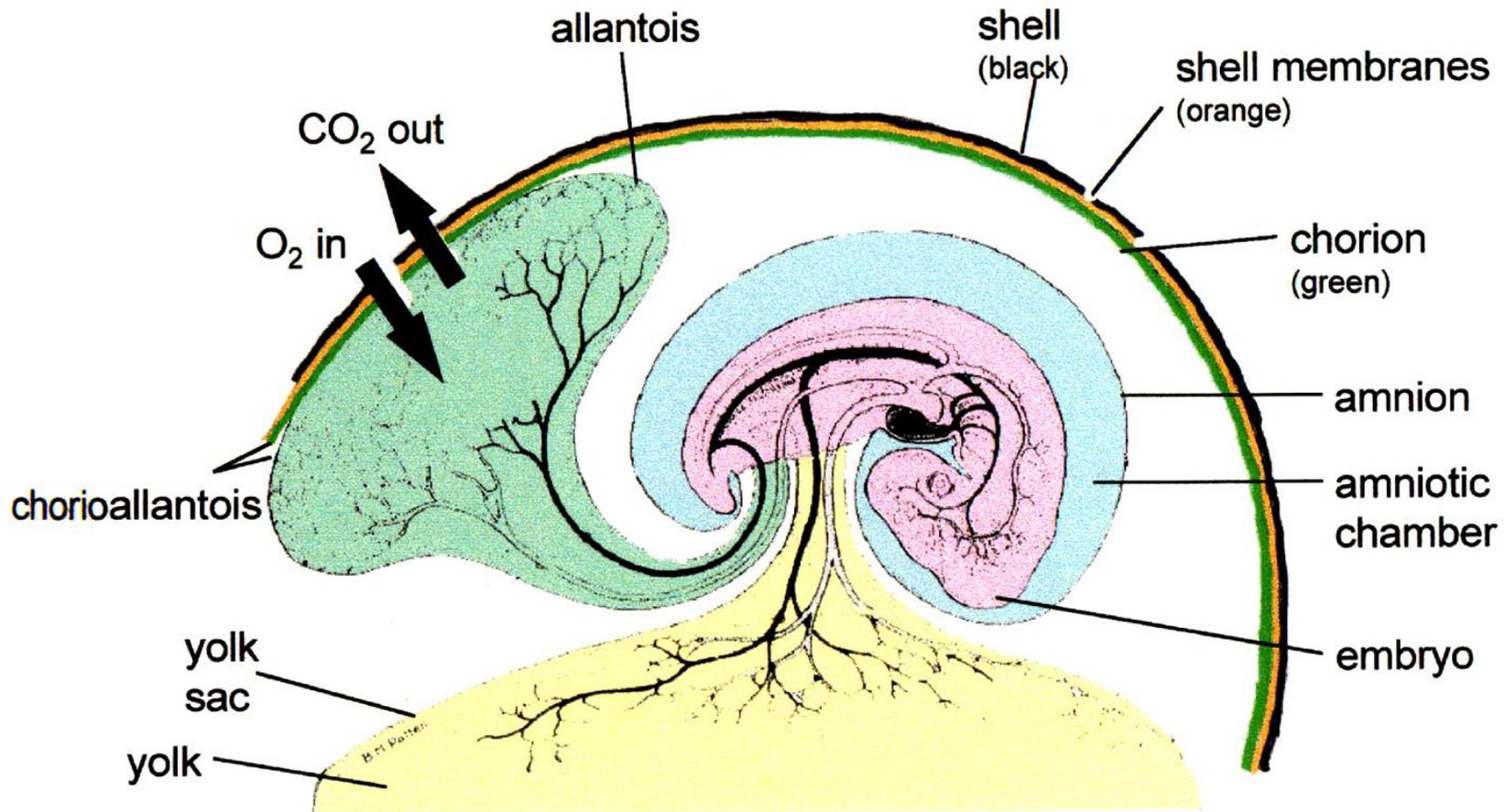


Embryo Weights



Extra-Embryonic Structures

- Chorion
- Amnion
- Yolk sac
- Allantois



Adapted from Patten, 1951

**Water content of the egg
is 67-72 %**

Albumen - 60% of water in egg

Shell and yolk has remainder

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is 67-72 %**

Albumen - 60% of water in egg

Shell and yolk has remainder

Water movement between the egg and the environment

- Physical process, dependent upon humidity of the incubator
 - High vapor pressure(egg) to low vapor pressure
 - Low humidity in incubator = elevated moisture loss
 - High humidity in incubator = low moisture loss
 - Eggshell is resistance to gas flow
 - Eggs usually warmer(embryonic heat) than environment (saturation vapor pressure function of temperature)

Within the egg

- **Water source**
 - **Water of the egg**
 - **Metabolic water produced by embryo**
- **Movement of water within egg because of complicated active and passive processes**

Within the egg

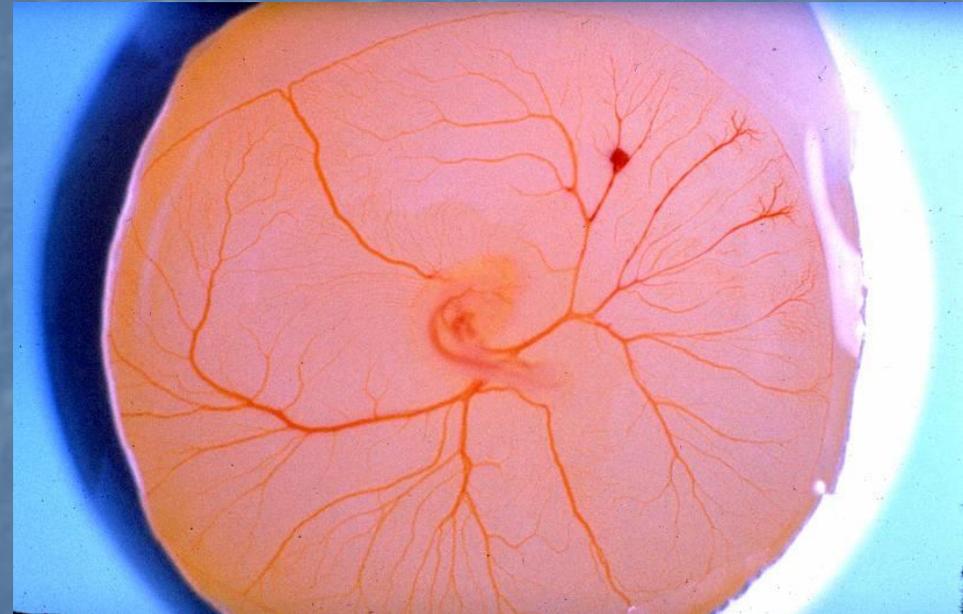
- **Water source**
 - Water of the egg
 - Metabolic water produced by embryo
- **Movement of water within egg because of complicated active and passive processes**

Compartments

- Non embryo
 - Yolk
 - Albumen
 - Shell membranes
 - Shell

Yolk sac membrane

- Vitelline membranes enclose yolk until day 4
- Yolk bounded by yolk sac membrane
 - mesoderm(vascularized 2-3d)
 - endoderm(endocytes)
- vitelline membrane slips down to vegetal pole



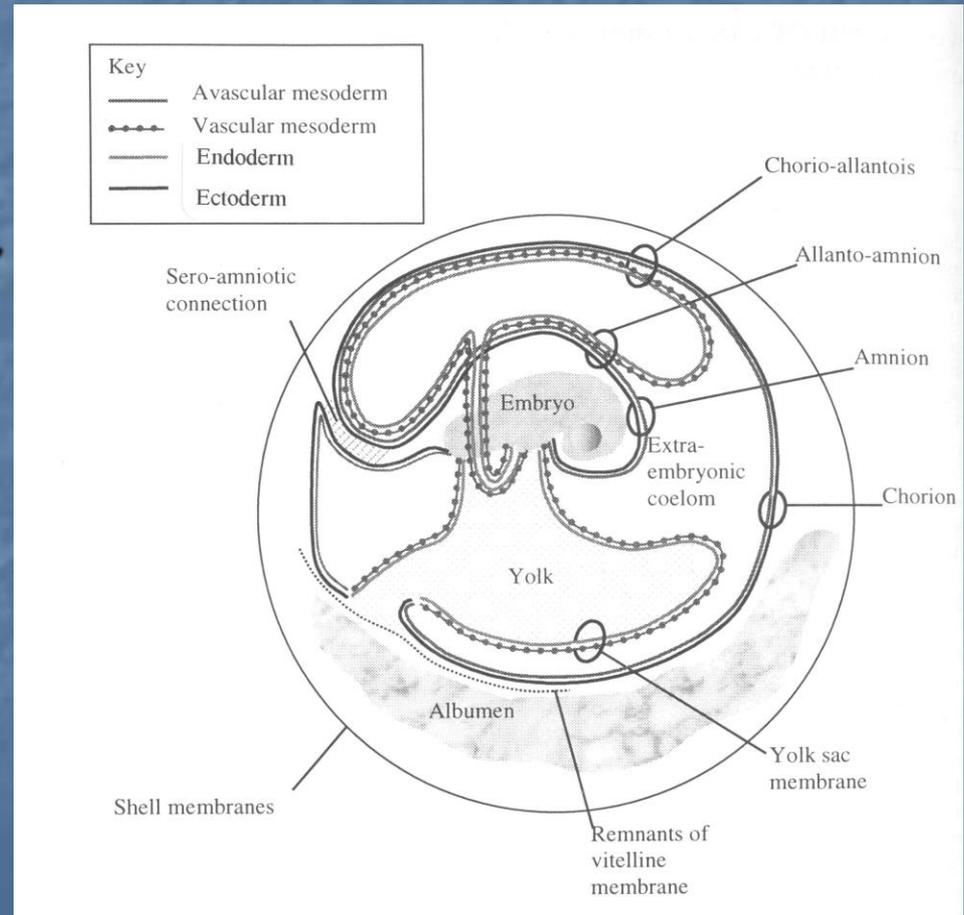
72 hrs.

Yolk sac membrane

- Passes equator at 5-7 days
- Maximum area 10-11 days
- After day 10-11 area of yolk sac membrane decreases
- Day 12 yolk sac becomes 3 flabby lobe mass
- Finally surrounds yolk at 14-15 days

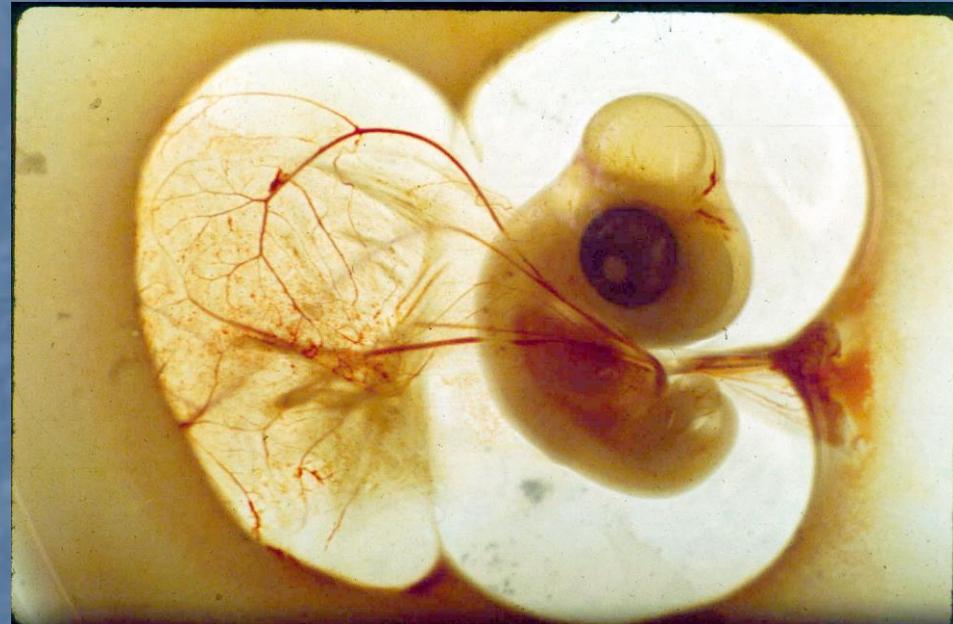
Amnion

- Formed from layer of ectoderm and avascular mesoderm (muscle cells for contraction properties)
- Folds form by day 4



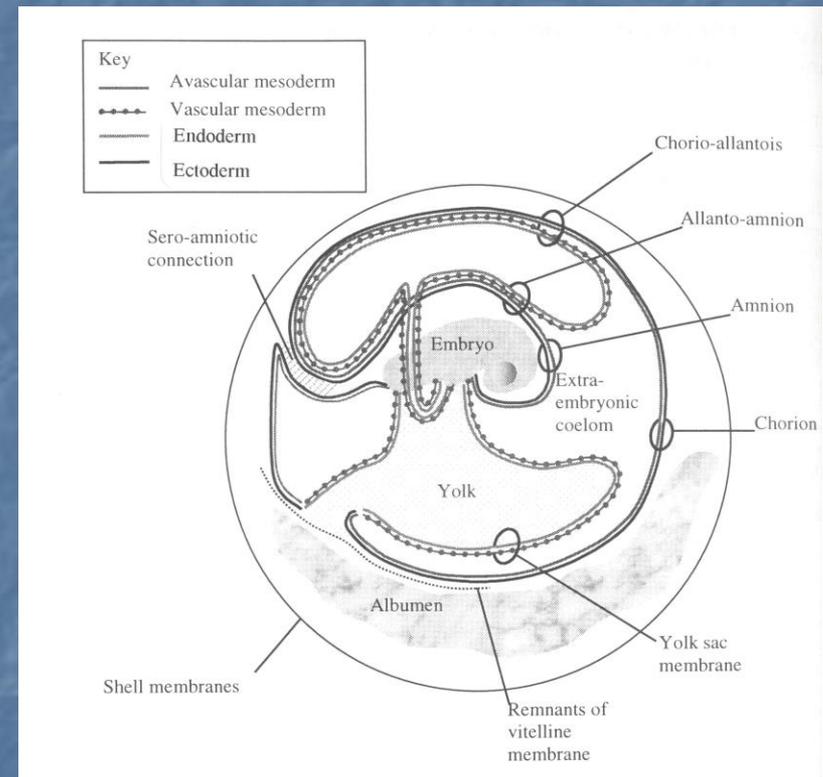
- **Day 12 sero-amniotic connection: a duct develops between the albumen sac and the amniotic sac**
- **Sero-amniotic duct allows the movement of albumen proteins into the amniotic fluid where they can be swallowed and end up in the yolk sac**

Amnion



- Day 2 is a small bud of endodermal cells
- Day 4 as a sac from primitive hindgut
- Inner surface is endoderm, outer surface is vascular mesoderm
- Day 6 vascular mesoderm is fused with chorion to form chorio-allantoic membrane and with the avascular mesoderm of amnion

Allantois

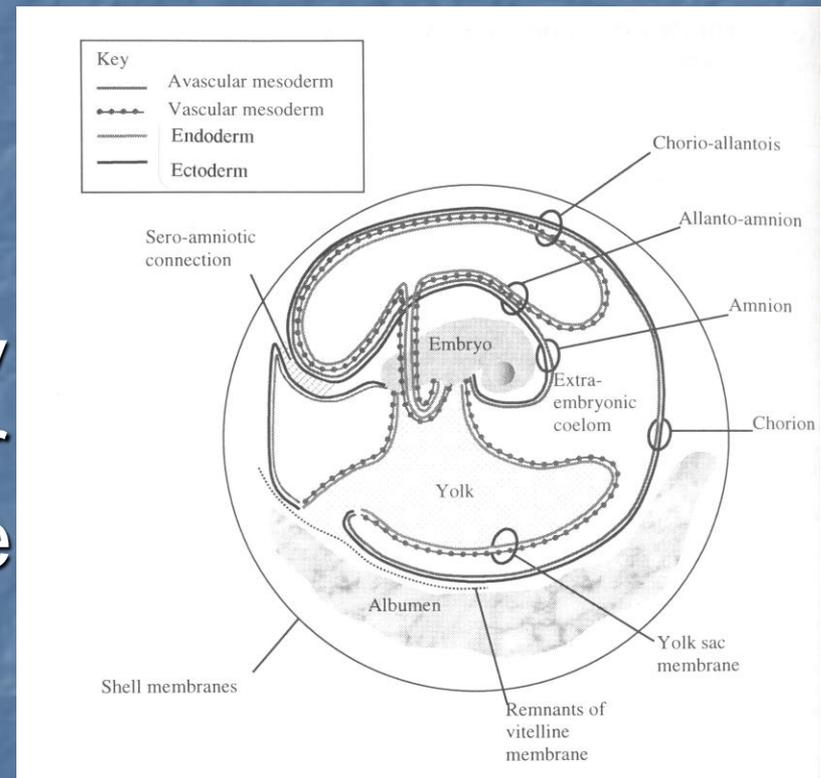


- Eventually fills the extra-embryonic coelom

- Fluid filled

- Respository for kidney excretions that appear by day 5 and enter the allantoic duct from cloacal region of hindgut

Allantois

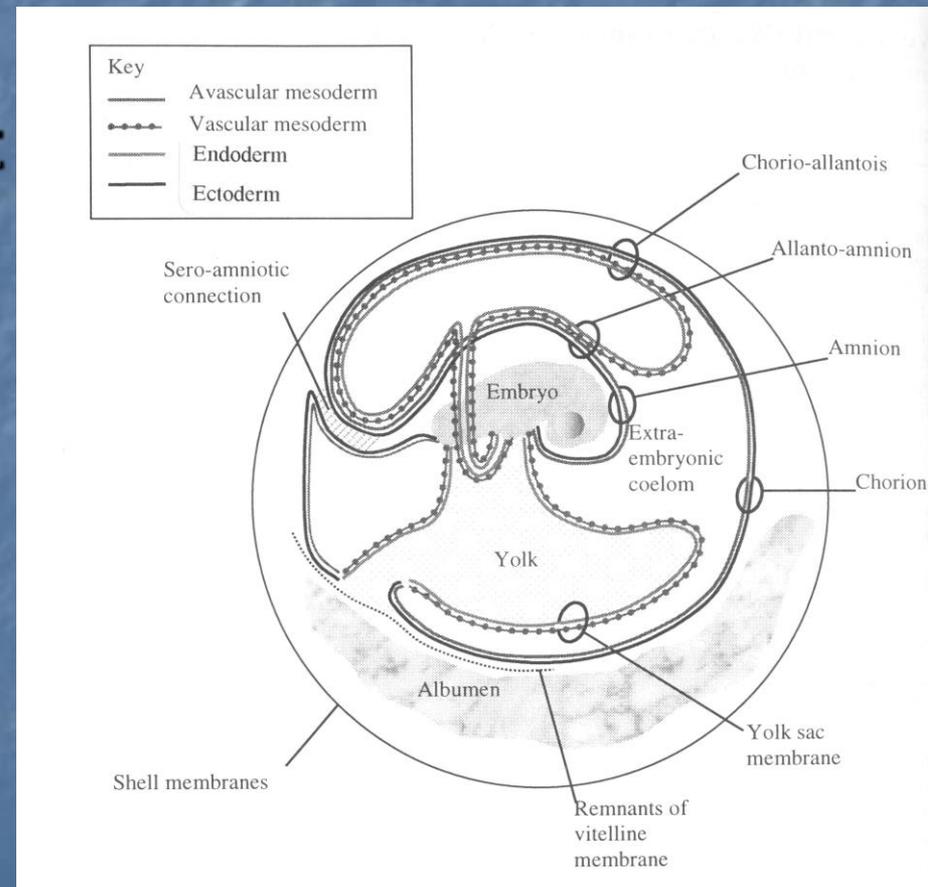


- Develops from tissue continuous with amnion

- Outside layer - ectoderm – adjacent to inner shell membrane

- Inner layer avascular mesoderm lines extra-embryonic coelom

Chorion

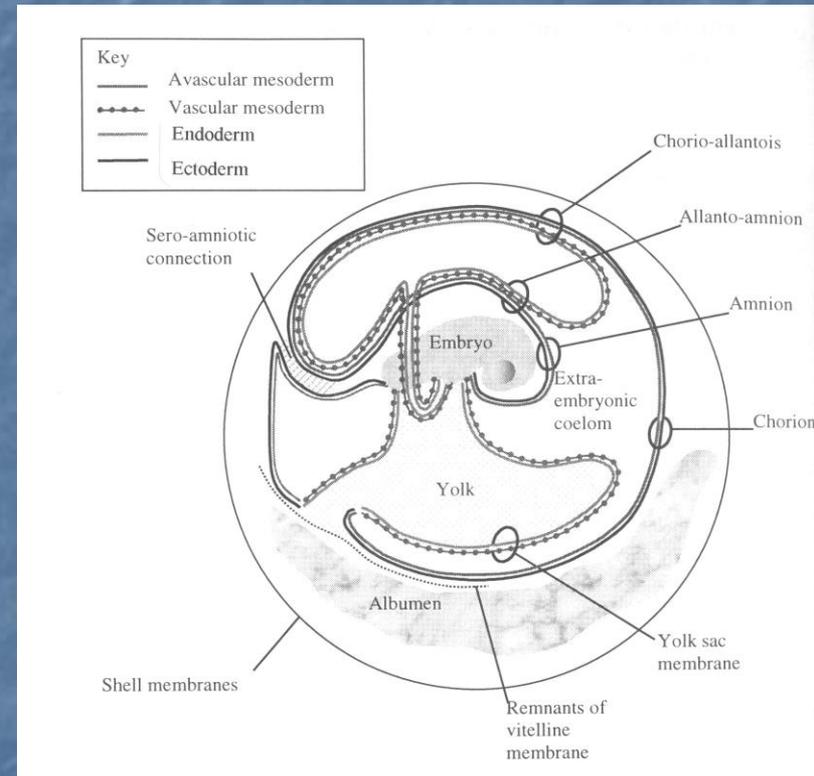


- mesoderm fuses with vascular mesoderm of allantois to form chorio-allantois

- Day 11 allantois completely lines the chorion

- Chorio-allantois covers 98% of the area of eggshell membranes

Chorion



Compartments

Within yolk: Subembryonic cavity/fluid develops during incubation

Sub-embryonic fluid

- A fluid which appears in the yolk sac beneath the embryo
- Noticeable at 2-3 days of incubation reaches maximum at day 6
- Is assumed that water from SEF is distributed to growing tissue (embryonic and extra-embryonic) by vascular system

Sub-embryonic fluid

- Water into yolk sac makes the yolk lighter than albumen and causes it to float to upper surface of egg
 - thus area vasculosa is close to shell membranes
 - improving embryo access to air easier early in incubation
- unturned eggs, yolk sac floats less and sits deeper in albumen

Sub-embryonic fluid

- Critical period for production of SEF
 - 3-7 days
 - Turning: Absence of turning reduces growth of area vasculosa over yolk sac and causes reduced SEF

Amniotic fluid

- Appears later than SEF
- Peak water content on day 13
 - High in chloride ions which are responsible for inflow of water into the amnion
- Function is mechanical protection of embryo

Amnion

- From maximum fluid, the fluid declines slightly until day 15
- Rises again (influx of albumen through sero-amniotic connection)
- Decreases to zero during last few days

Amniotic fluid

- Absence of turning decreases mass of amniotic fluid (d12-18) (less albumen entering the amnion via the sero-amniotic connection)
- By mid incubation the volume of albumen is greater in unturned than turned eggs (less movement into SEF)(amnion??)

Amnion

- Amniotic fluid volume is unaffected by hydration status of egg
- Subnormal incubation temperatures cause a slight delay of a day or two in the accumulation of maximum fluid amount
- Too high a temperature starts the intermediate decrease sooner but then a precipitous rise to greater than normal

Allantoic fluid

- Maximum fluid content is day 15
- Source of this fluid is blood filtered by embryonic kidney
- Not influenced much by not turning

Allantoic fluid

- Excretory nitrogen (ammonia, urea & uric acid) present on day 5
- Primarily is uric acid that increases as development proceeds

Allantoic fluid

- **Ionic composition of allantoic fluid determined**
 - by capacity of allantoic membrane to reabsorb water and ions
 - the composition of urine flowing in from kidney
 - interactions between excretory uric acid and ions in the fluid (solid uric acid sequesters sodium ions)
- **under dry incubation conditions**
 - uric acid excretion is increased
 - allantoic fluid contains more solid uric acid and more sodium ions are removed from the fluid
 - Resulting in increased potential for water resorption into the blood across the allantoic membrane)

Allantoic fluid

- Incubation temperatures
 - >37.5 or at 34.5 the fluid is less than normal volume and disappears sooner
 - At 35.5 is present in normal amount but may persist in measurable quantity until day 21

Allantoic fluid

- Incubation temperatures
 - Fluid accumulates more rapidly at elevated temperatures
 - Fluid accumulates more slowly at sub optimal temperatures

Malpositions

- Head between the thighs
- Head under right wing
- Upside down
- Head over wing

18d hbl

19 d urw

20 d urw



19d urw



Embryology of the Chick

- Functional properties of eggshells
- Incubation periods of chicks
- Breed and age differences
- Conductance constant k ?

Hatchery Related Problems

- Dehydrated chicks
- Weak chicks
- Large, soft-bodies chicks
- Rough navels
- Omphalitis
- Chick delivery

Hatchery Related Problems (Continued)

- Poult grading
- Nutritional deficiencies
- Irregular-sized chicks

Dehydrated Chicks

■ Causes

- Low humidity during incubation
- Early hatching
- Long holding period

■ Remedies

- Easy access to H₂O
- Correct brooding temperature

Weak Chicks

- Causes
 - High incubation temperature
 - Inadequate ventilation
 - Over fumigation
 - Infection
 - Rough handling
 - Old eggs
- Remedy
 - Improved brooder care

Large, Soft Bodied Chicks

- Cause
 - High humidity during incubation
- Remedy
 - Keep chicks active

Rough Navels

- Causes

- Late hatching
- High temperatures

- Remedy

- Chicks should be given antibiotic to prevent infection

Omphalitis

- Cause
 - Unsanitary hatchery conditions
- Remedies
 - Administer selective antibiotic
 - Cleanup hatchery

Chick Delivery

- Causes
 - Overheating in delivery truck
 - Chilling in delivery truck
 - CO₂ or CO poisoning
- Remedy
 - TLC

Improper Hatchery Servicing

- Causes
 - Quality Control Problems
 - Sanitation
- Remedies
 - Hold poult overnight
 - Antibiotic injections

Chick Grading Problems

- Cause
 - Improper grading at the hatchery

- Remedy
 - Remove all abnormal chicks

Nutritional Deficiencies

- Cause

- Marginal nutrition in breeder diets

- Remedies

- Consult a reliable nutritionist
- Feed poults a nutrient fortified diet

Irregular Sized Chicks

■ Causes

- Different age breeder flocks
- Incubator temperature or humidity

■ Remedies

- Reduce number of poults per feeder
- Closely control brooder temperature

Egg Handling Prior to Incubation (Continued)

- Temperature
- Cracks
- Transportation

Artificial Incubation of Eggs

- Five Basic Principles of Incubation
 - Temperature
 - Humidity
 - Turning
 - Ventilation
 - Light and Sound