



**TO**  
**Hatchery Management**  
**ONLINE TRAINING**

**Dr Balai Chandra Dutta**

<https://sites.google.com/view/drbaichandradutta/home>

# DEVELOPMENT STAGE of CHICKEN EMBRYO to DOC



504  
Hours



20-09-2020

Dr B C Dutta

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# **DEVELOPMENT STAGE of CHICKEN EMBRYO to DOC**

- The development of the chick begins in the single cell, the zygote formed by the union of two parental cells, egg & sperm in the process of fertilization.
- Within 5 hours after fertilization the zygote enters the isthmus and it is here that the new embryo starts to develop by simple cell division.



- By the time the egg leaves the isthmus, the zygote, now called the blastoderm or embryo, comprises eight cells and after four hours in the uterus it has grown to 256 cells.
- At the time of laying the small whitish blastoderm or germinal disc, accumulation of hundreds of cells is easily seen on the surface of the yolk

# **DEVELOPMENT STAGE of CHICKEN EMBRYO to DOC**

## **Formation of ectoderm, endoderm and mesoderm**

- **Initially the dividing cells form one layer over the yolk, but as cell division continues two layers are formed. These are called the ectoderm (upper) and the endoderm (underneath) layers.**
- **At this stage the central cells of the blastoderm separate from their contact with the yolk to form a cavity, where subsequent embryo development occurs.**
- **Soon after the formation of the ectoderm and endoderm, a third layer of cells called the mesoderm, or middle layer, is formed.**

**From here, the organs & tissues of the chicken will develop from these three layers of cells.**

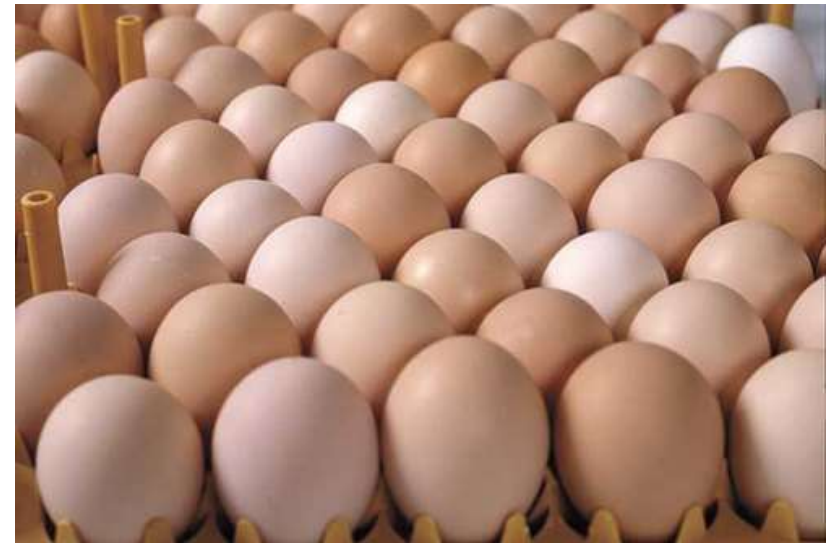
- **The ectoderm produces the nervous system, parts of the eyes, feathers, beak, claws & skin.**
- **The endoderm produces the respiratory system, the digestive system and secretory organs.**
- **The mesoderm produces the skeleton, muscles, circulatory system, reproductive organs and excretory system**
- **Another important development at this stage is the way the cells change to allow the production of the different types of cells that make up the tissues.**
- **By the time the egg is laid the embryo consists of many cells differentiating into the various tissues, organs and body systems**

# DEVELOPMENT STAGE of CHICKEN EMBRYO to DOC



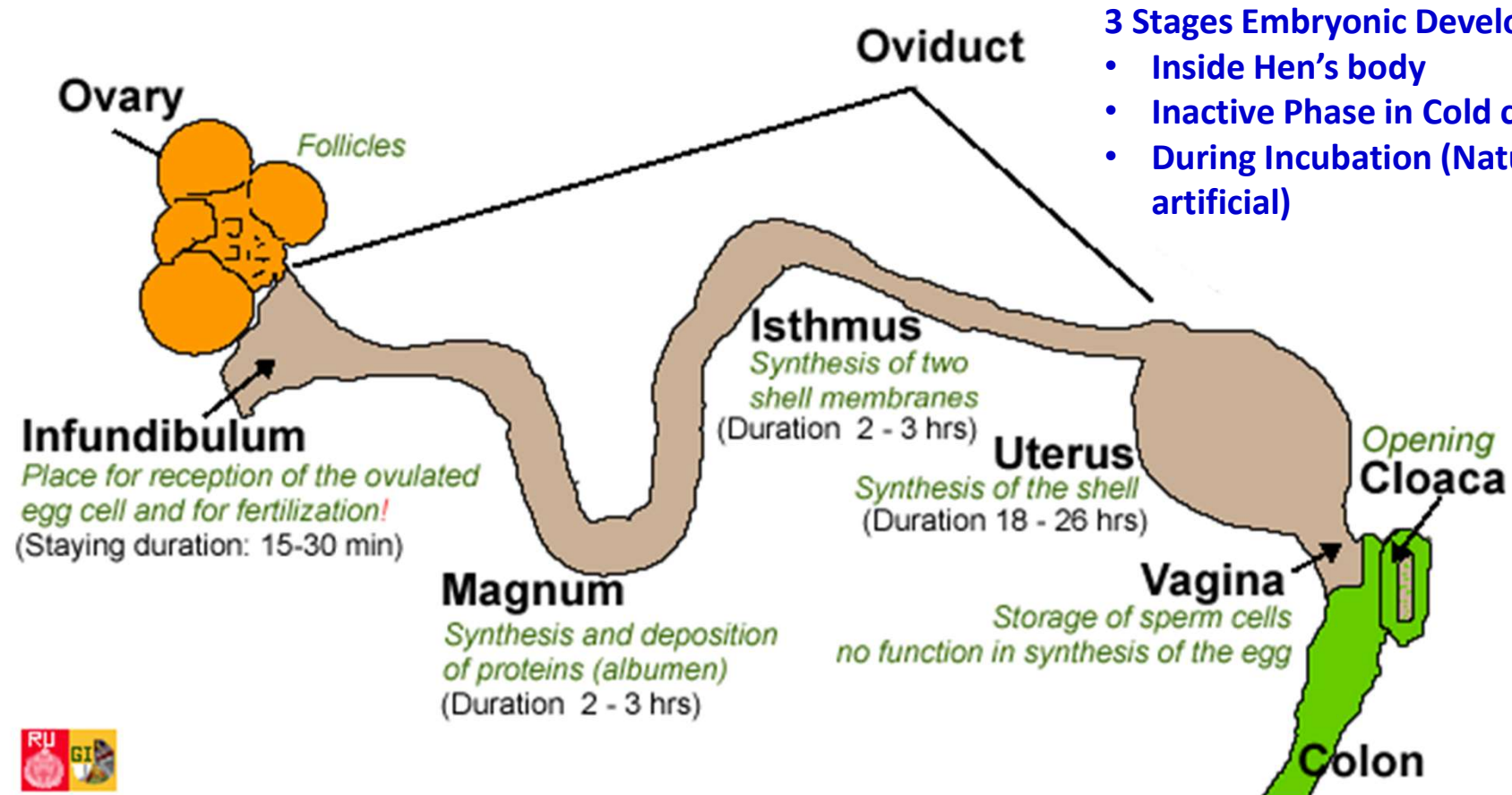
20-09-2020

- Ambient temperature has characteristic influence of on embryonic development of bird during the post laying period. When the temperature of the egg below 20°C, the embryo becomes dormant and development stops (Inactive Embryonic life). When the temperature rises above 20°C, embryonic activity re-initiates. This 20°C Temperature where embryonic activity starts or stops is referred to as a physiological Zero
- Cooling the egg after it is laid does not result in the death of the embryo.
- It may resume its development after few days of rest if it is again heated by the hen or in an incubator



Dr B C Dutta

# DEVELOPMENT STAGE of CHICKEN EMBRYO to DOC



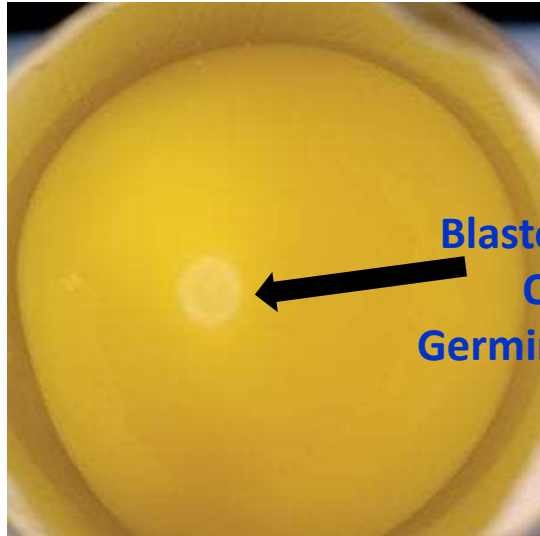
## 3 Stages Embryonic Development

- Inside Hen's body
- Inactive Phase in Cold climate
- During Incubation (Natural or artificial)

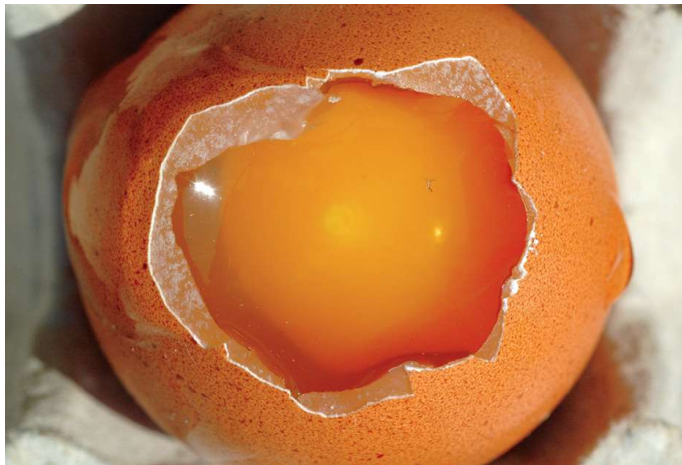


Hen's body takes 25 – 27 hours to transform a yolk into a fully developed egg and lay that egg

# FERTILE & INFERTILE EGG



Blastoderm  
OR  
Germinal Disc



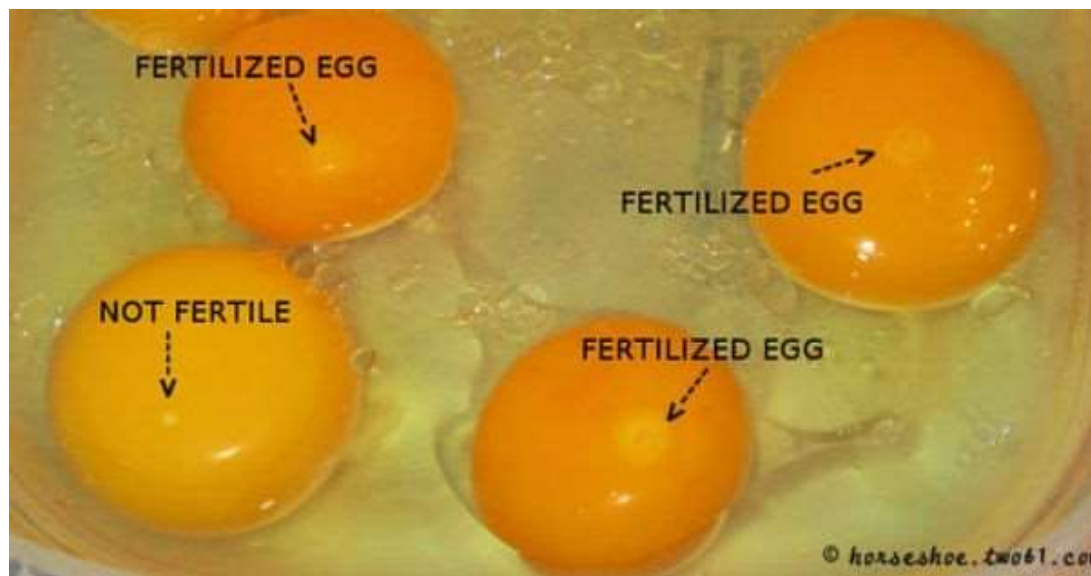
**Infertile Un-Incubated Egg**  
Blastodisc on top of yolk, irregular in shape, an accumulation of white material at it's centre



**Fertile Un-Incubated Egg;**

- Blastoderm larger, regular in shape and has a “donut-appearance”
- Embryonic disc looks like a ring; central area lighter in colour, which is to house the Embryo

# FERTILE & INFERTILE EGG OF CHICKEN

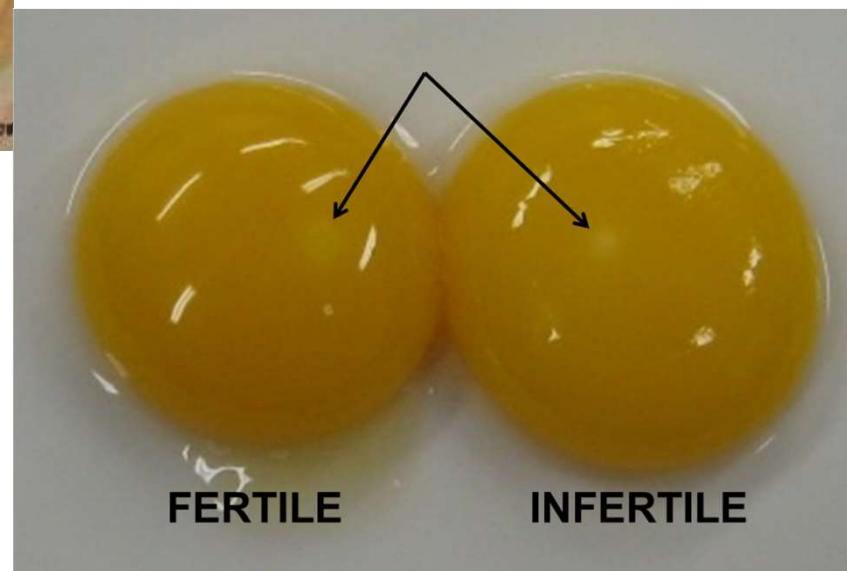


## Infertile Un-Incubated Egg

Blastodisc on top of yolk, irregular in shape, an accumulation of white material at it's centre

## Fertile Un-Incubated Egg;

- Blastoderm larger, regular in shape and has a “donut-appearance”
- Embryonic disc looks like a ring; central area lighter in colour, which is to house the Embryo





Incubator Temperature: 99.5° F

Incubator Humidity 58%

## **DEVELOPMENT STAGE of CHICKEN EMBRYO to DOC**

### **DAY 1**



- Greatly enlarged “Donut-shape” embryo lies within the donut ring
- Appearance of Tissue development



- 16 hours - first sign of resemblance to a chick embryo
- 18 hours - appearance of alimentary tract
- 20 hours - appearance of vertebral column
- 21 hours - beginning of nervous system
- 22 hours - beginning of head
- 24 hours - beginning of eye

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 2



**25 hours - beginning of heart**

**35 hours - beginning of ear**



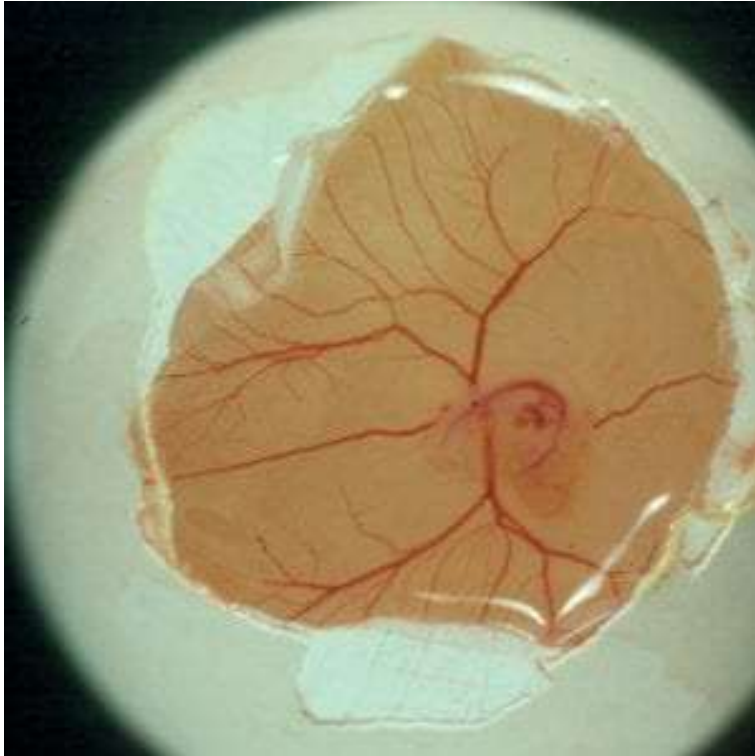
- Tissue development clearly visible
- Blood appears as “blood islets” in outer ring of developing embryo
- Appearance of Vitelline membrane which is going to play a major role in embryo nutrition

Incubator Temperature: 99.5° F

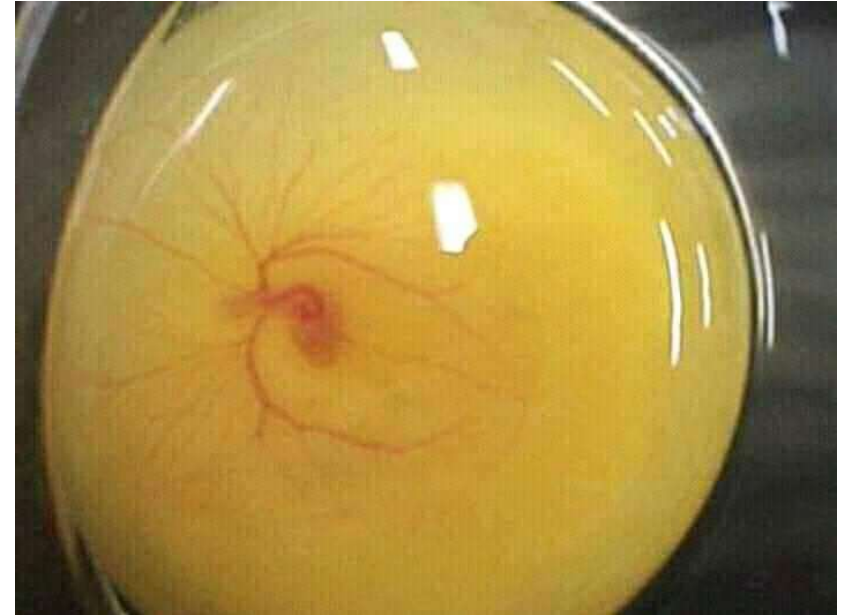
Incubator Humidity 58%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 3



**60 hours - beginning of Nose**  
**62 hours - beginning of Legs**  
**64 hours - beginning of Wings**



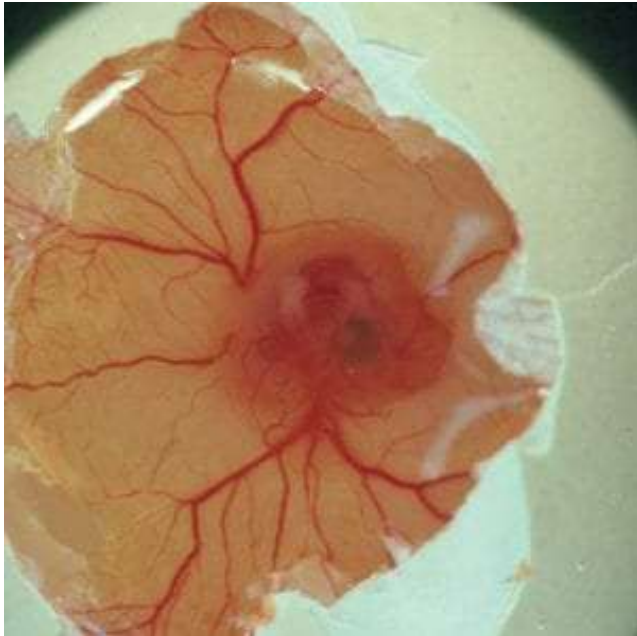
- **Heart beats clearly detectable**
- **Blood vessels very visible**

Incubator Temperature: 99.5° F

Incubator Humidity 58%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 4



- Development of Amniotic cavity, which will surround the embryo; filled with amniotic fluid, to protect the embryo and allow it to move

- Appearance of Allantoic vesicle; it plays a major role in calcium resorption, respiration and waste storage
- Eye pigmented
- Brain to body size relation noticeable

Incubator Temperature: 99.5° F

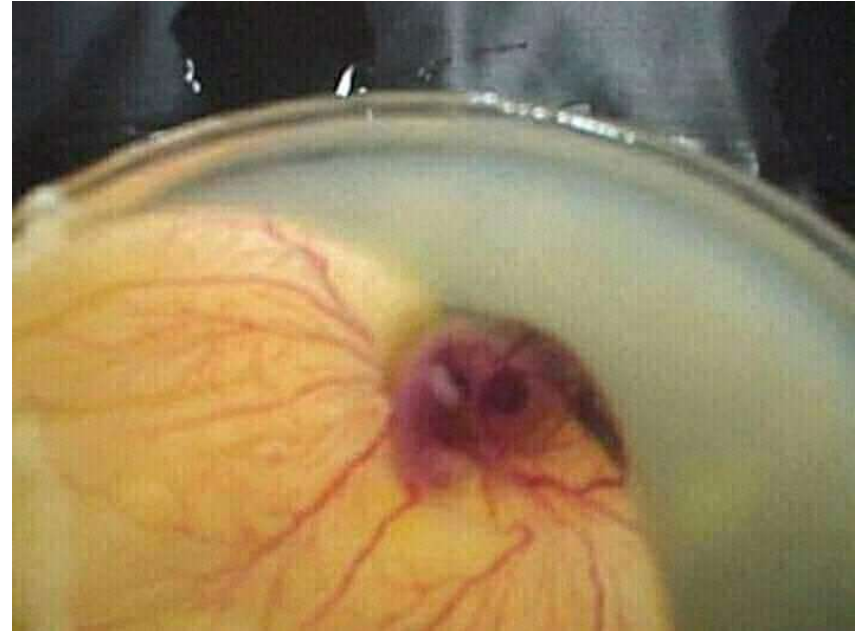
Incubator Humidity 58%

## **EMBRYONIC DEVELOPMENT OF THE CHICKEN**

### **DAY 5**



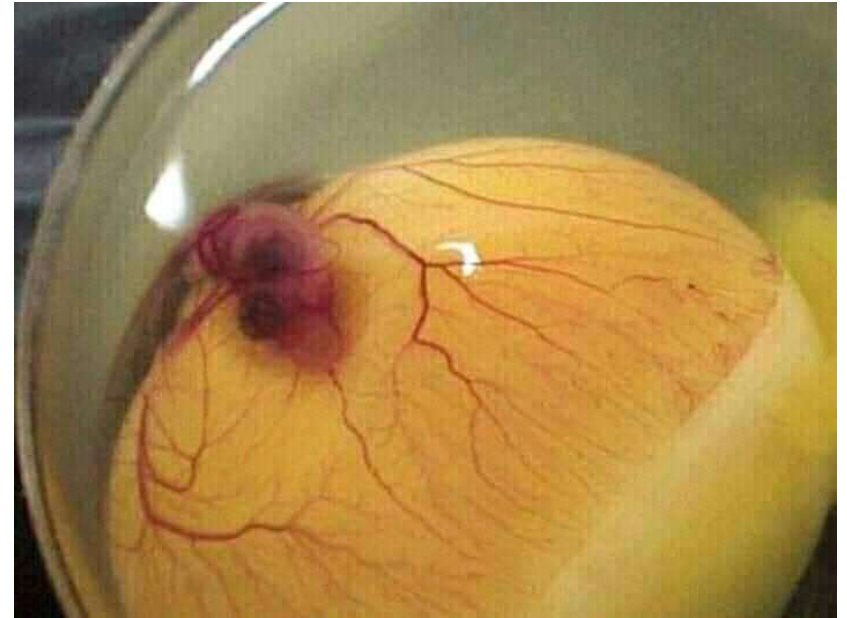
- Extension of limbs; appearance of elbows & knees
- Brain continues to develop at rapid rate



**Sensible increase in the embryo's size; the embryo takes a C shape, the head moves closer to the tail**

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 6



**Vitelline membrane continues to grow and now surrounds more than half of the yolk**

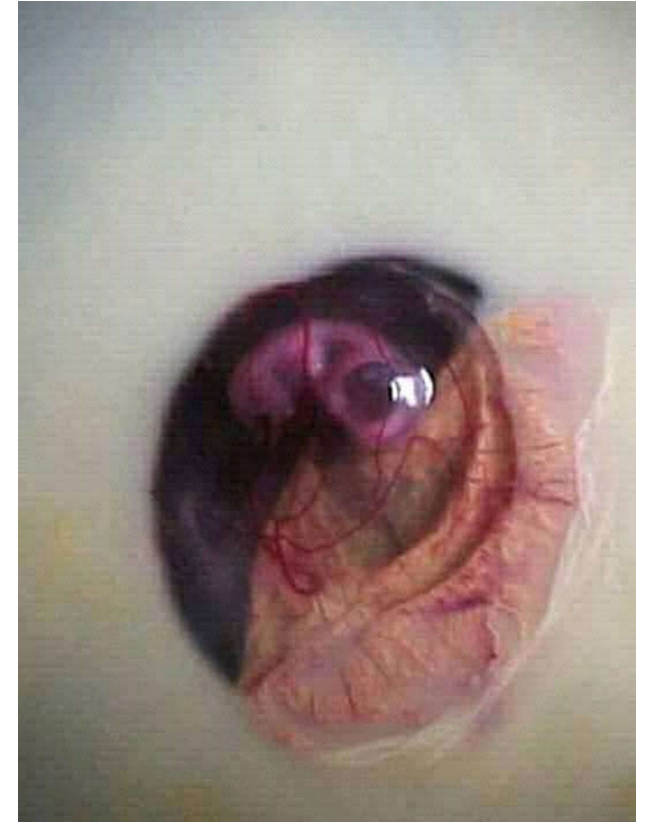
- **Appearance of beak**
- **Voluntary movement Begins**
- **Wing development rapid**
- **Development of egg tooth begins.**
- **Fissure between fingers of limb develops**

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 7



- Thinning of Neck which now clearly separates the head from the body
- The brain progressively grows smaller proportionally to the embryo size



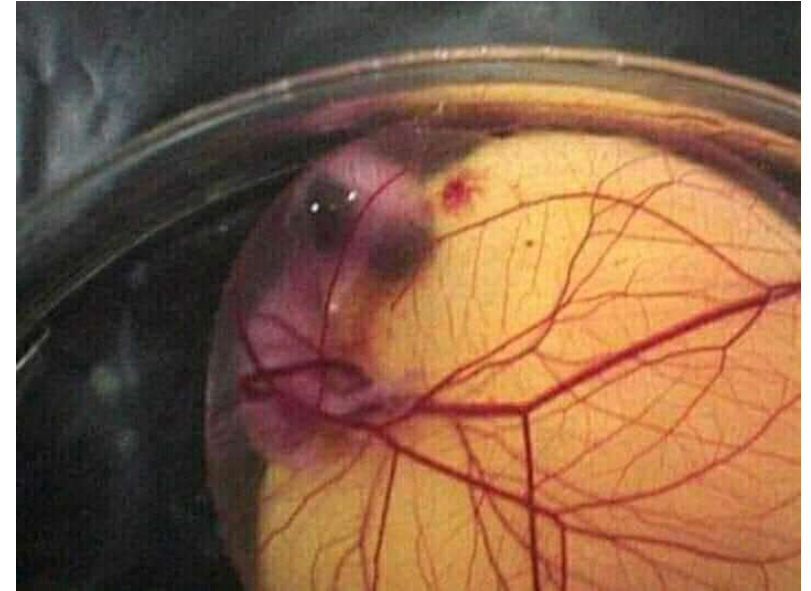
- Comb growth begins
- Egg tooth seen on tip of beak
- Eyes very conspicuous

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 8



- The Vitelline membrane covers almost the entire yolk
- The neck stretches and the brain is completely settled in it's cavity



- Feather tracts seen on the back.
- Wings, feet, toes well developed.
- Upper and lower beak equal in length

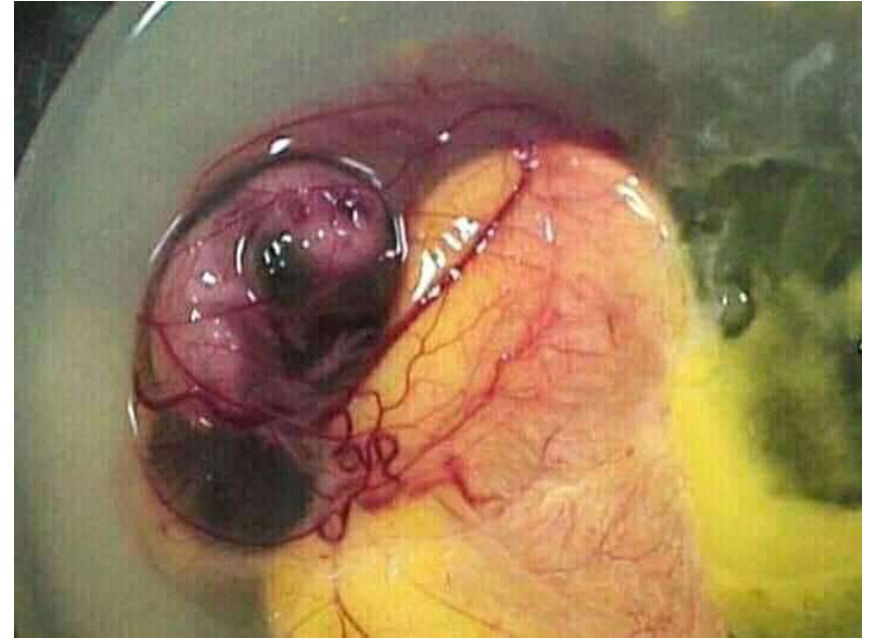


Incubator Temperature: 99.5° F

Incubator Humidity 58%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 9



- Embryo starts to look bird - like
- Growth of allantois
- Mouth opening appears
- Beginning formation of feathers
- Appearance of Claws

Incubator Temperature: 99.5° F

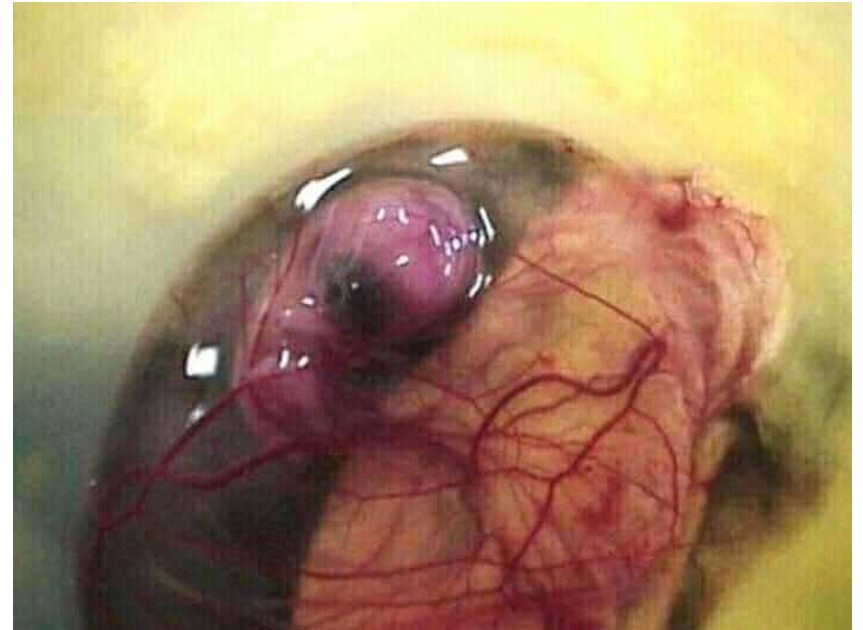
Incubator Humidity 58%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 10



- Down Feathers appear
- Hardening of beak & Toe nails
- Egg tooth Prominent

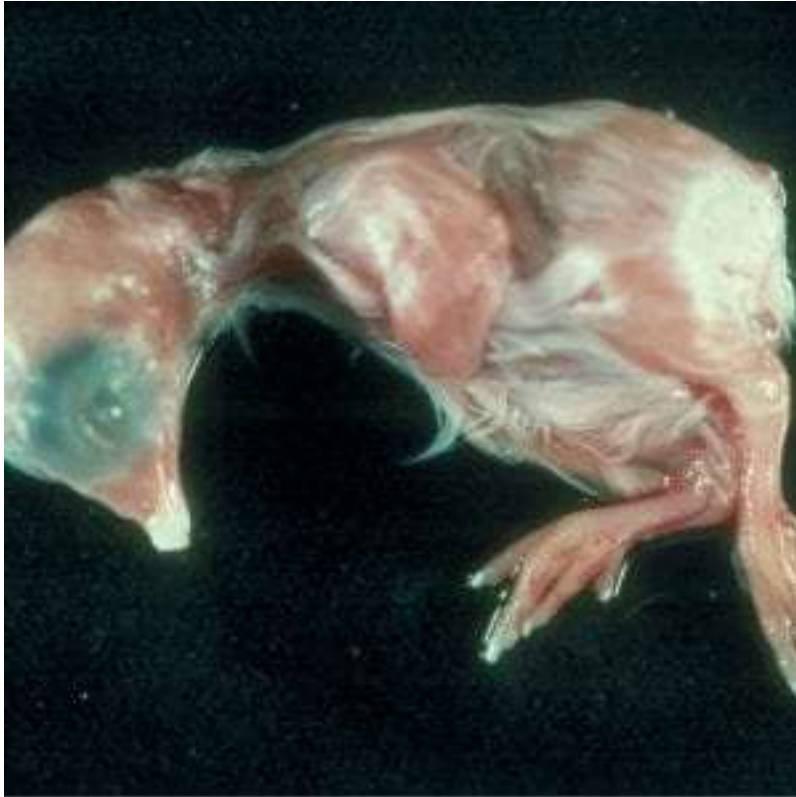


- Nostrils are present as narrow apparatus
- Growth of Eyelids
- Vitelline membrane completely surrounds the yolk

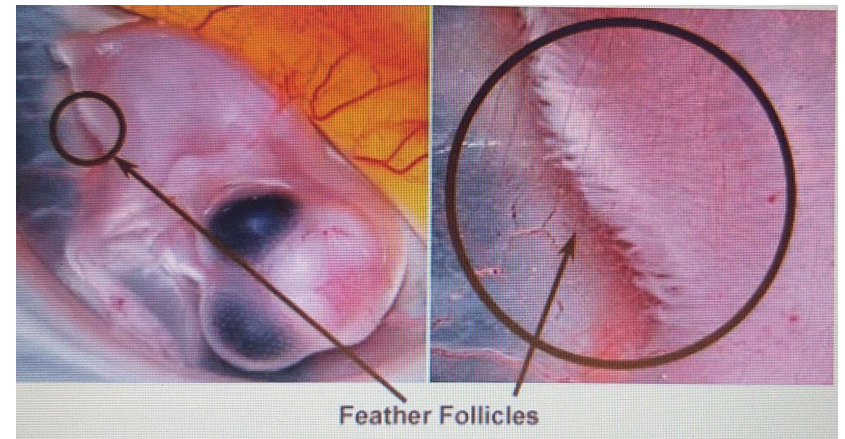
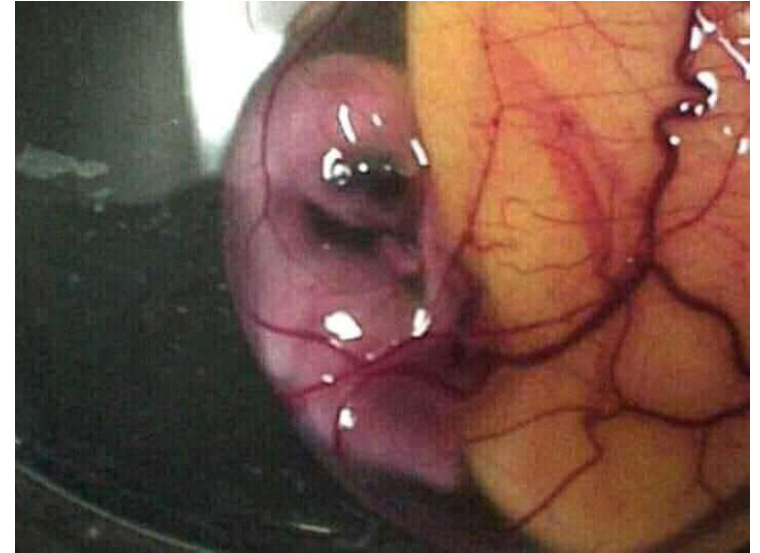
# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 11

The Allantois reaches its maximum size while the vitellus begins to shrink

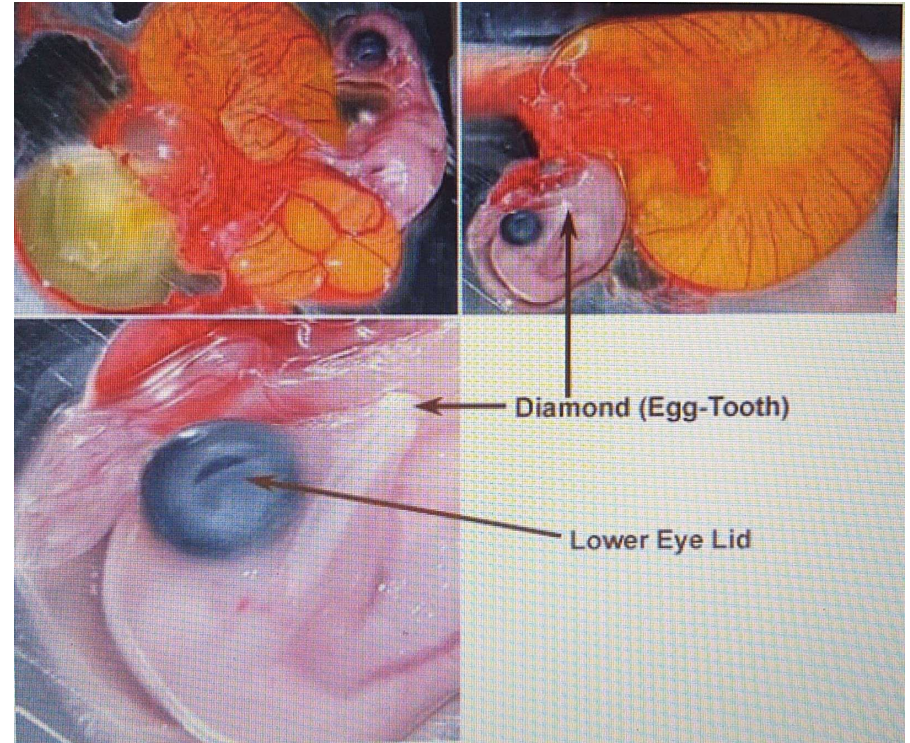


- Eyelids have overgrown eyes
- Comb serrated
- Tail feathers apparent



# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 12



- Calcification of bone started.
- Toe nails fully formed
- Down feathers on neck, thighs and wings
- Feather follicle covers the upper eyelid
- The lower eyelid covers 2/3 or even 3/4 of the cornea

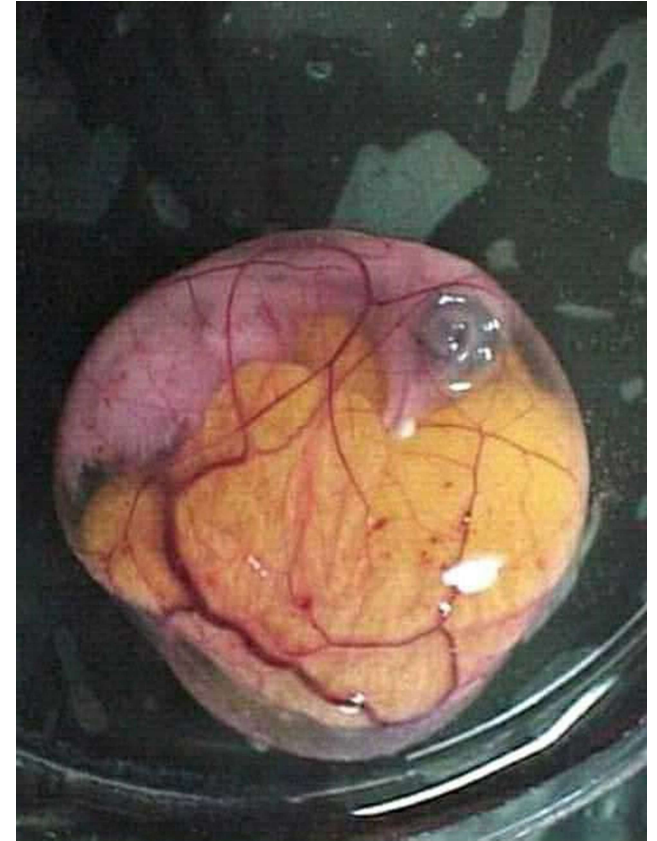
# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 13



Allantois fuses with chorion completely to become Chorioallantoic membrane

- Comb and Wattles Noticeable
- Appearance of Scales on legs
- Body covered lightly with feathers



Incubator Temperature: 99.5° F

Incubator Humidity 58%

# **EMBRYONIC DEVELOPMENT OF THE CHICKEN**

## **DAY 14**



- Embryo acquires a more chick-like appearance
- Embryo turns head towards large end of egg

Incubator Temperature: 99.5° F

Incubator Humidity 58%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 15



- Gut is drawn into abdominal cavity
- Remaining yolk sac begins entering body cavity



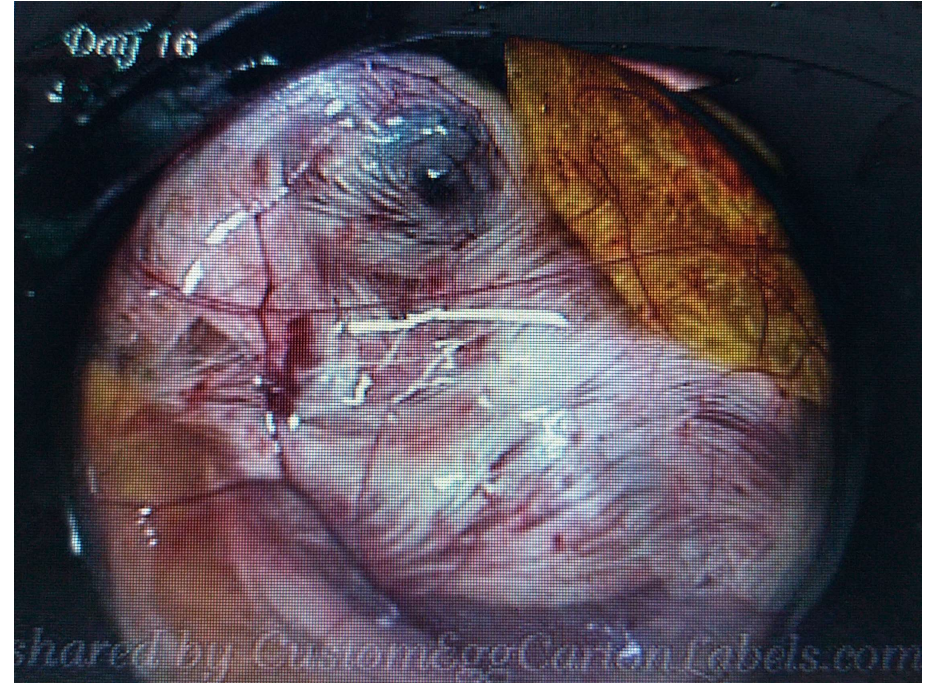
From 15 day onwards the Embryo grows rapidly assuming hatching position with the head under the right wing and beak toward the air cell

Incubator Temperature: 99.5° F

Incubator Humidity 58%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 16



- Feathers cover complete body
- Albumen nearly gone
- Vitellus shrinking accelerates
- The head moves towards the pipping position, under the right wings

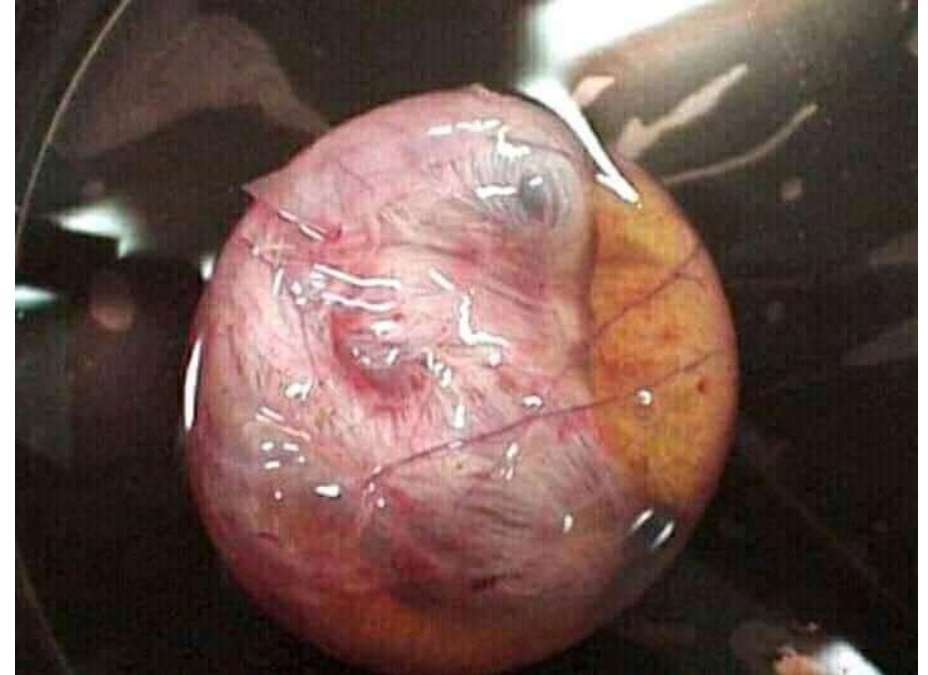


Incubator Temperature: 99.5° F

Incubator Humidity 58%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 17



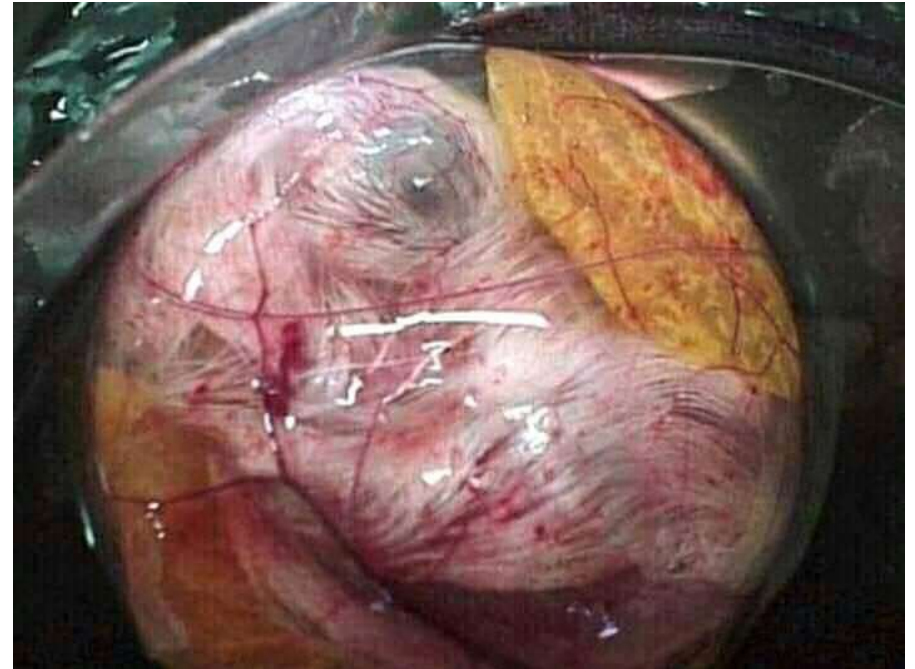
- Amniotic fluid decreases
- Head is between legs
- The albumin fully resorbed
- The renal system of embryo start producing urates

Incubator Temperature: 99.5° F

Incubator Humidity 58%

# **EMBRYONIC DEVELOPMENT OF THE CHICKEN**

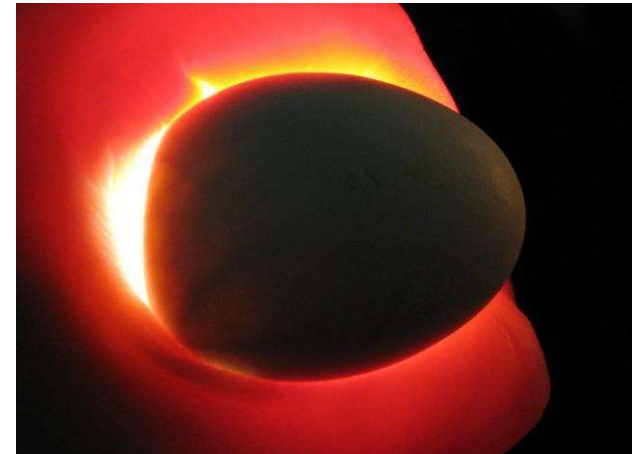
## **DAY 18**



- **Reduction of Amniotic fluid, internalization of vitellus and is time to transfer from incubator to hatcher**
- **Growth of embryo nearly complete**

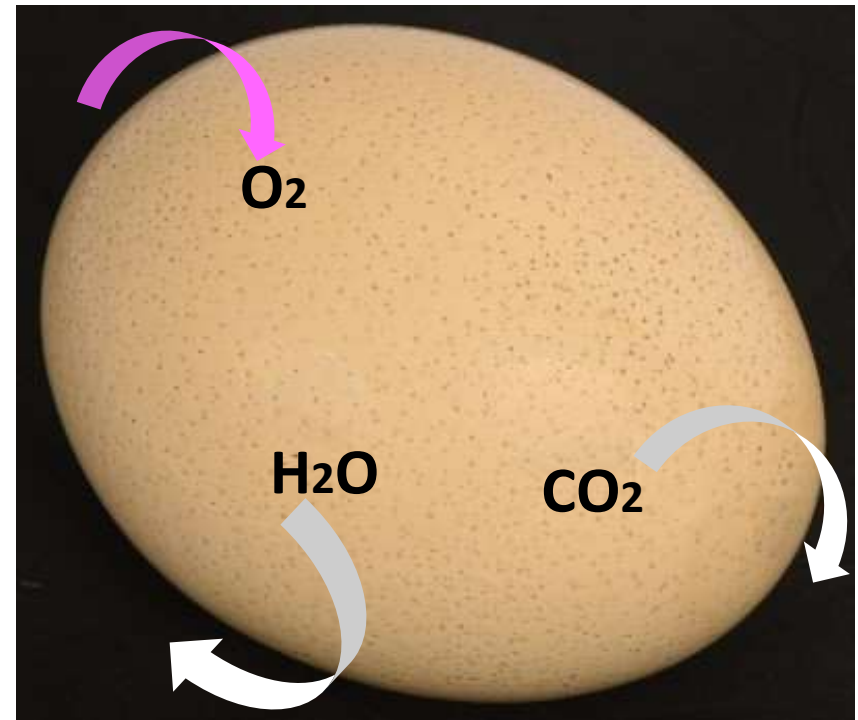
# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## Candling



## PHYSIOLOGY OF CHICKEN EMBRYONIC DEVELOPMENT

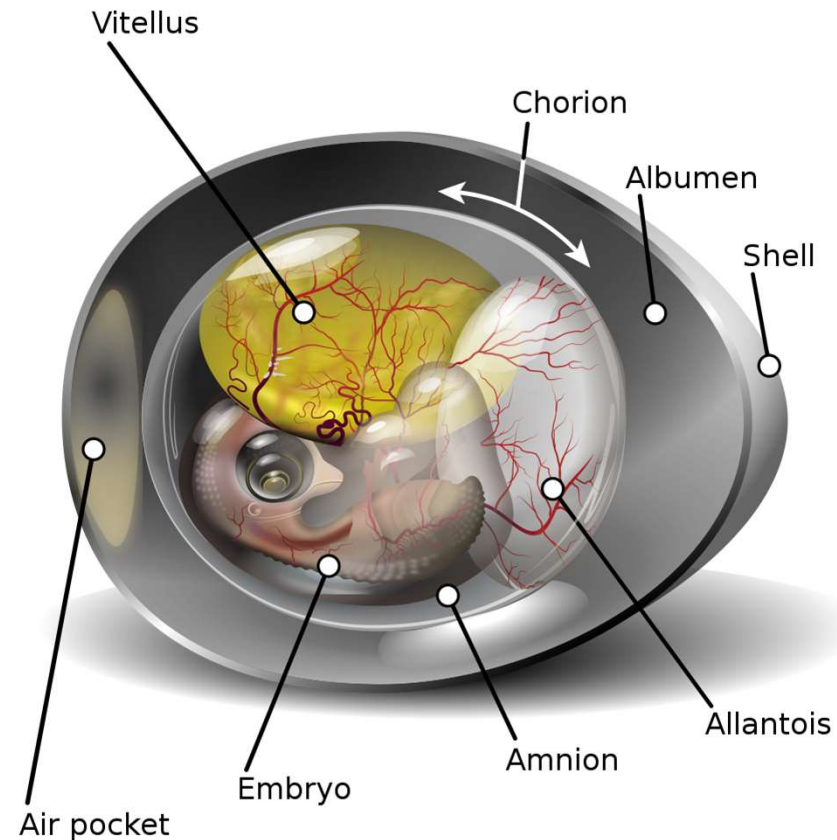
- The freshly laid avian egg contains most of the materials needed for embryonic development, but lacks the oxygen and heat needed for successful development
- Microscopic pores in the eggshell allow O<sub>2</sub> to diffuse into the egg from the environment and Water vapor & CO<sub>2</sub> produced by the embryo to diffuse out
- In the poultry industry, the hen (providing not only the heat necessary for embryonic development but also controlling the microclimate of the egg) is replaced by incubator



- The egg is composed of the eggshell and outer & inner shell membranes that encompass the albumen, which serves as a source of water and protein; and yolk, a source of necessary nutrients
- The egg with its hard shell does not enable embryonic ventilatory movements, and thus there is no convective gas exchange until the embryo's lungs begin to function

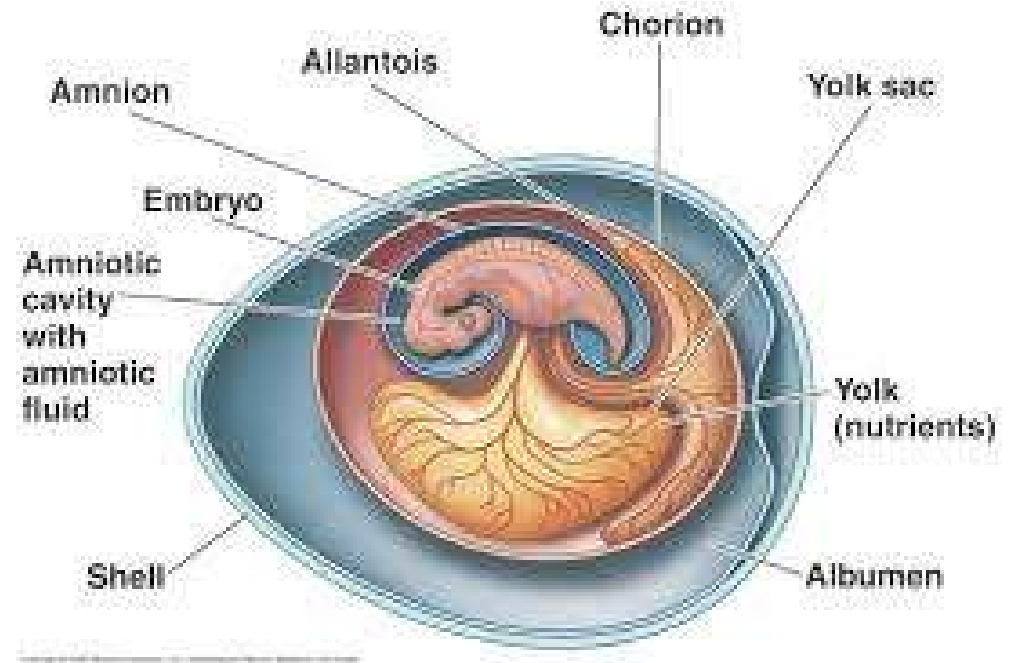
# PHYSIOLOGY OF CHICKEN EMBRYONIC DEVELOPMENT

- Early in incubation, before formation of heart and even after initial formation, O<sub>2</sub> is adequately supplied from the environment to the embryo through diffusion
- When gas transport by diffusion alone becomes inadequate, blood convection begins and 3 different gas exchangers sequentially function in the egg; the area vasculosa, the chorioallantois, and the lungs
- The area vasculosa is a well-vascularized region of the yolk sac that fans out from the embryo and grows around the yolk during days 2 to 5. The blood vessels of the yolk sac connect with the dorsal aorta of the embryo by day 2 and blood begins to circulate through the embryo and the area vasculosa
- The fine reticulation of the vitelline circulatory system plays the role of the main gas exchanger until the chorioallantois makes contact with the inner shell membrane around day 6. Subsequently, respiratory function transitions from area vasculosa to the chorioallantois



# PHYSIOLOGY OF CHICKEN EMBRYONIC DEVELOPMENT

- On day 5, the mesenchyme of Allantoic sac comes into contact with the mesenchyme of Chorion; both membranes begin to fuse to form Chorioallantois. The Chorioallantois grows rapidly, reaching the embryo size on day 6. By day 12, it envelops the whole egg, lining the entire surface of the inner shell membrane.
- The primordial heart is a paired tubular structure. The heart begins to elongate more rapidly than the pericardial cavity containing it; this space limitation forces the tubular heart to bend. Only the ventricle & bulbus are present on days 2



- The structural alterations that separate atrium from ventricle, ventricle from aorta, and left from right chamber happens during days 3 - 8, resulting in a four-chambered heart by days 8 - 9
- The growth of the heart is greatest in early development and declines during incubation. The ratio of heart mass to whole body mass falls from 1.8% on day 4 to 0.7% on day 18
- The heart begins to beat at about 30 hours of incubation and blood begins to circulate after 40 hours, when the connections between the dorsal aorta and the vessels of the yolk sac complete the circulation

# **PHYSIOLOGY OF CHICKEN EMBRYONIC DEVELOPMENT**

- **During development, avian embryos face one of two osmoregulatory challenges: water loss through the pores of the eggshell, in desiccating arid environments; or excess water gain from the metabolic production of water as part of metabolizing the yolk stores**
- **The embryonic kidney of chickens has 3 stages, actually comprising separate structures: the pronephros, mesonephros, and metanephros.**
- **The pronephros appears first and functions until day 5 to 6. Mesonephros function takes over from day 5, is maximal on days 10 to 15, and then degrades between days 18 and 19**
- **The mesonephros functions simultaneously with the metanephros, which begins developing from day 4 and continues to develop post-hatching**
- **The metanephros is the most complex embryonic kidney structures, and comprises the functioning structure in adults**
- **The allantoic sac first appears at about days 3 to 4, and acts as a repository for kidney secretions, as evident by the increase in uric acid content throughout development.**

Incubator Temperature: 98.5° F

Incubator Humidity 70%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 19



- Yolk sac draws into body cavity
- Amniotic fluid gone
- Embryo occupies most of space within egg
- The Beak is against the inner shell membrane, ready to pierce it



Incubator Temperature: 98.5° F

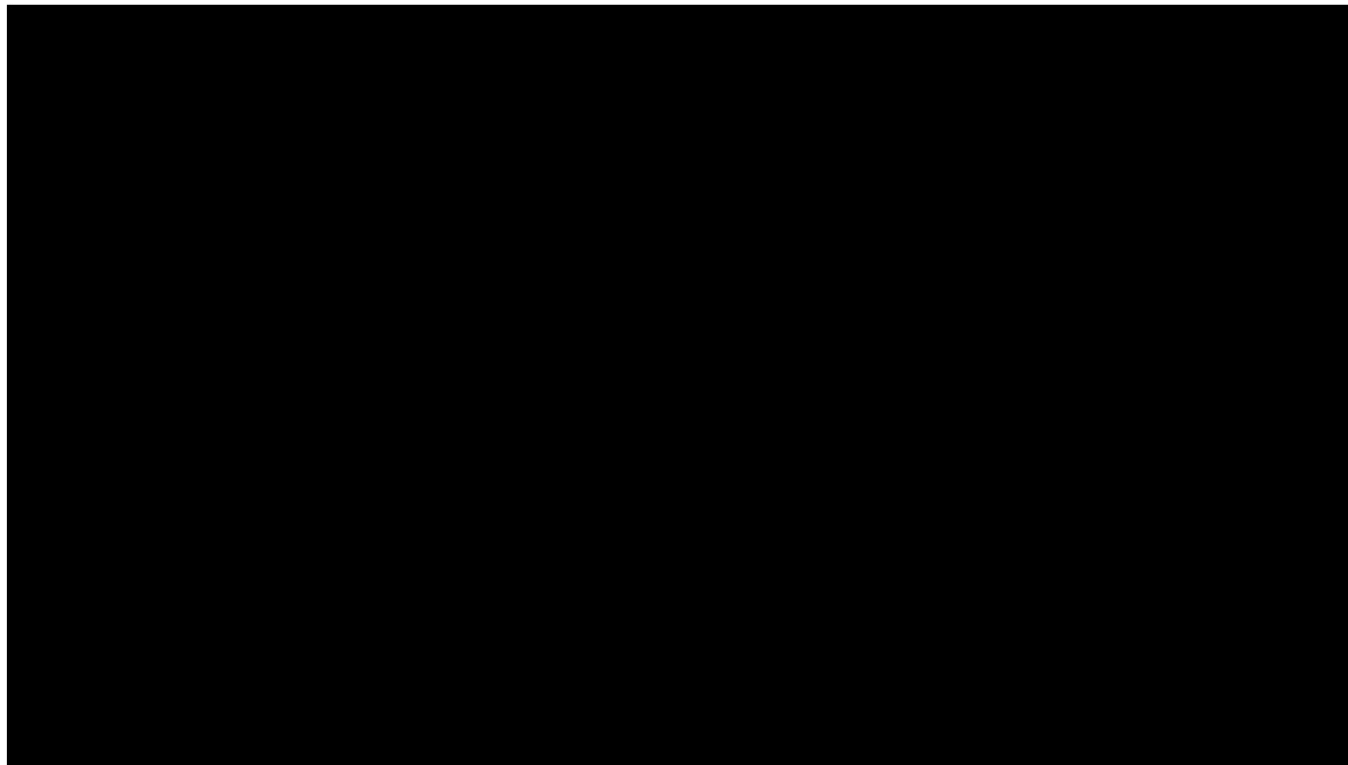
Incubator Humidity 70%

# EMBRYONIC DEVELOPMENT OF THE CHICKEN

## DAY 20

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

Chick begins Pipping through Egg Shell





# CHICK EMBRYO DEVELOPMENT

 <p><b>INFERTILE</b> • No development.</p>	 <p><b>DAY 1</b> • Appearance of tissue development.</p>	 <p><b>DAY 2</b> • Tissue development very visible. • Appearance of blood vessels.</p>	 <p><b>DAY 3</b> • Heart beats. • Blood vessels very visible.</p>	 <p><b>DAY 4</b> • Eye pigmented.</p>	 <p><b>DAY 5</b> • Appearance of elbows and knees.</p>	 <p><b>DAY 6</b> • Appearance of beak. • Voluntary movements begin.</p>
 <p><b>DAY 7</b> • Comb growth begins. • Egg tooth begins to appear.</p>	 <p><b>DAY 8</b> • Feather tracts seen. • Upper and lower beak equal in length.</p>	 <p><b>DAY 9</b> • Embryo starts to look bird-like. • Mouth opening appears.</p>	 <p><b>DAY 10</b> • Egg tooth prominent. • Toe nubs.</p>	 <p><b>DAY 11</b> • Comb serrated. • Tail feathers apparent.</p>	 <p><b>DAY 12</b> • Toes fully formed. • First few visible feathers.</p>	 <p><b>DAY 13</b> • Appearance of scales. • Body covered lightly with feathers.</p>
 <p><b>DAY 14</b> • Embryo turns head towards large end of egg.</p>	 <p><b>DAY 15</b> • Gut is drawn into abdominal cavity.</p>	 <p><b>DAY 16</b> • Feathers cover complete body. • Albumen nearly gone.</p>	 <p><b>DAY 17</b> • Amniotic fluid decreases. • Head is between legs.</p>	 <p><b>DAY 18</b> • Growth of embryo nearly complete. • Yolk sac is still on outside of embryo. • Head is under the right wing.</p>	 <p><b>DAY 19</b> • Yolk sac draws into body cavity. • Amniotic fluid gone. • Embryo occupies most of space within egg (not in the air cell).</p>	 <p><b>DAY 20</b> • Yolk sac drawn completely into body. • Embryo becomes a chick (breathing in air cell). • Internal and external pip.</p>

## **HATCH DAY OF (Day 21) CHICKEN from EMBRYO to DOC**

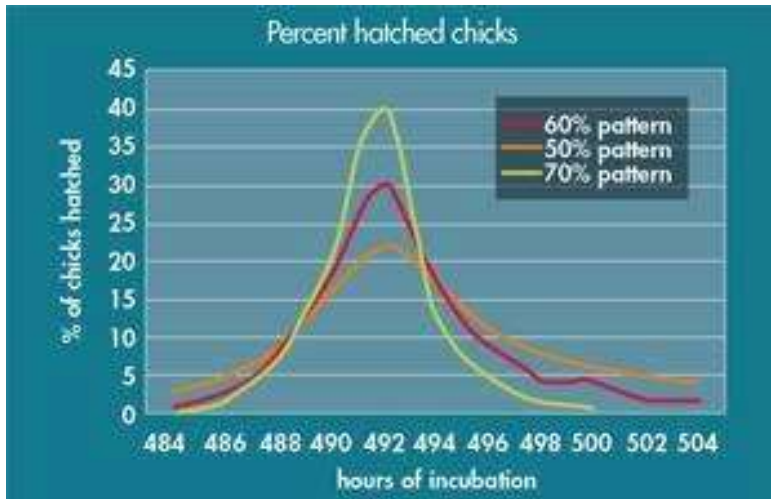
- After 21 days, the chick finally begin to escape from the shell.
- The chick begins by pushing its beak through the air cell.
- The chick continues to push its head outward. The sharp horny structure on the upper beak (egg tooth) and the muscle on the back of the neck help cut the shell
- The chick rests, changes position, and keeps cutting until its head falls free of the opened shell. It then kicks free of the bottom portion of the shell.
- The chick get exhausted and rests while the navel openings heal and its down dries.
- Gradually, it regains strength and walks.
- The incubation and hatching is complete; it's time to **Pull-Out**
- The Egg tooth will fall off the beak within days after hatch

### **Normal Hatching Position**

- Forepart of the body towards the large end of the egg
- Head under the right wing
- Leg up under the head

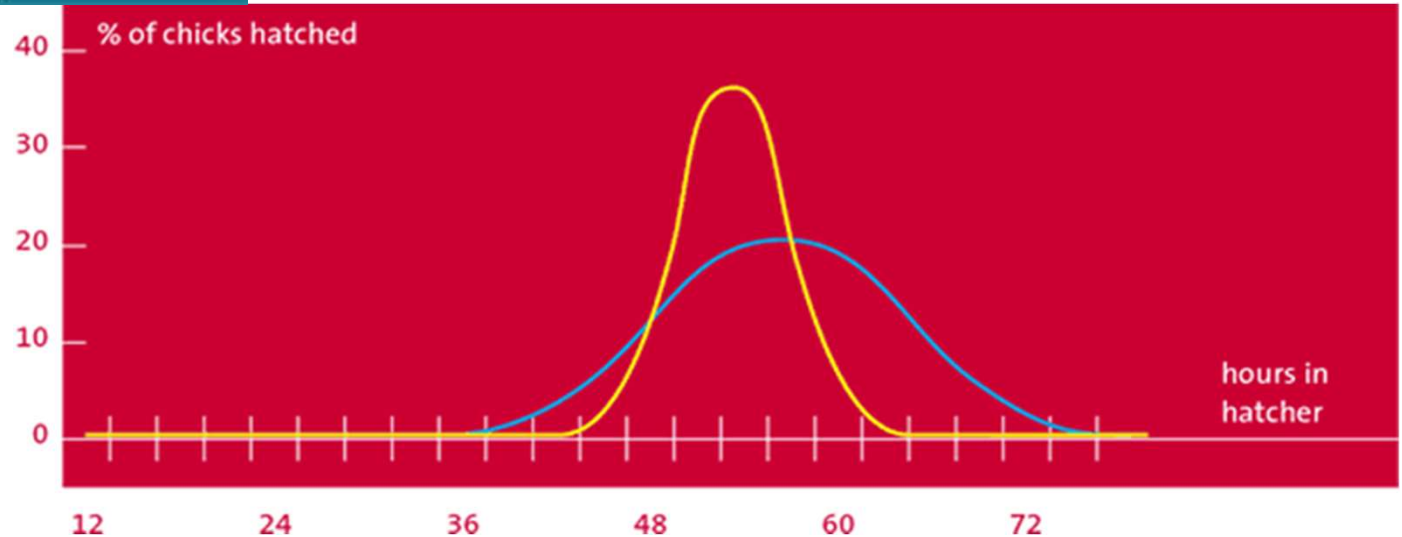


# CHICKEN EMBRYONIC DEVELOPMENT – HATCH WINDOW



- Hatch Window is the time span between the hatching of the first and the last chick in a particular hatcher
- In perfect Embryonic development under good hatchery operation it should be 12 – 24 hours
- First chicks should come just at the end of 20<sup>th</sup> day and last at the end of 21<sup>st</sup> day

- Extended hatch window confirms disturbance in Embryonic development process
- Chick Quality & may be quantity will be Poor



# CHICKEN EGG HATCHING – EMBRYONIC COMMUNICATION

- With natural incubation chicks hatch take relatively shorter time, despite the eggs laid in the nest over a period of several days and the hen sitting on different eggs on different period of time



- This indicates that there is a system to synchronize the hatching process. It is now accepted that different embryos communicate with each other by a series of clicking sounds, the rate of clicking being important feature
- Ensuring the eggs on the hatching trays are in contact with each other facilitates the synchronization of hatching. This help to reduce the hatching windows and ultimately the Quality & quantity of chick

# THANK YOU

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