

# Fertilization, Maternal recognition of pregnancy and Implantation

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# Some definitions

- Obstetrics Science of midwifery (**obstare** "stand opposite to)
- A branch of medicine that deals with care of pregnant women during pregnancy, at child birth and afterwards
  
- Veterinary Obstetrics:
  - A branch of Veterinary Medicine that deals with
  - care of animals during pregnancy, at parturition
  - and during the postpartum period

- **Embryo**: from fertilization to the differentiation stage (45 days in cattle)
- Fetus: from differentiation till parturition
- **Conceptus**: Fetus with its fetal membranes.
- **Nullipara**: An animal which has not become pregnant and not parturated.
- **Primipara**: An animal which has become pregnant and would parturate for the first time
- **Monotocous**(Uniparous): Animals giving birth to single young ones
- **Polytocous** : Animals giving birth to many young ones
- **Embryology**: Science of physiological development of the fetus
- **Teratology**: Embryology + pathology dealing with abnormal fetal development
-

**Carazol:** a beta-blocker given to sows to reduce the expulsive time of labor in sows.

**Clenbuterol:** A beta-adrenergic that quietens the uterus and inhibits labor.

**Pseudopregnancy:** False pregnancy occurs in the bitch and the goat and in many other species like mare.

**Feathering:** Tapping of the vagina of a whelping bitch with finger leads to oxytocin release and delivery of a pup.

**Single pup syndrome:** The presence of a single pup in a bitch leading to problem in initiation of parturition and development of an extra large puppy.

**Spalding sign:** Overlapping of the fetal skull bones seen on radiography of a bitch with dead fetuses.

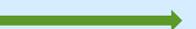
**Fergusons reflex:** The release of huge quantities of oxytocin in cows when the fetal legs touches the pelvis during parturition.

**Theilers disease:** Infectious hepatitis in mare developing due to injection of an eCG.

# PREGNANCY IN DOMESTIC ANIMALS

- The period of intrauterine development (from fertilization to parturition) in mammals is termed pregnancy or gestation.
- Ovum + sperm → fertilization → Embryo ↓  
Completion of gestation ← Growth in uterus  
(Pregnancy) → Parturition

# FERTILIZATION

- External  Amphibians
- Internal  Mammals
- Fertilization in mammals
  - Gamete transport
  - Changes in gamete structure
  - Cleavage and blastocyst formation
  - Maternal recognition of pregnancy

# Gamete transport

- Synchronous transport of male and female gametes to oviduct ampulla should occur
- Semen deposited in vagina (human, cattle, buffalo, sheep, goats, rabbits).
- Semen deposited in the uterus
- (in dogs, horses, pigs).



www.nucleus.com

During sexual intercourse about 300 million sperm enter the vagina

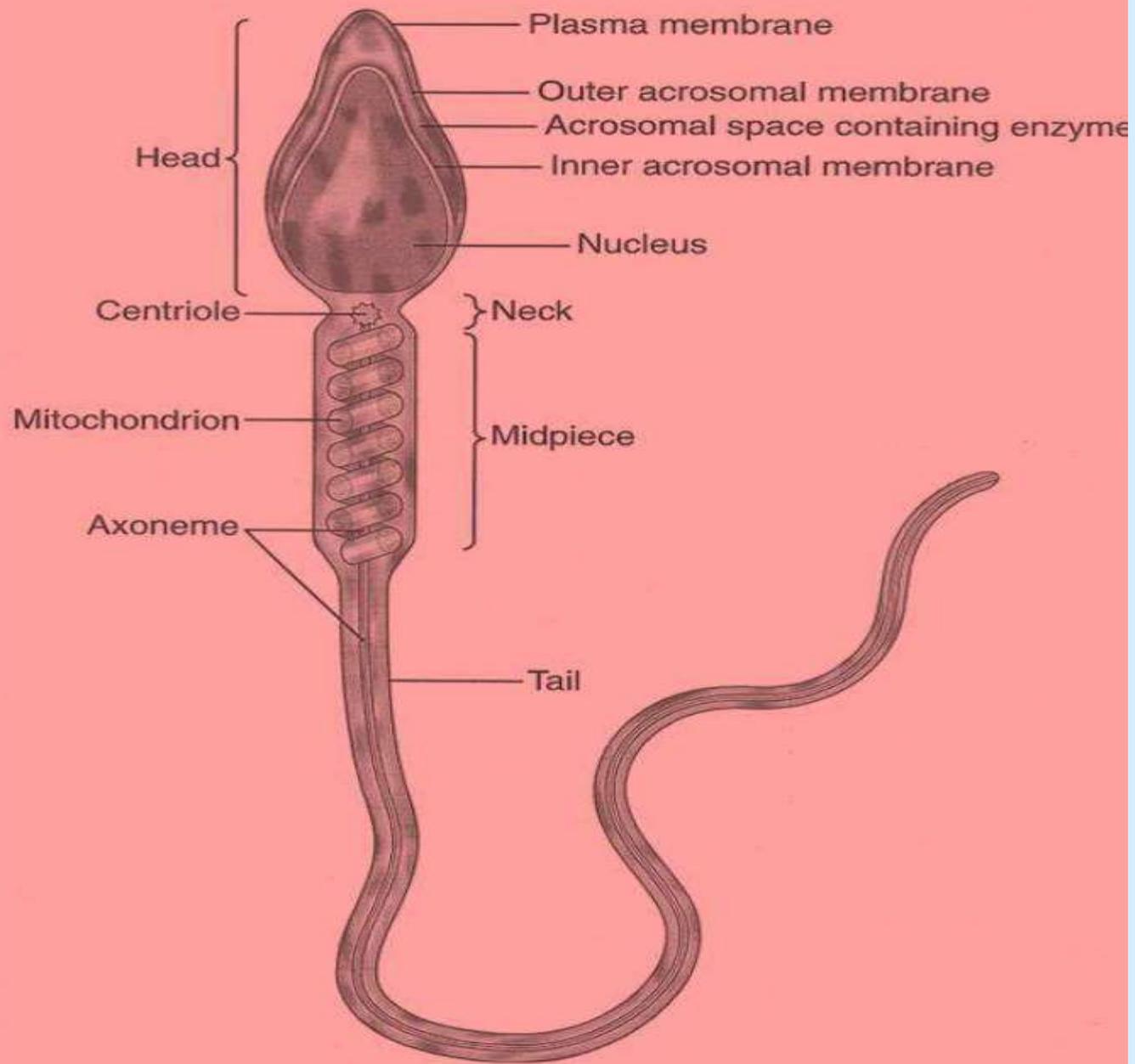


# Oocyte transport

- Except mares the oocyte is picked by the fimbriae and enters the ostium
- Propelled towards the ampulla by ciliated cells

# Fertile life of gametes in domestic animals

Species	Fertile life sperm (hrs)	Fertile life ovum (hrs)	Day of entry of embryo in uterus	Blastocyst formation
Cattle	24-48	20-24	3-3.5	7-8
Horse	72-120	6-8	4-5	6
Sheep	30-48	16-24	3	6-7
Swine	24-72	8-10	2	5-6
Dog	120-168	48-72	5	7-8
Buffalo	24-32	6-12	4	5-6

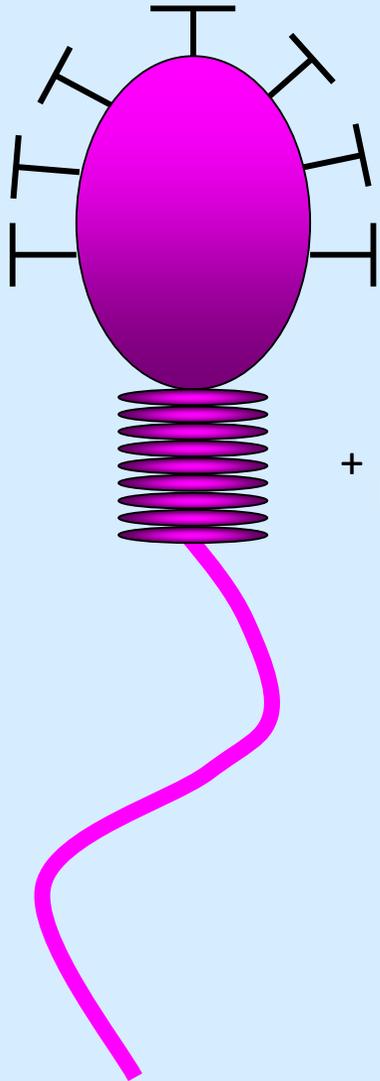


# Changes in gamete structure

- *Sperm capacitation, sperm oocyte interaction, acrosome reaction, oocyte activation, zona reaction and intermingling of male and female gametes*
- Capacitation occurs in female tract

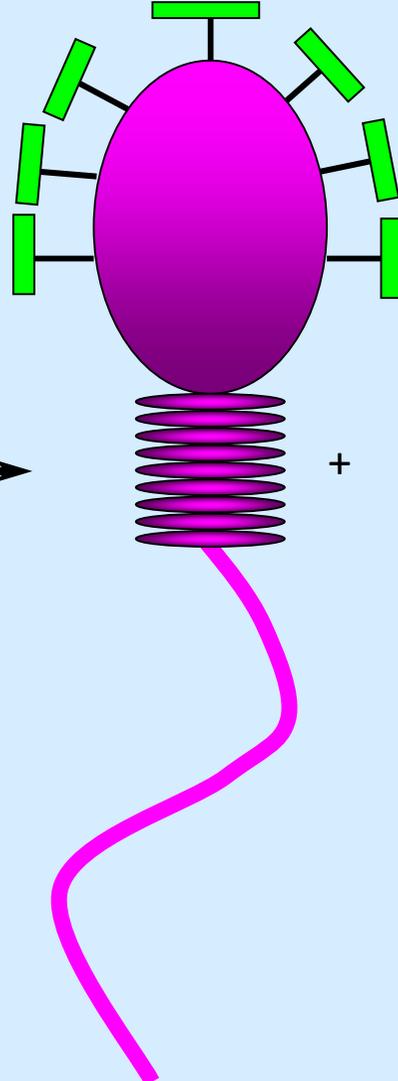
# Effect of Capacitation

Epididymal



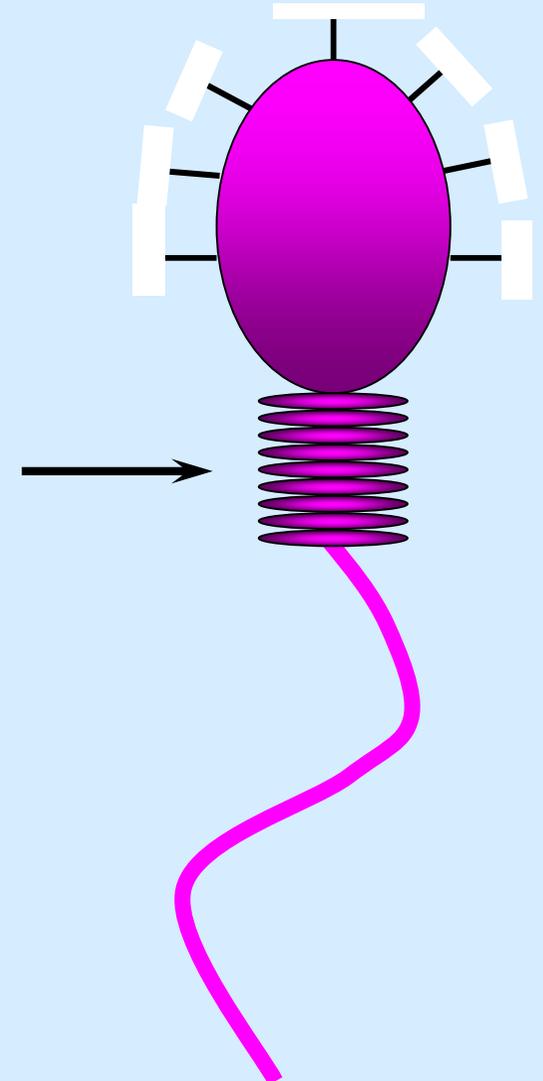
Seminal Plasma  
and/or  
Epididymal  
Secretions  
+

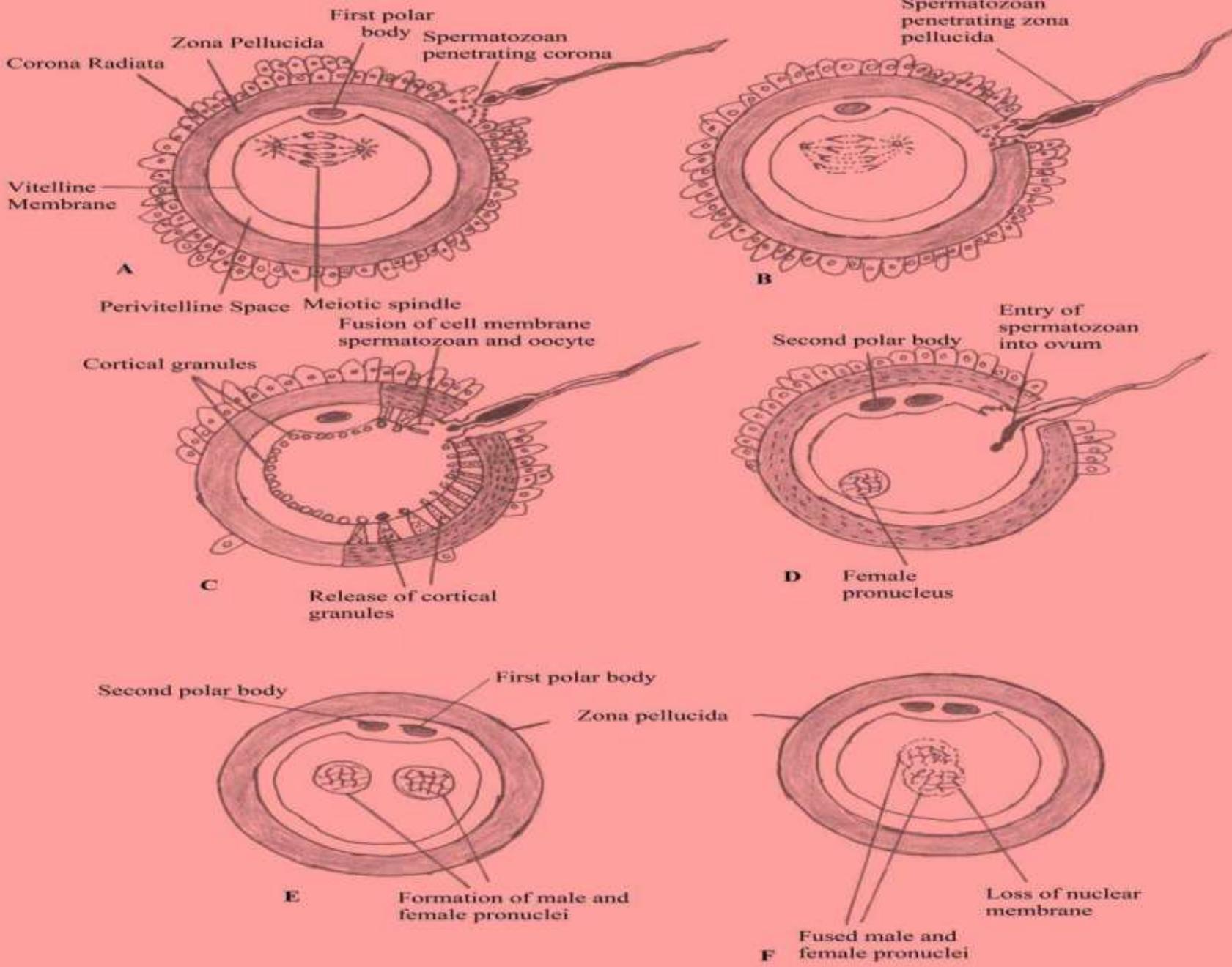
Ejaculated



Female  
Tract  
+

Capacitated





Zona Pellucida



Oocyte

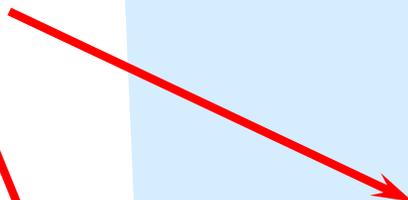
Ca<sup>2+</sup>



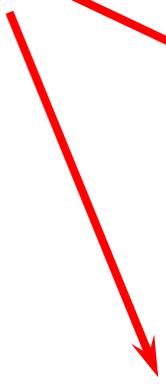
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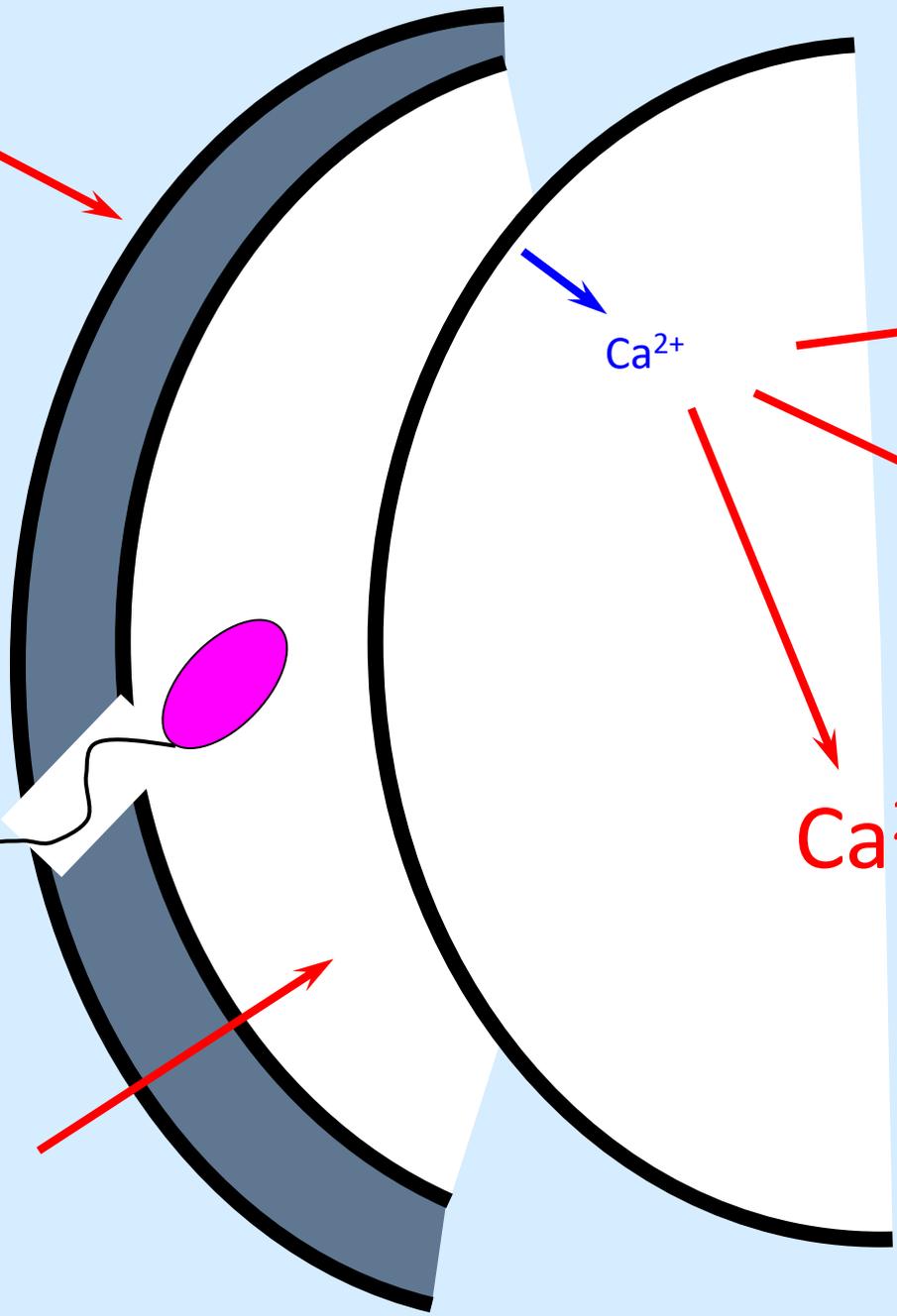
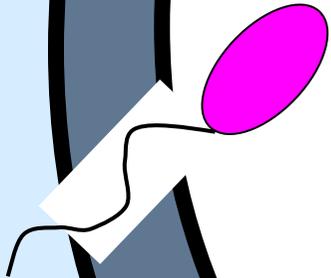
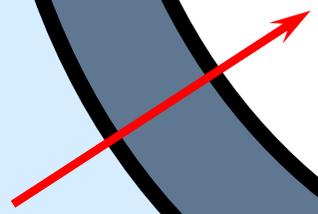
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Ca<sup>2+</sup>



Perivitelline  
Space



Zona Pellucida

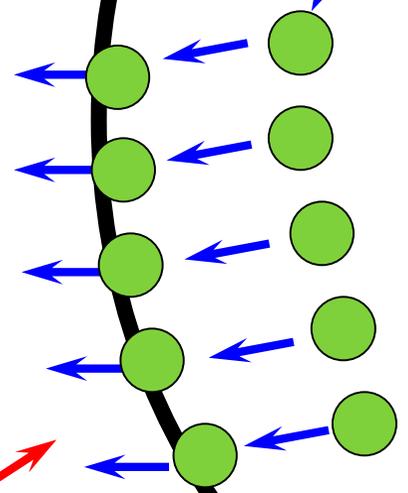


Oocyte

Ca<sup>2+</sup>

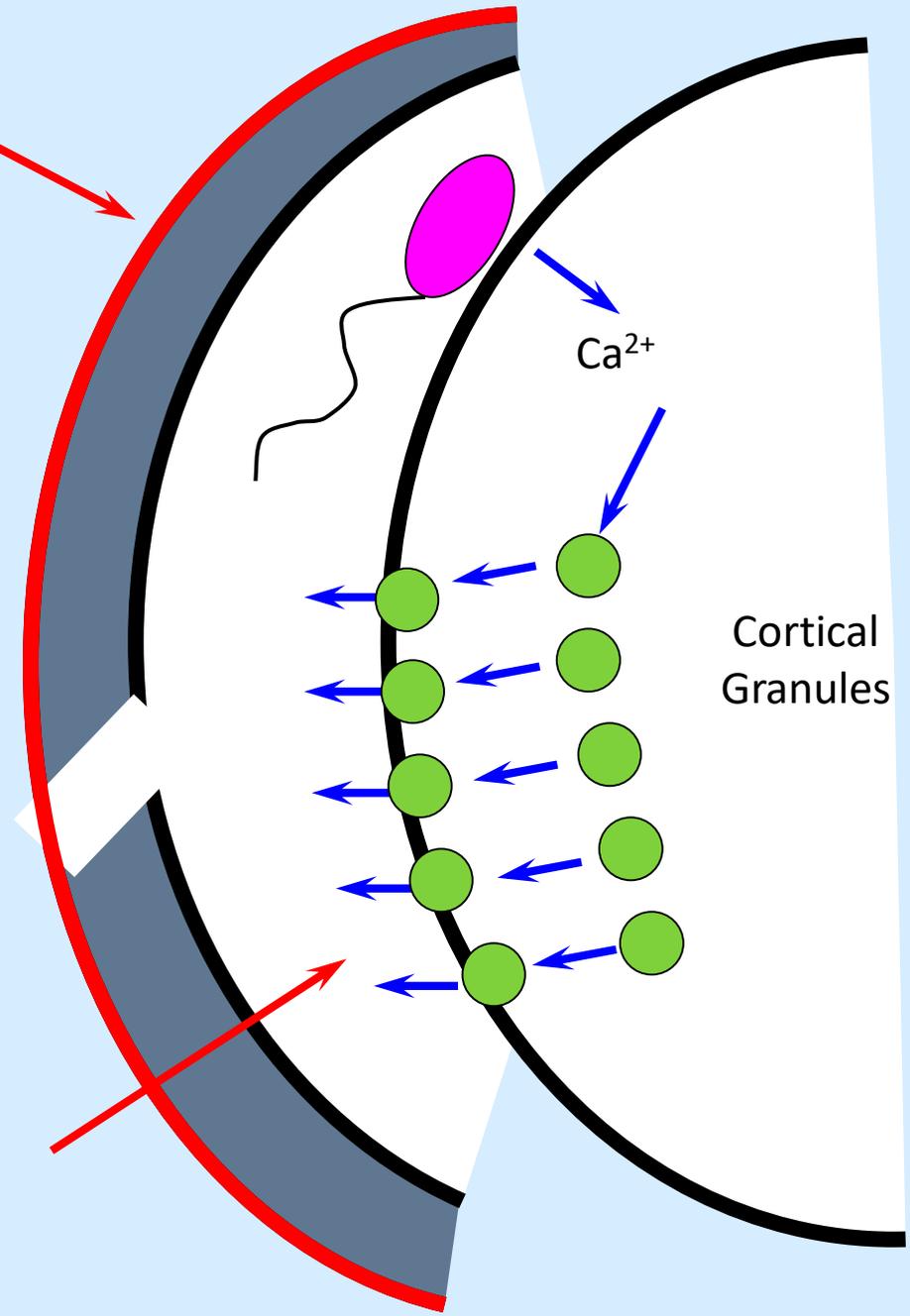
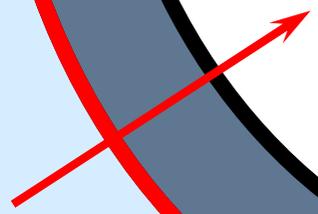


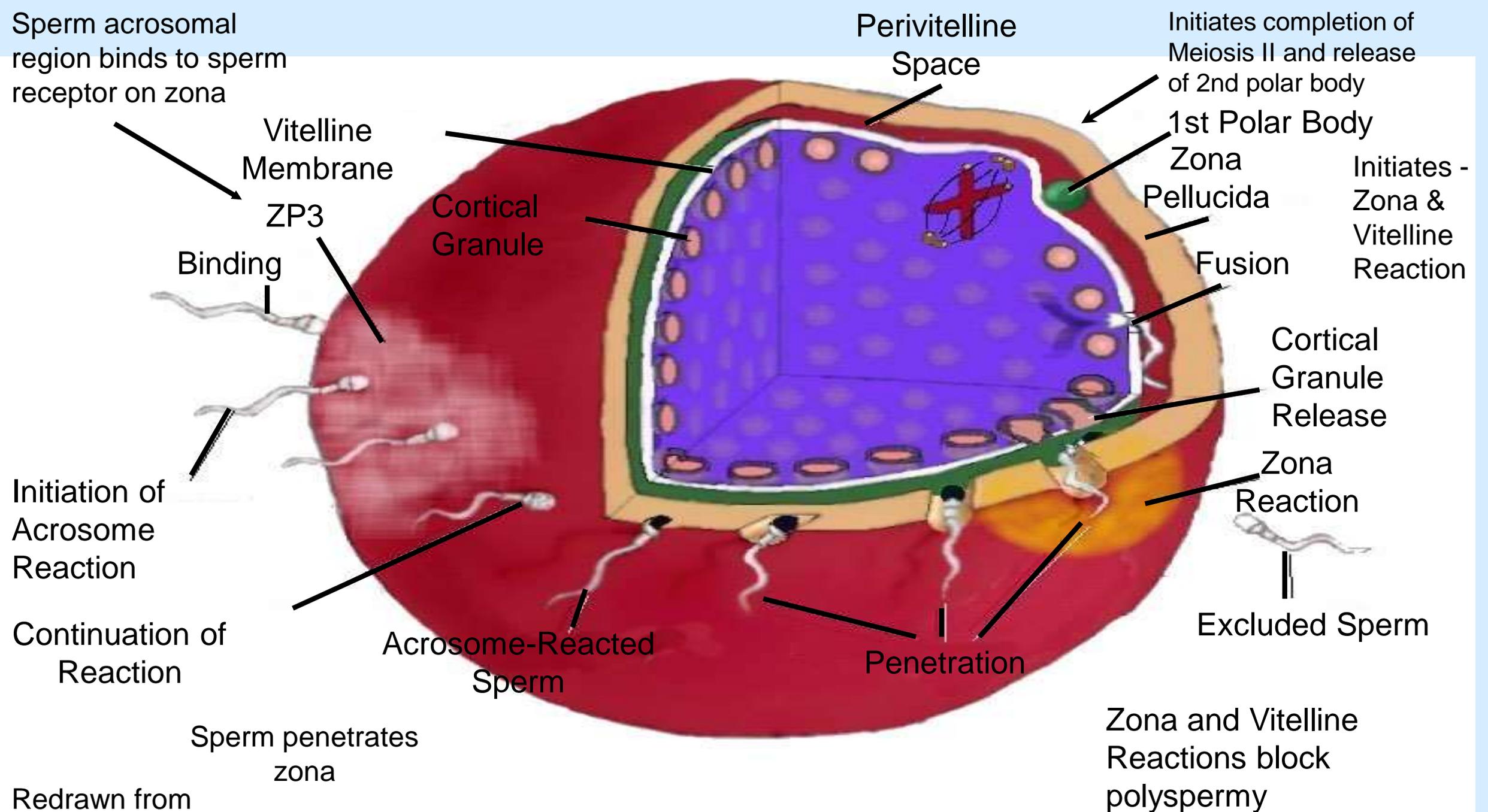
Cortical Granules



Zona Block to Polyspermy

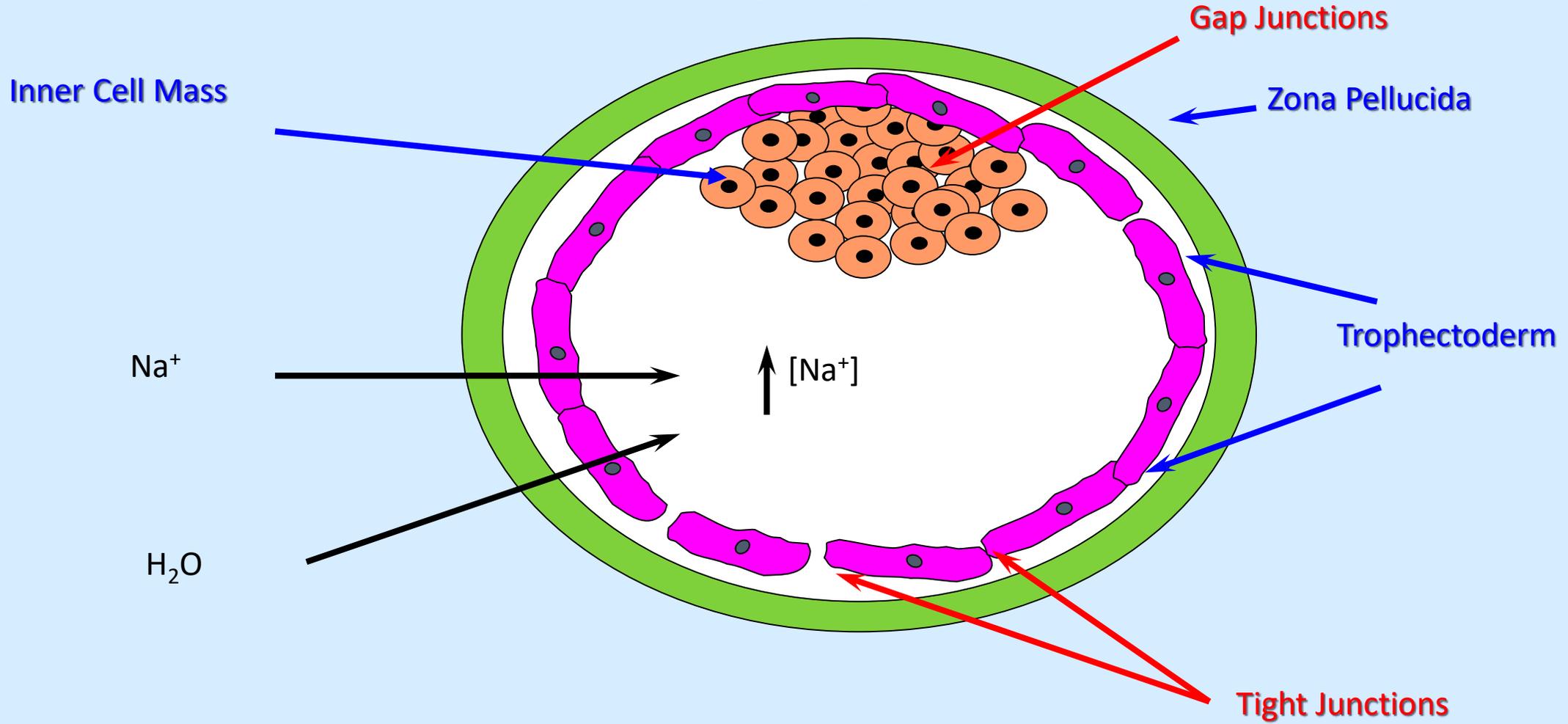
Perivitelline Space





Redrawn from Wasserman, P.M. 1988 Scientific American. p78

# Blastulation



# Hatching

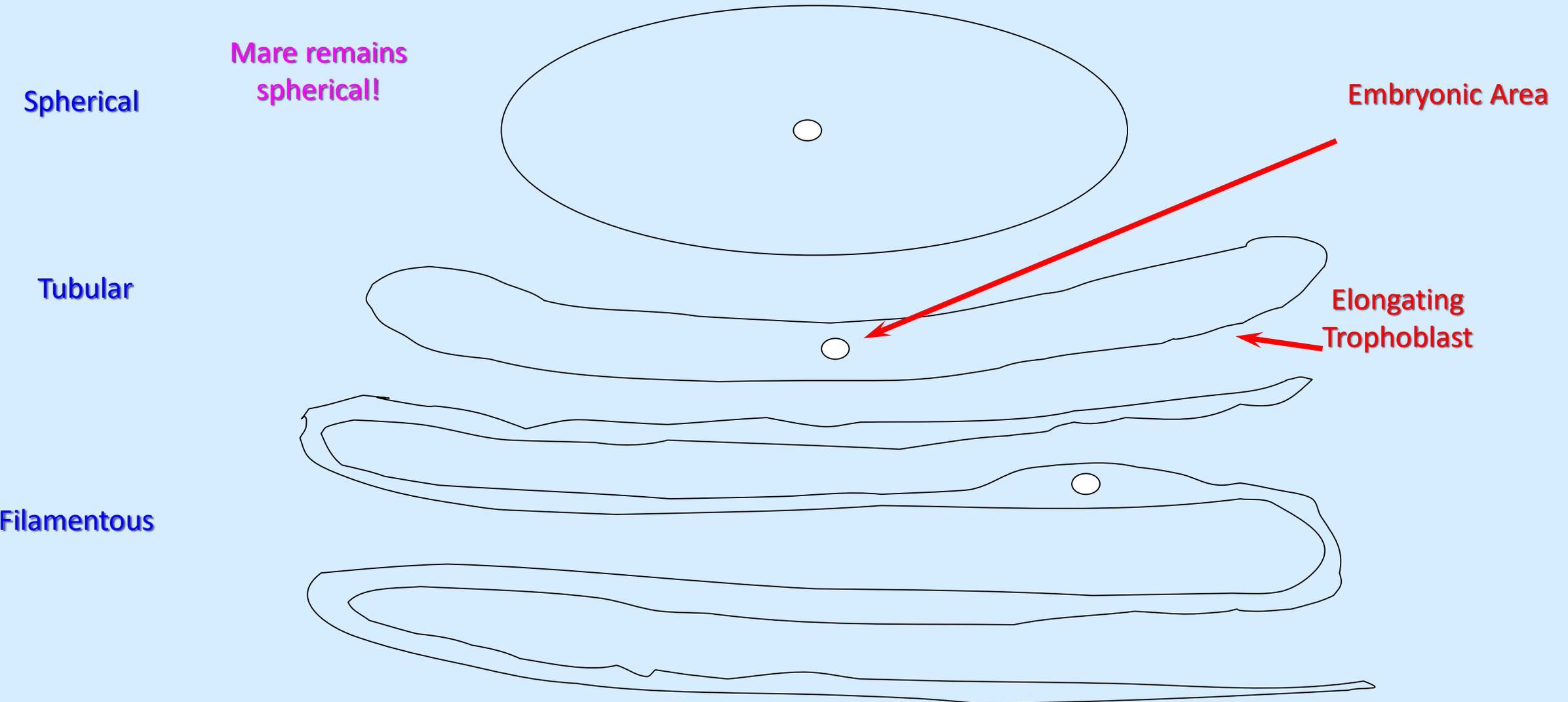
- Bovine
  - 9 - 11 days
- Equine, Ovine
  - 7 - 8 days
- Porcine
  - 6 days
- Buffalo
  - 6.5 days

# Conceptus Growth

Occurs in cow, pig and sheep

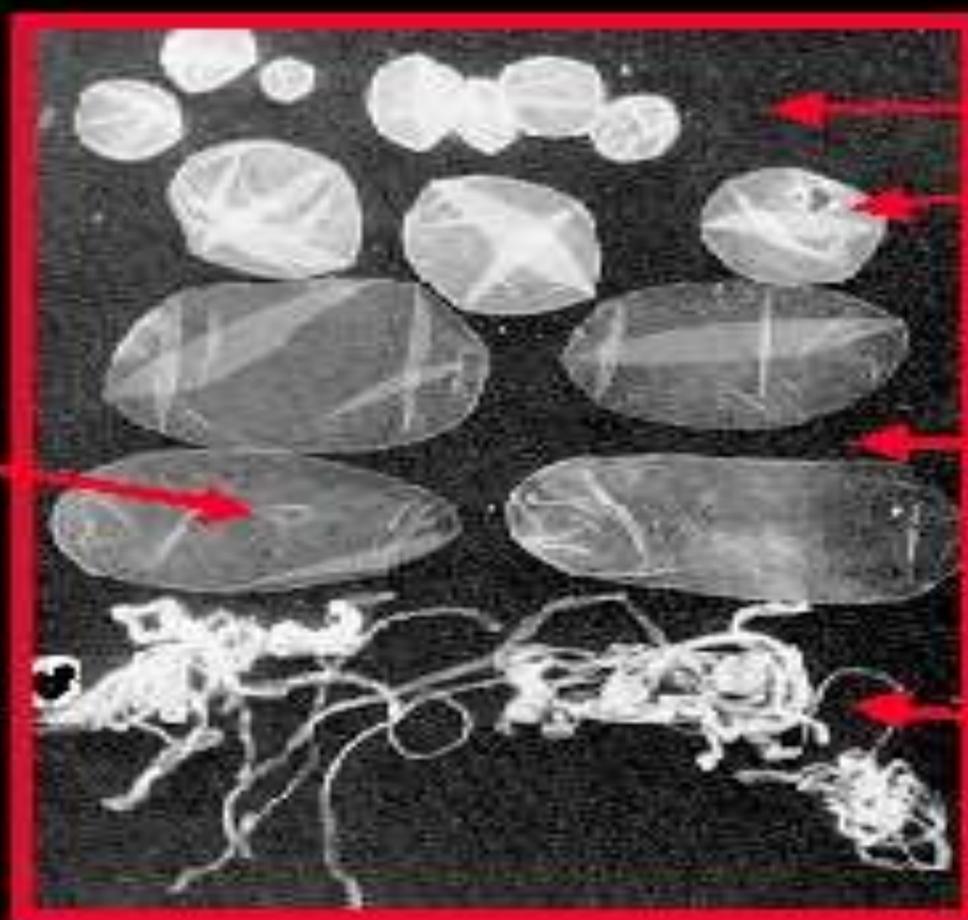
Cow

- Day 15, 1-2 mm
- Day 18-19, 10-20 cm



# Conceptuses from Day 10 to 12

Inner Cell  
Mass



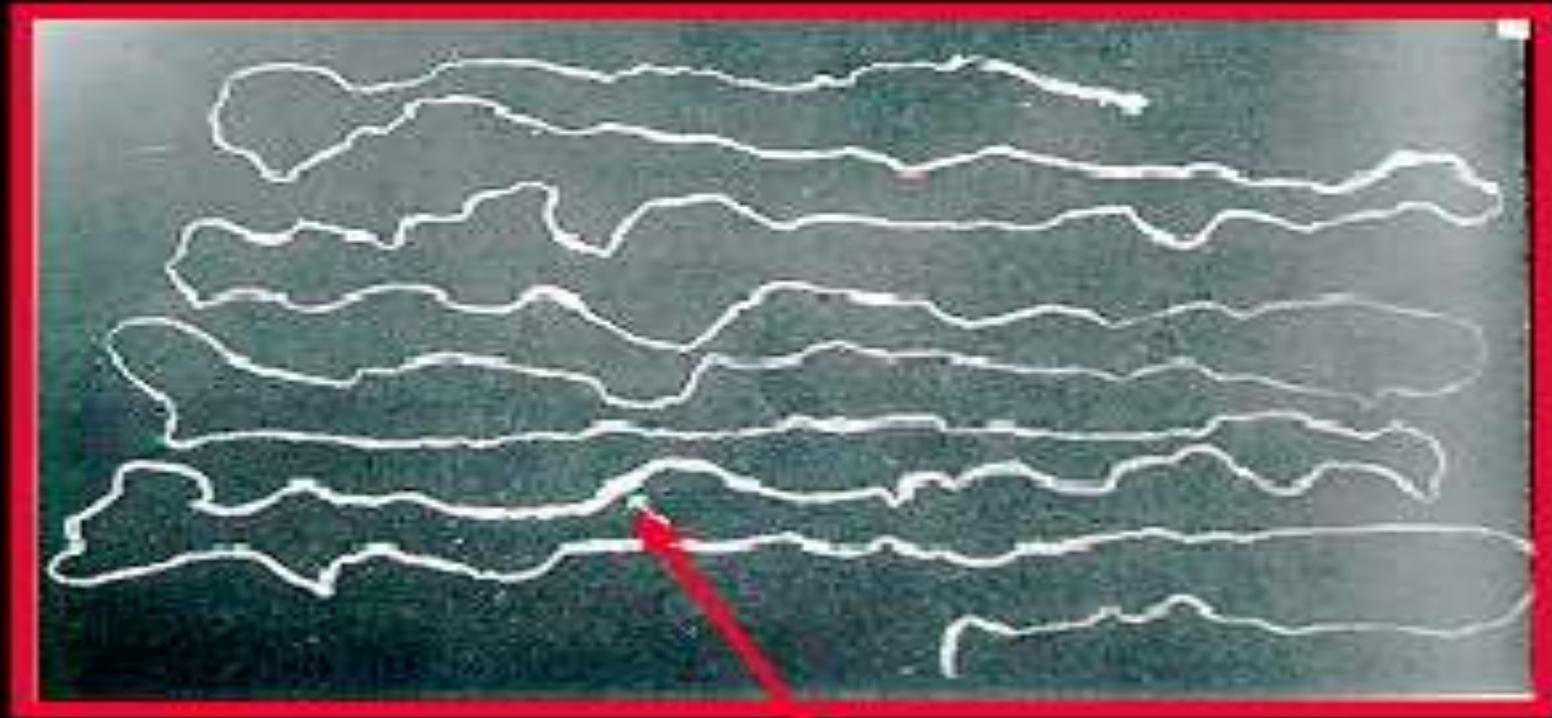
5 mm Spherical

10 mm Spherical

14 mm Tubular

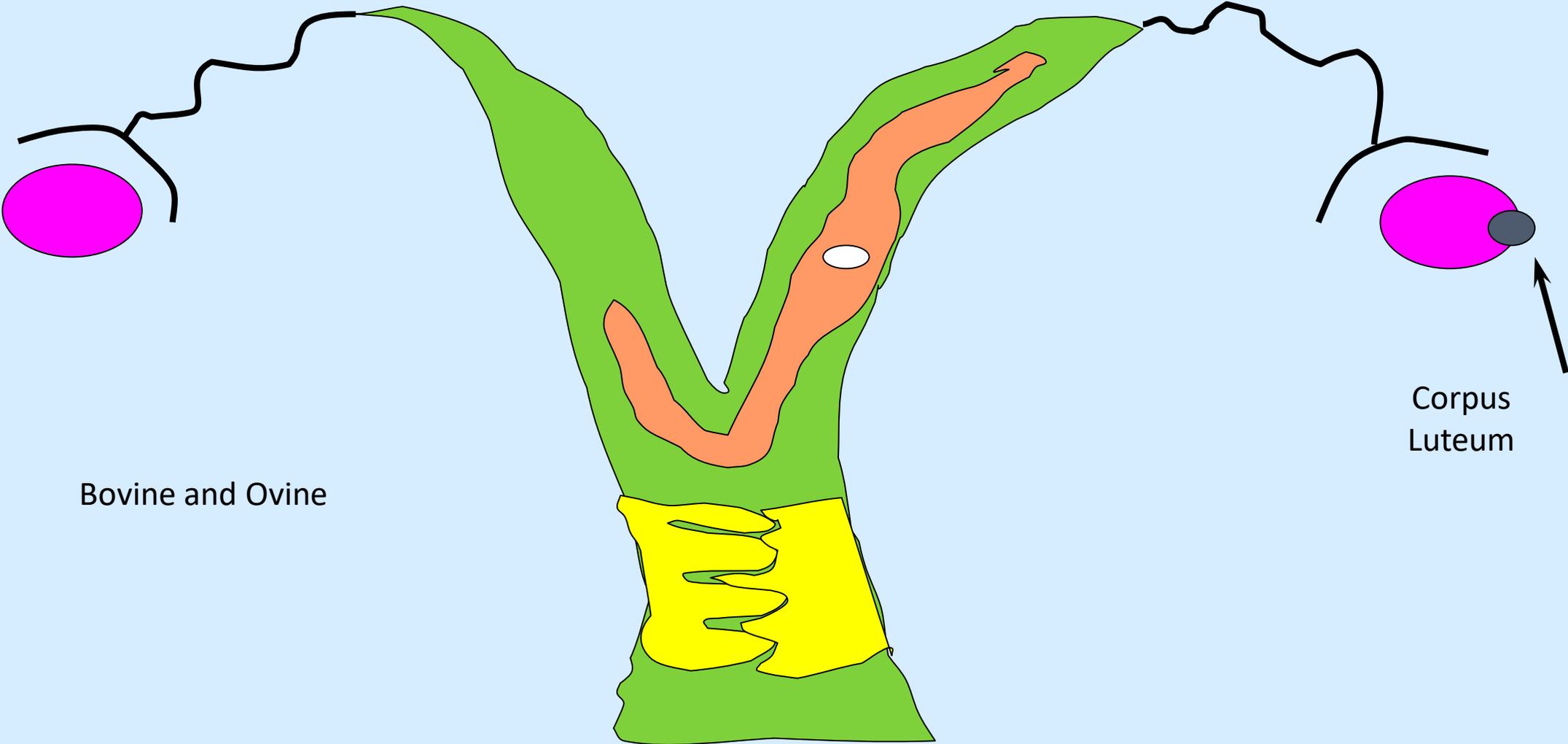
150 mm Filamentous

# Elongated Day 15 Porcine Conceptus

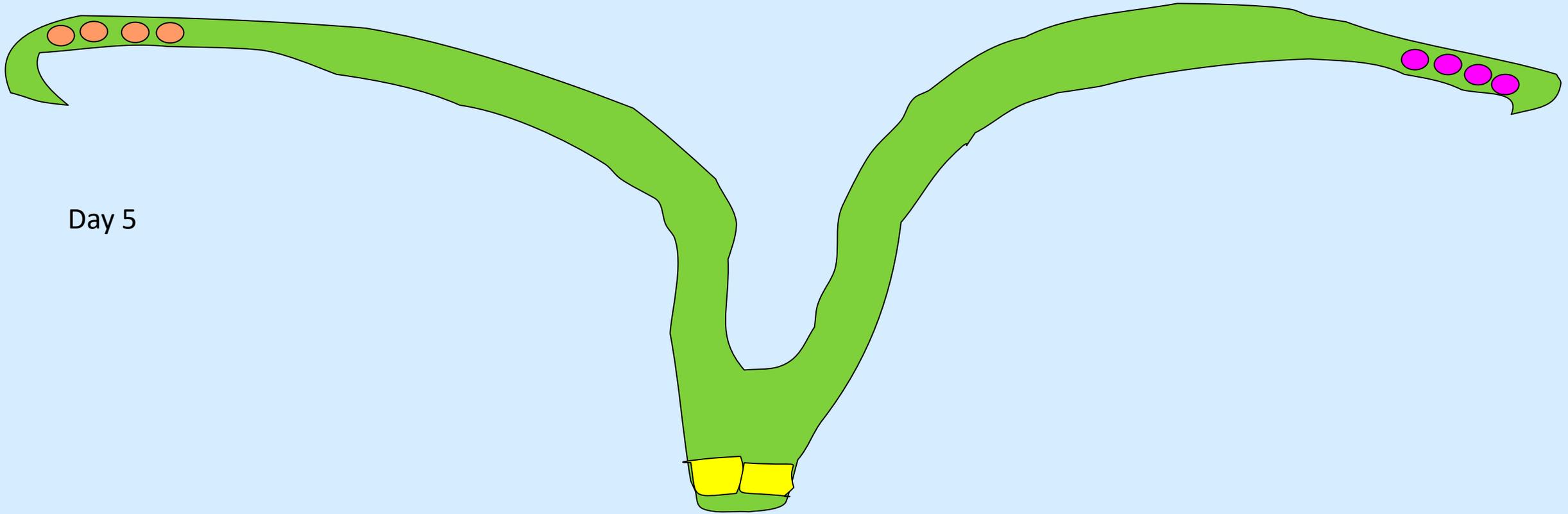


Embryo

# Uterine Location of Elongating Ruminant Blastocyst

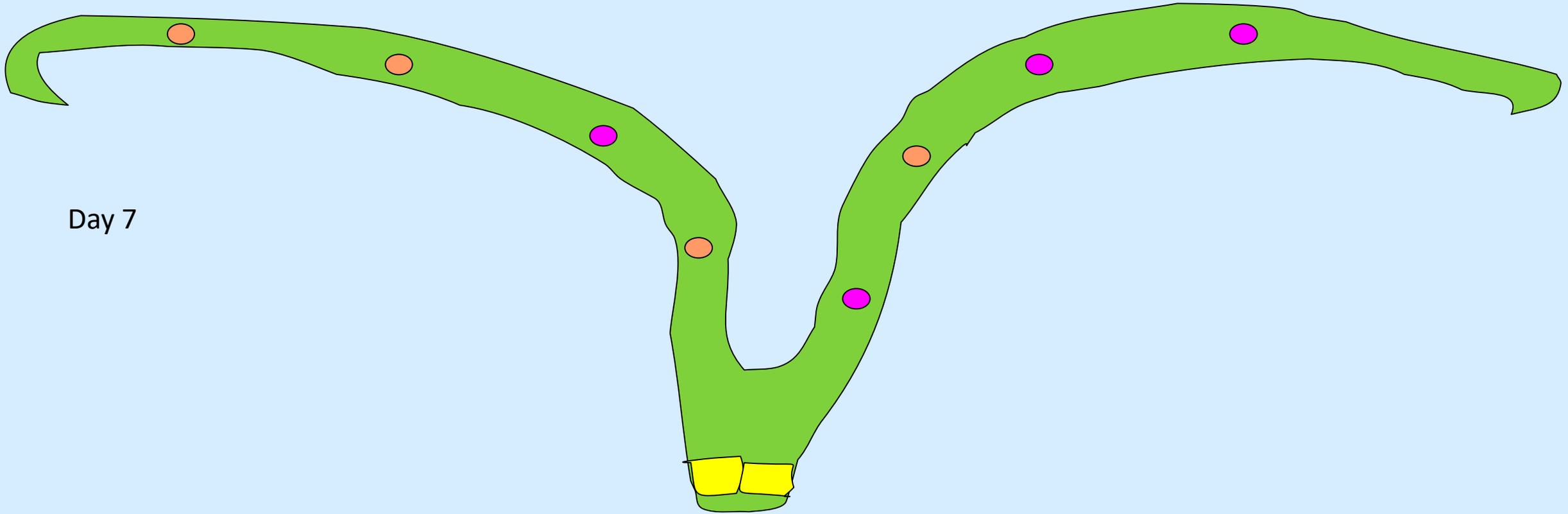


# Pig Intrauterine Migration



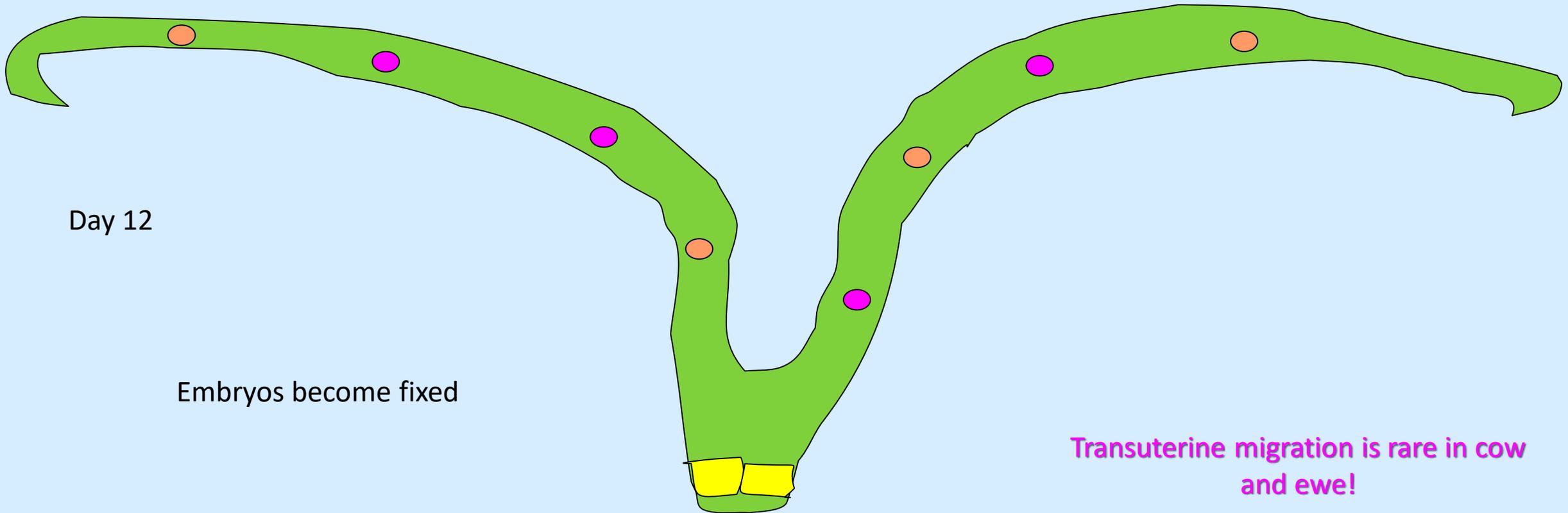
Day 5

# Pig Intrauterine Migration



Day 7

# Pig Intrauterine Migration

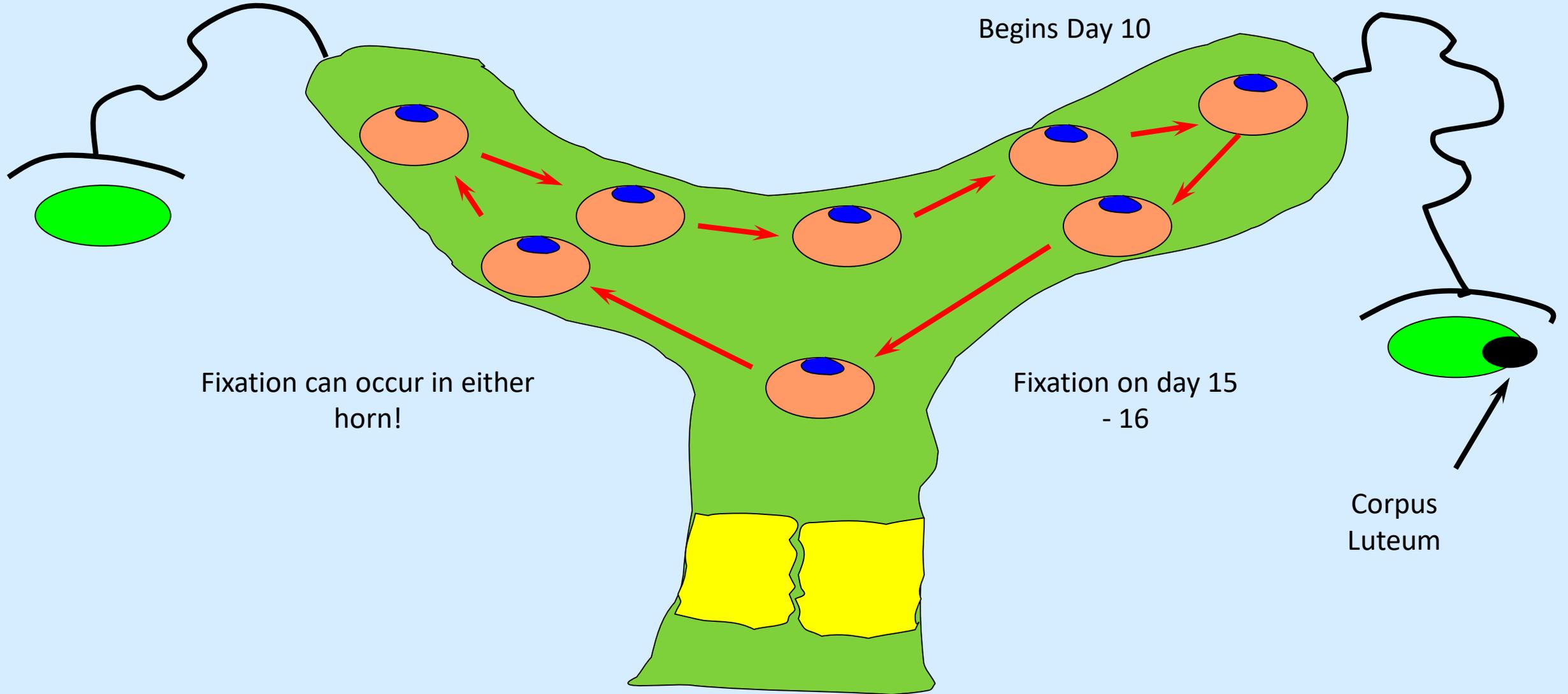


Day 12

Embryos become fixed

Transuterine migration is rare in cow and ewe!

# Trans-uterine Migration in the Mare

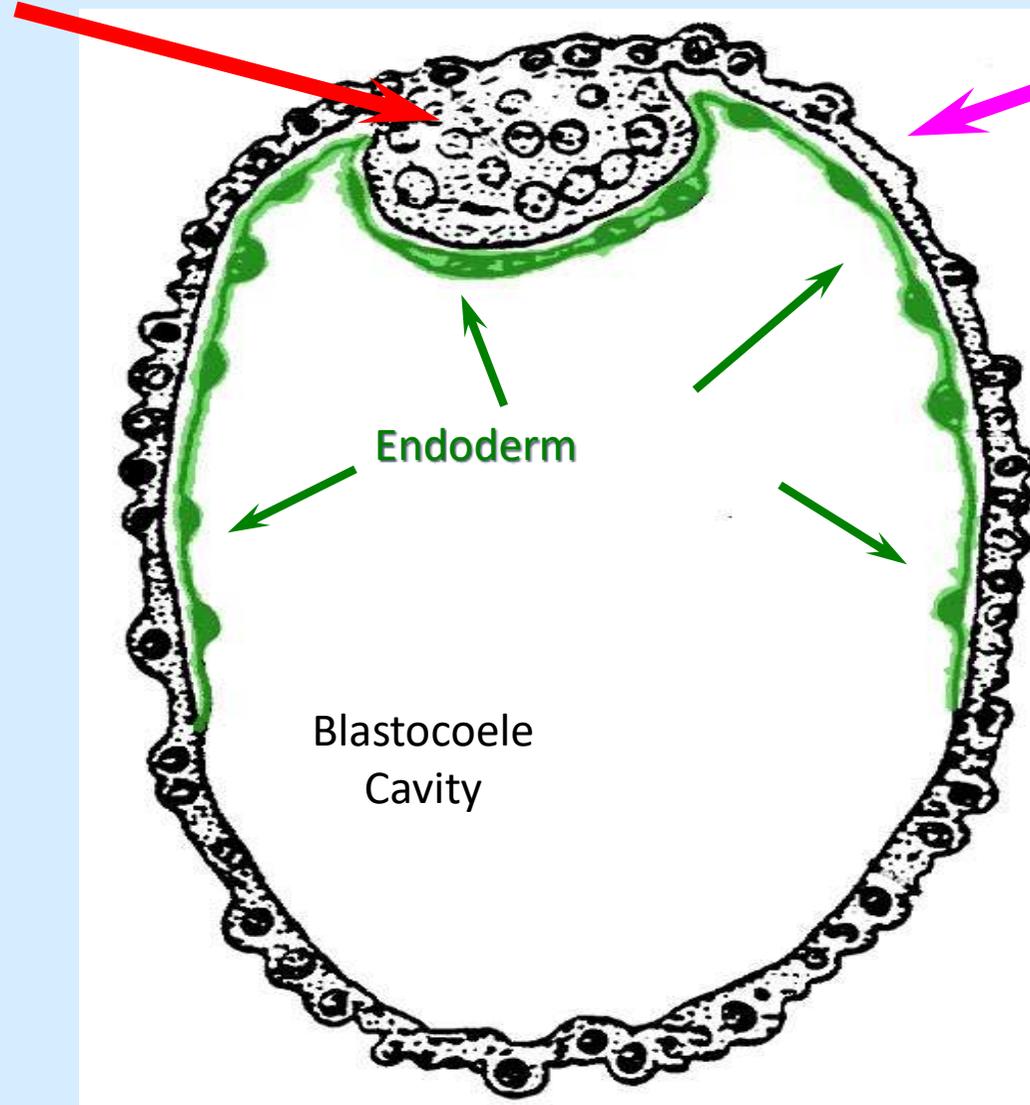


# Gastrulation

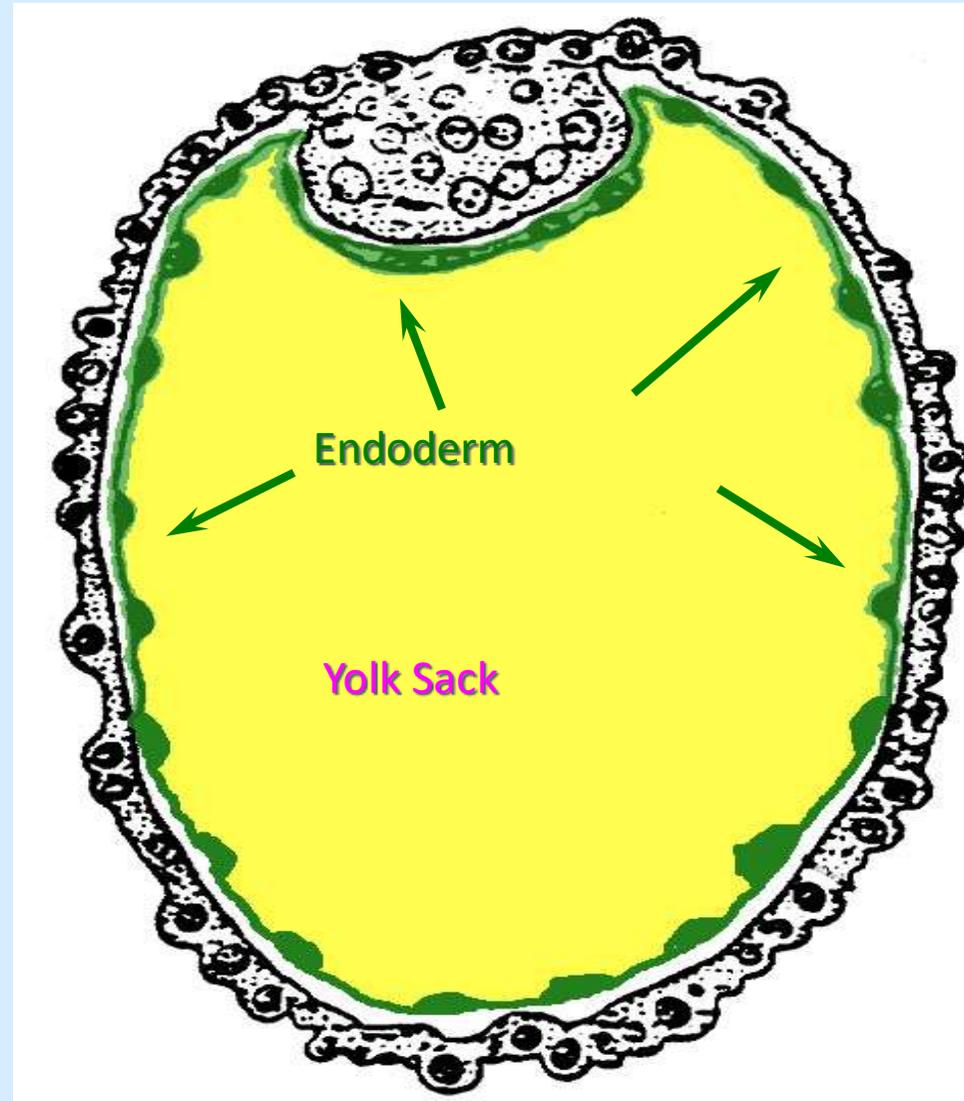
Inner Cell Mass

Trophectoderm

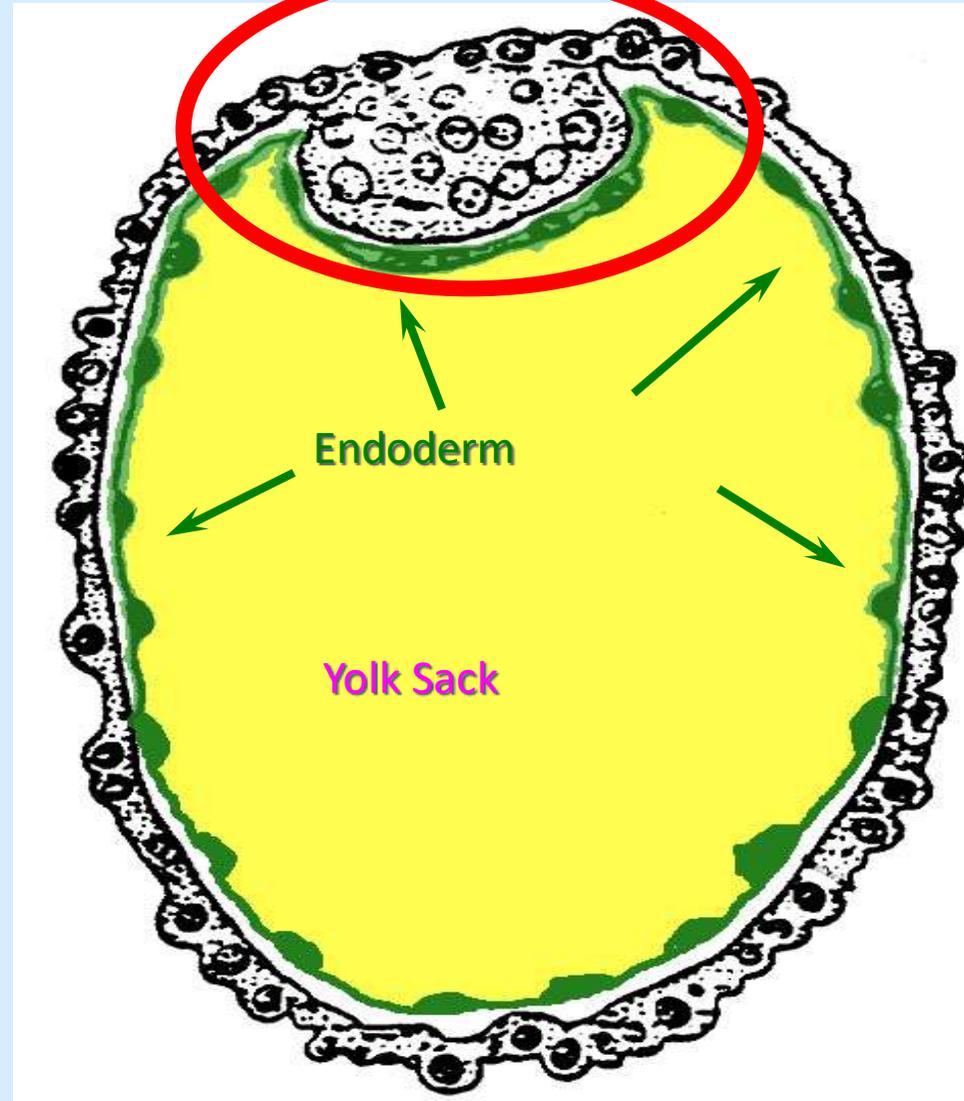
Formation of  
Germ Layers



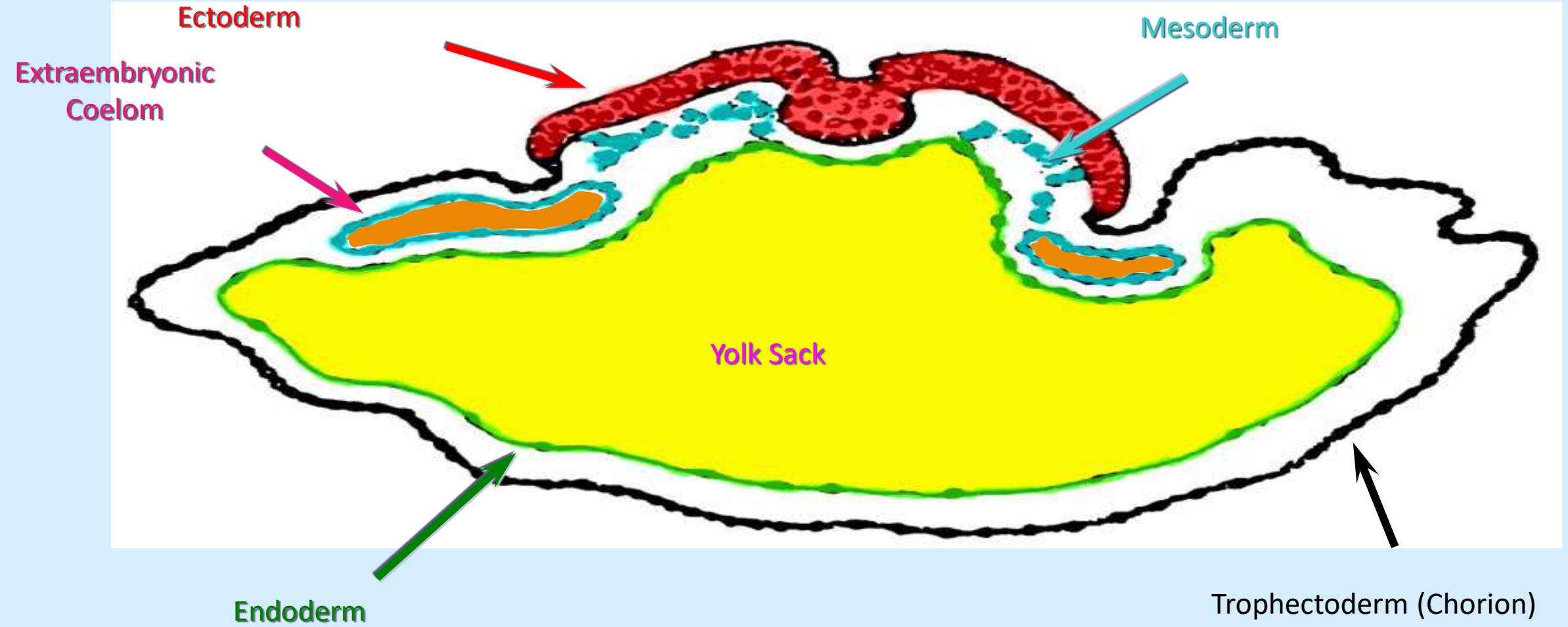
# Gastrulation



# Gastrulation



# Gastrula



# Germ Layers

- Ectoderm
  - CNS
  - Sense organs
  - Mammary glands
  - Sweat glands
  - Skin
  - Hair
  - hooves
- Mesoderm
  - Circulatory
  - Skeletal
  - Muscle
  - Reproductive tracts
  - Kidneys
  - Urinary ducts
- Endoderm
  - » Digestive
  - » Liver
  - » Lungs
  - » Pancreas
  - » Thyroid gland
  - » Other glands

# Fetal membrane Formation

Embryonic  
Ectoderm

Amniotic Folds

Extraembryonic Coelom

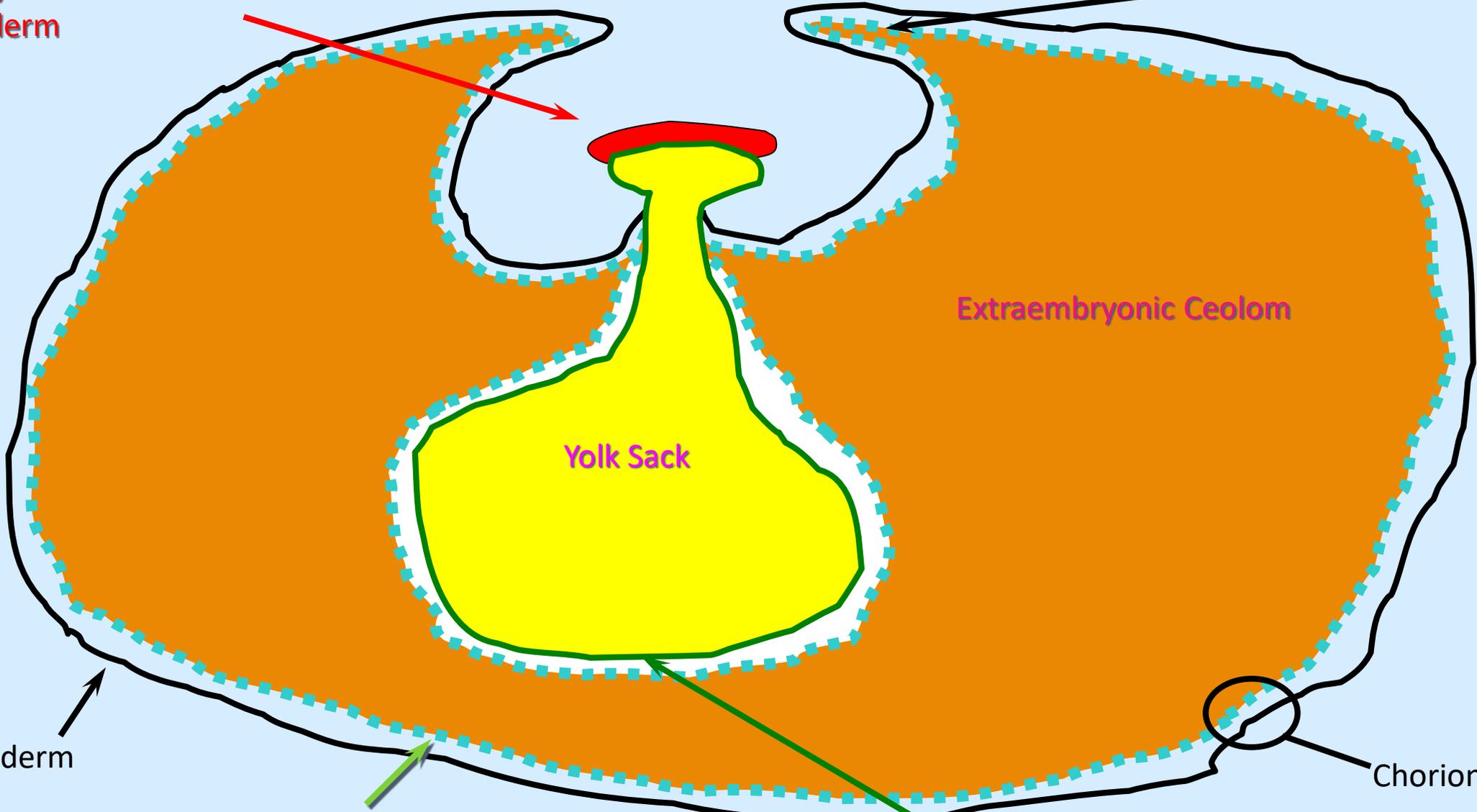
Yolk Sack

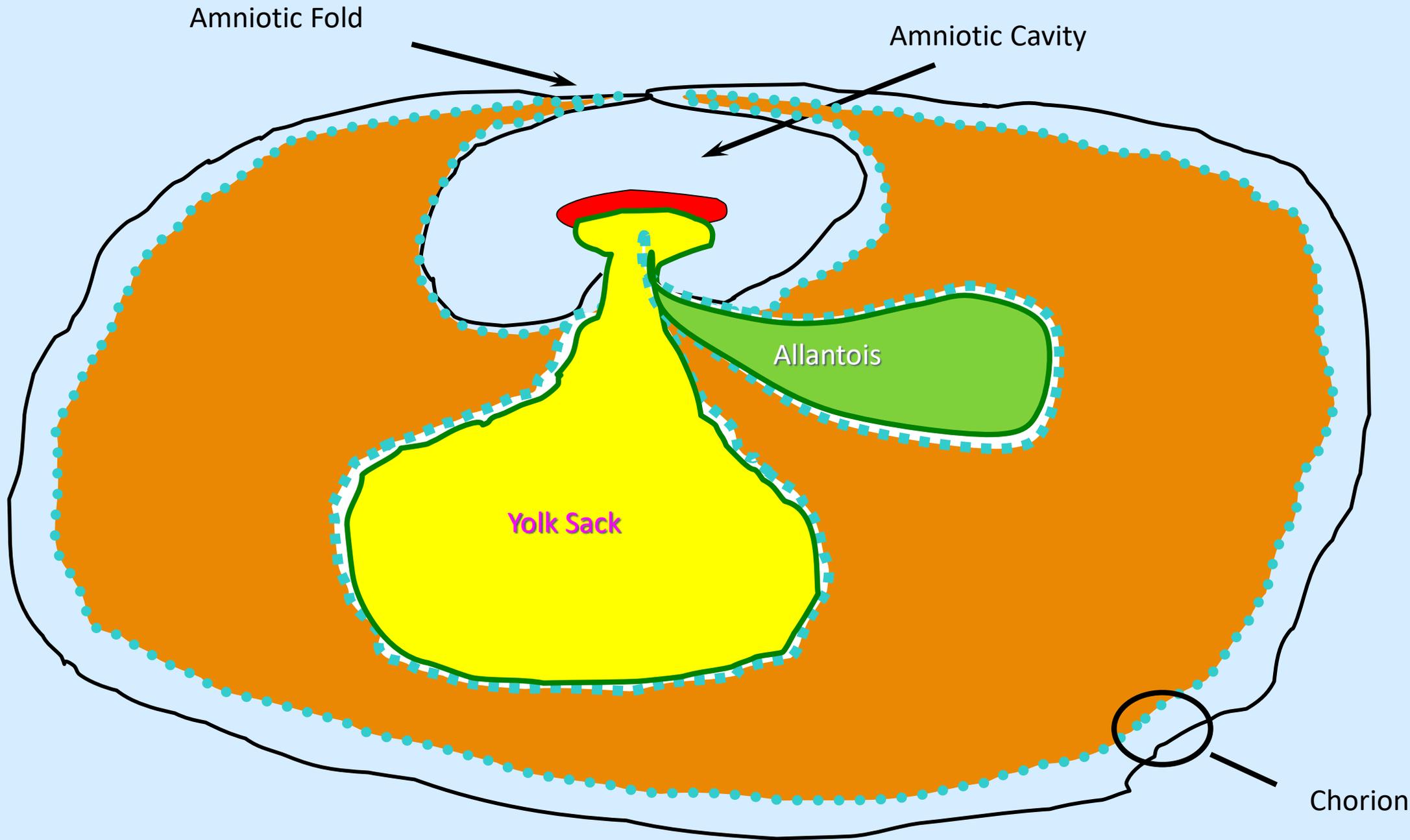
Trophectoderm

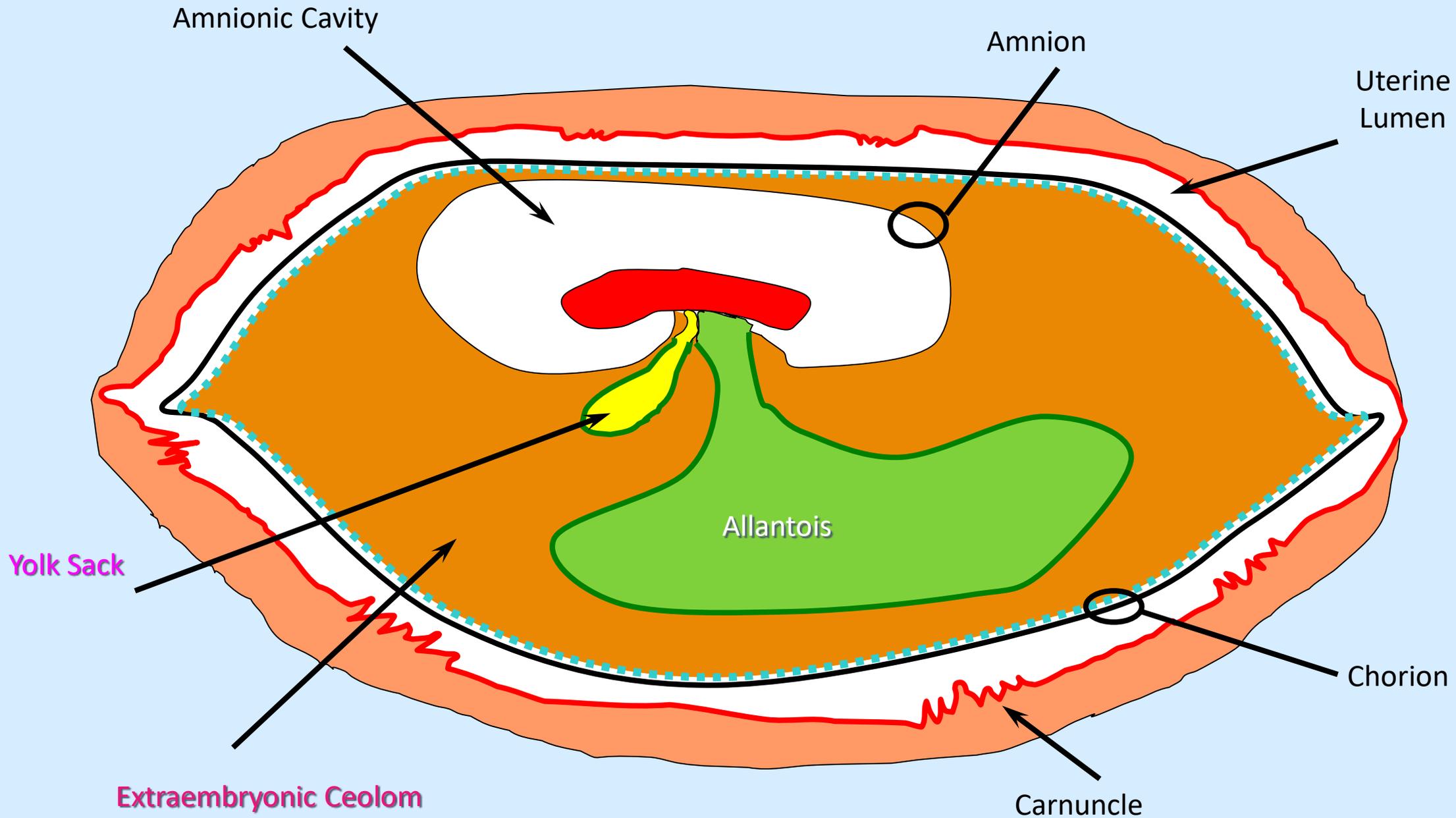
Mesoderm

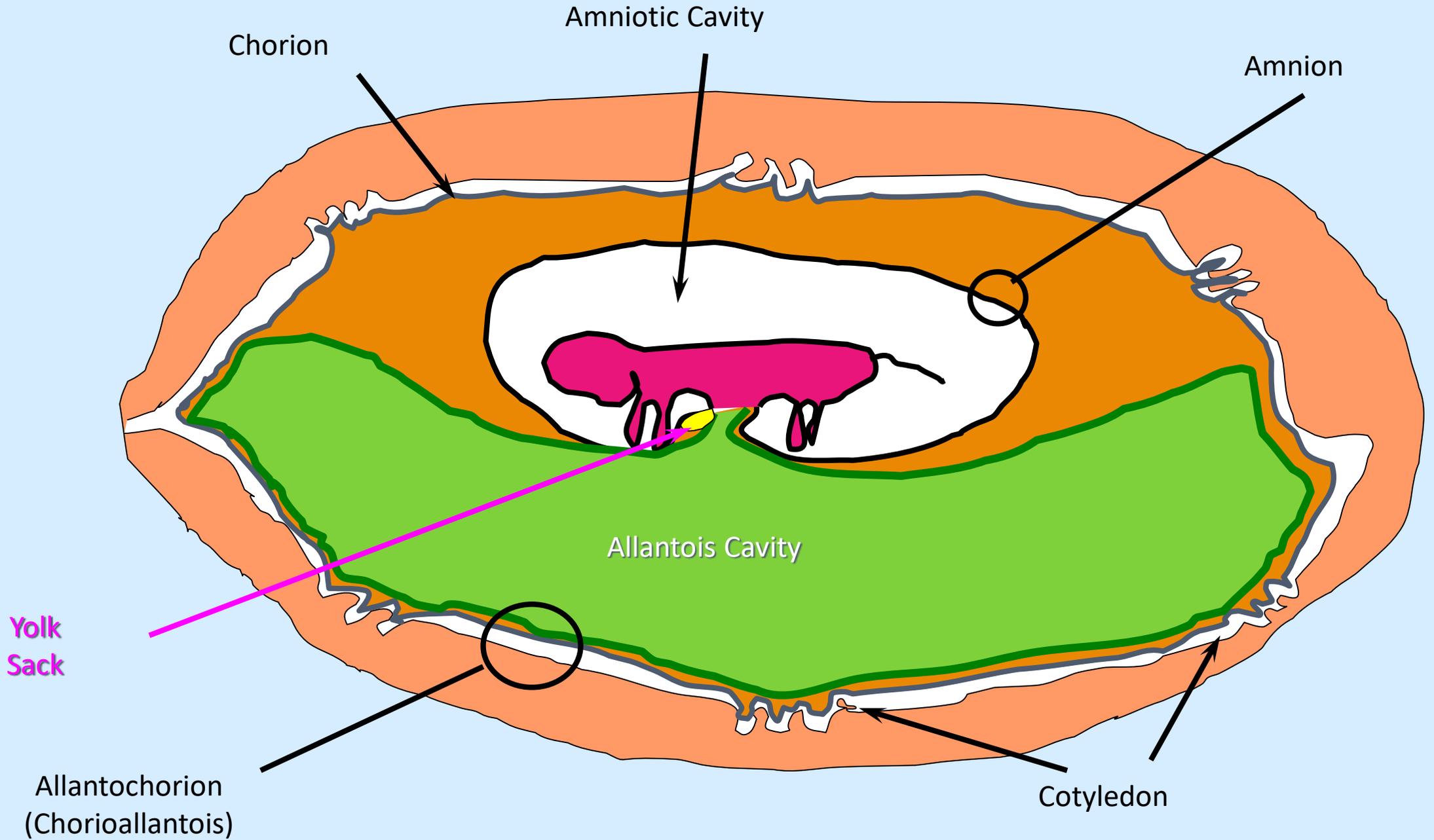
Endoderm

Chorion









# Fetal (Placental) Membranes

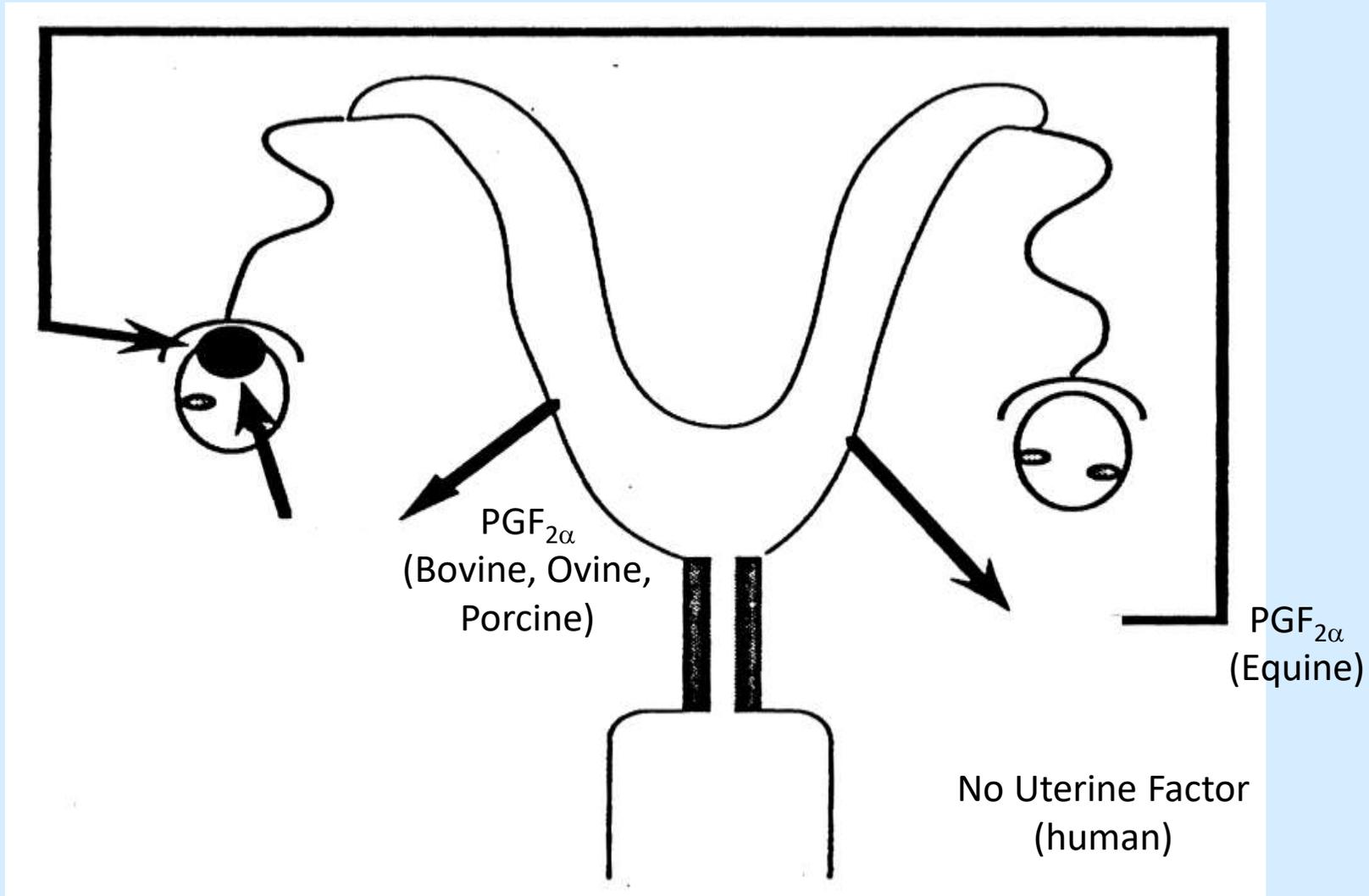
- Yolk Sack
  - In birds to nourish embryo
  - In mammal atrophies but source of blood cells and primordial germ cells
- Amnion
  - Non-vascular, fluid filled
  - Fluid produced by fetus
  - Protective cushion
  - Ruptures at birth (not breaking of water)

# Placental Membranes

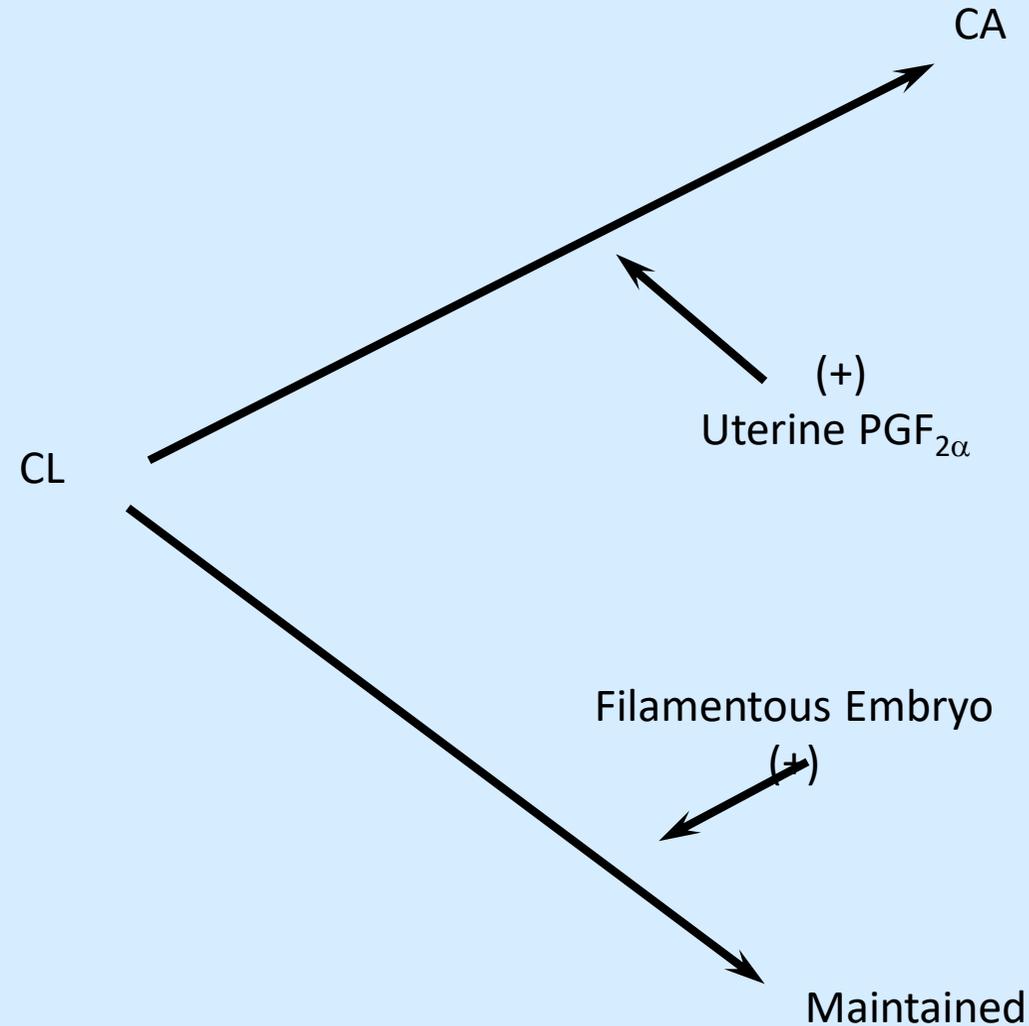
- Allantois
  - Blood vessels
  - Fuses with chorion
    - Allantochorion or chorioallantois
    - Brings blood vessels to chorion
- Chorion
  - Outermost membrane
  - Attachment to mother

# Maternal Recognition of Pregnancy

# Luteal Regression



# CL Status



## Mechanisms

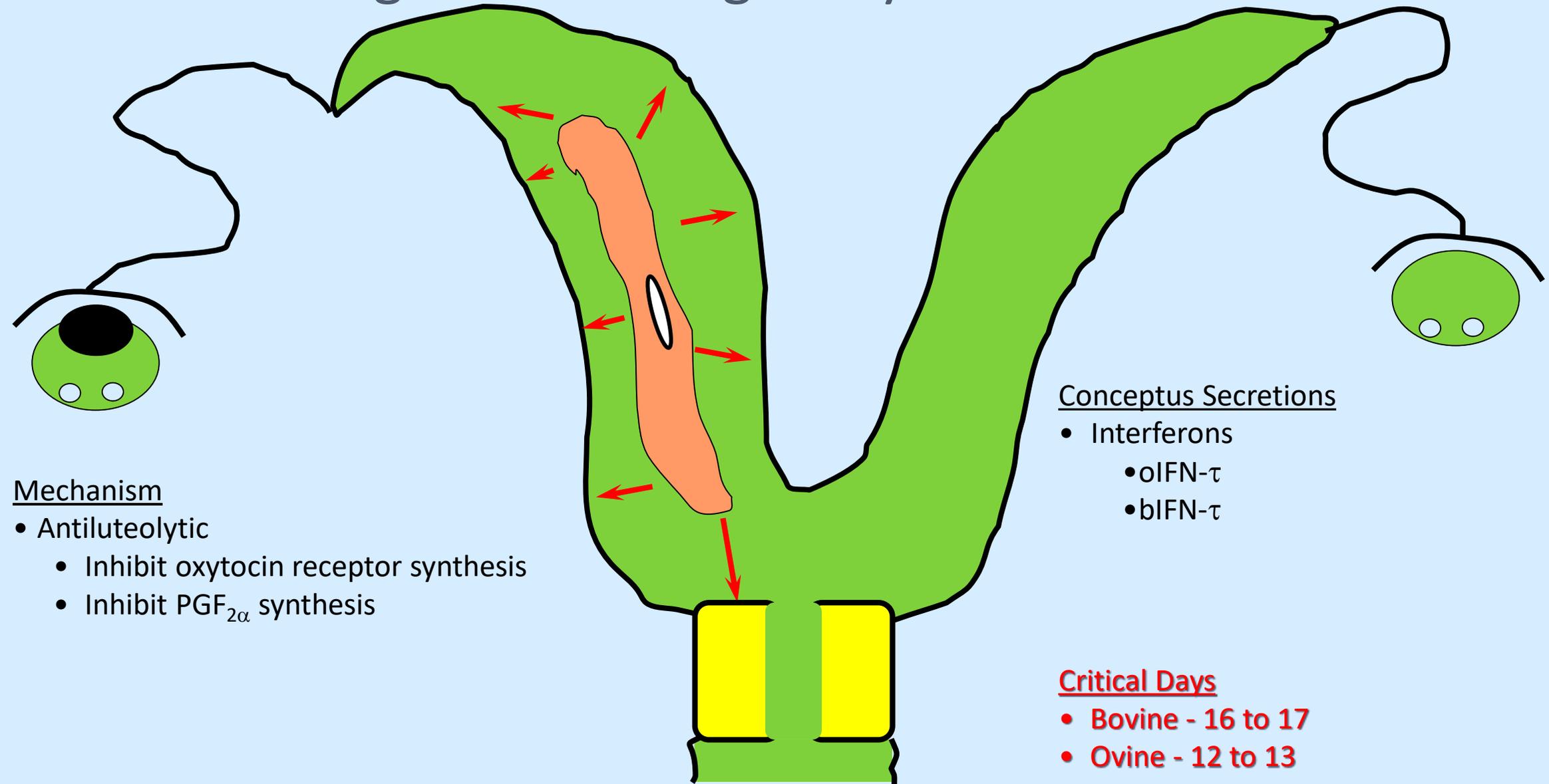
### CL Regression

- Luteolytic
- No CL support

### CL Maintenance

- Antiluteolytic
  - » Block PGF<sub>2α</sub> effects
- Luteotrophic
  - » Stimulate progesterone production by CL

# Recognition of Pregnancy in Bovine and Ovine



## Mechanism

- Antiluteolytic
  - Inhibit oxytocin receptor synthesis
  - Inhibit  $\text{PGF}_{2\alpha}$  synthesis

## Conceptus Secretions

- Interferons
  - oIFN- $\tau$
  - bIFN- $\tau$

## Critical Days

- Bovine - 16 to 17
- Ovine - 12 to 13

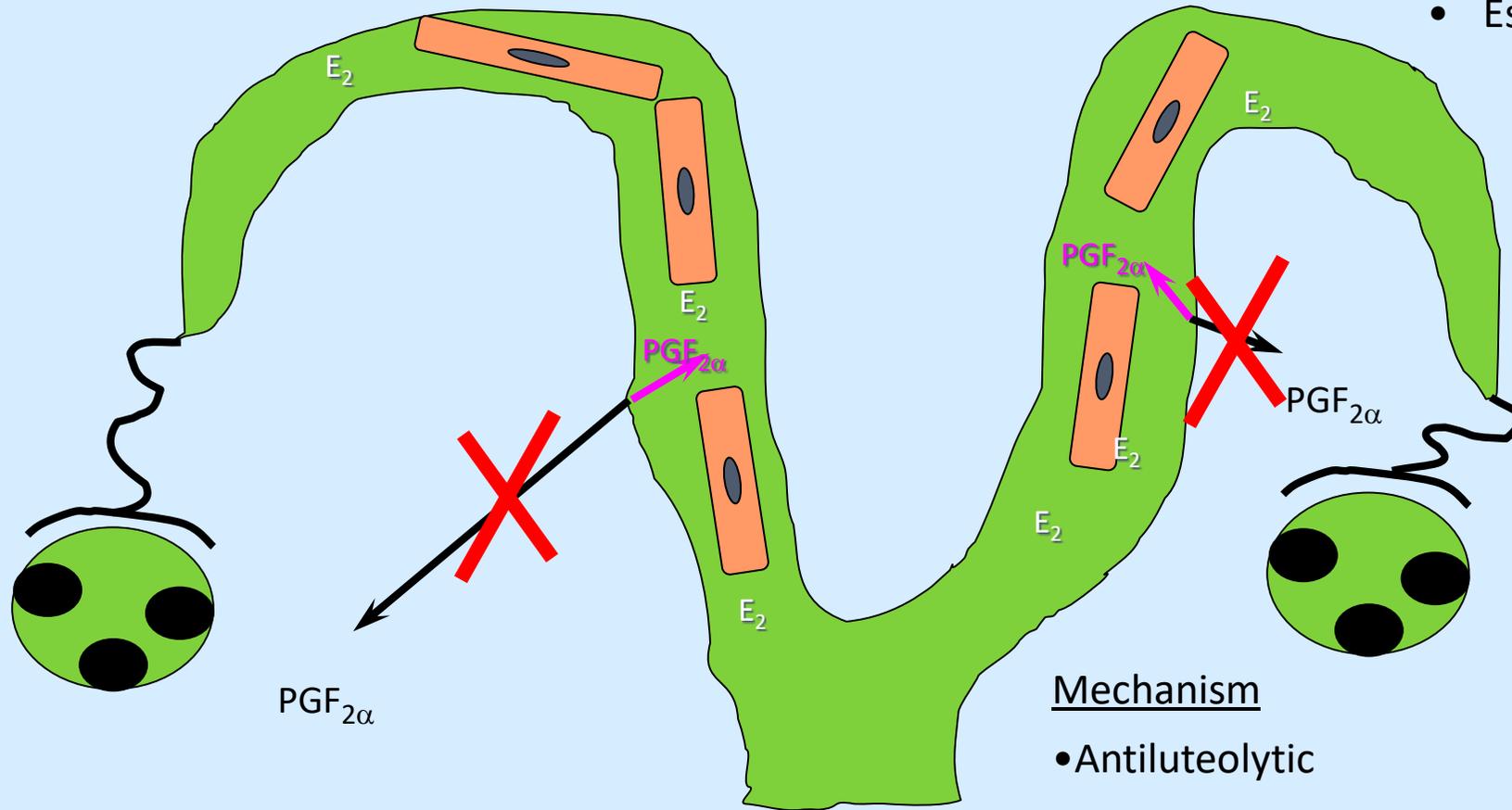
# Recognition of Pregnancy in the Porcine

## Conceptus Secretions

- Estradiol

## Critical Days

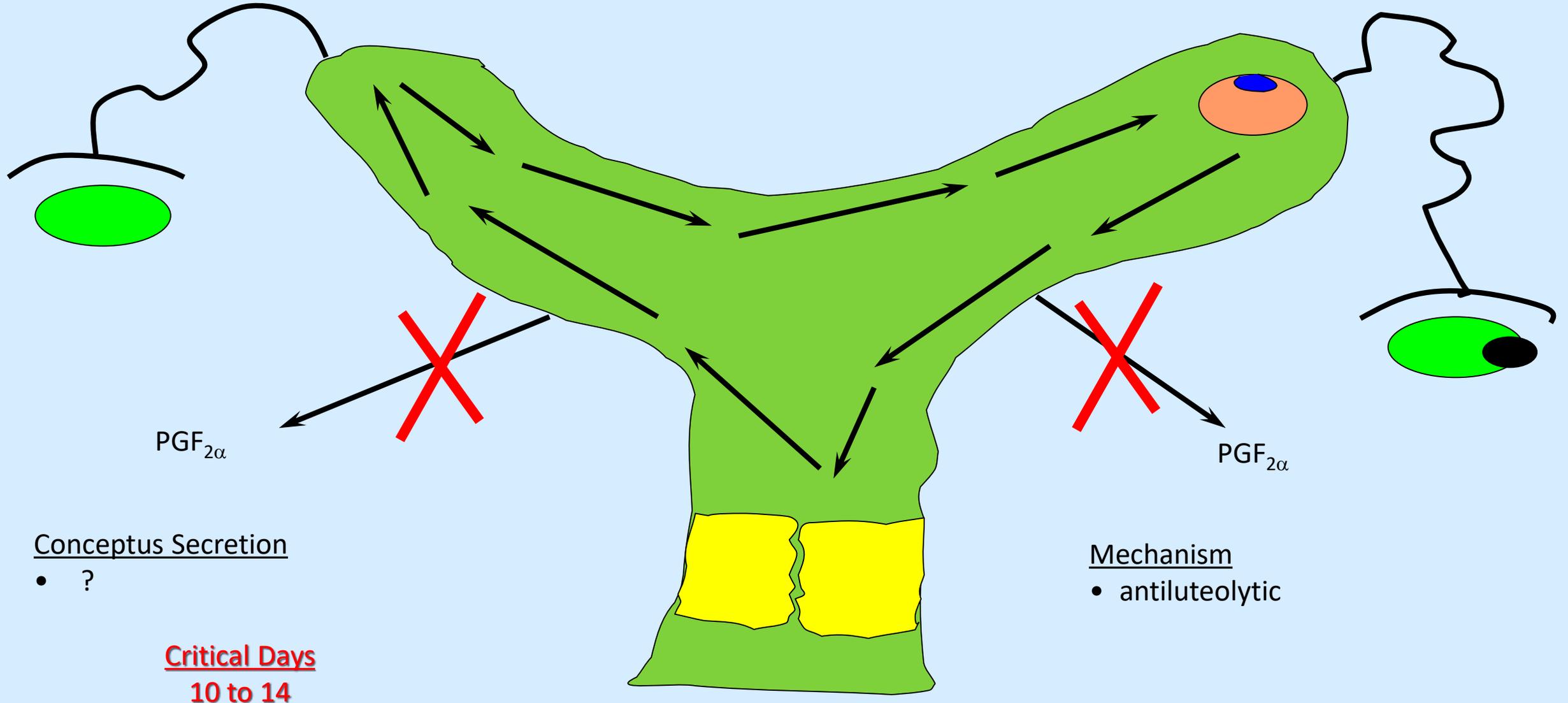
11 to 12



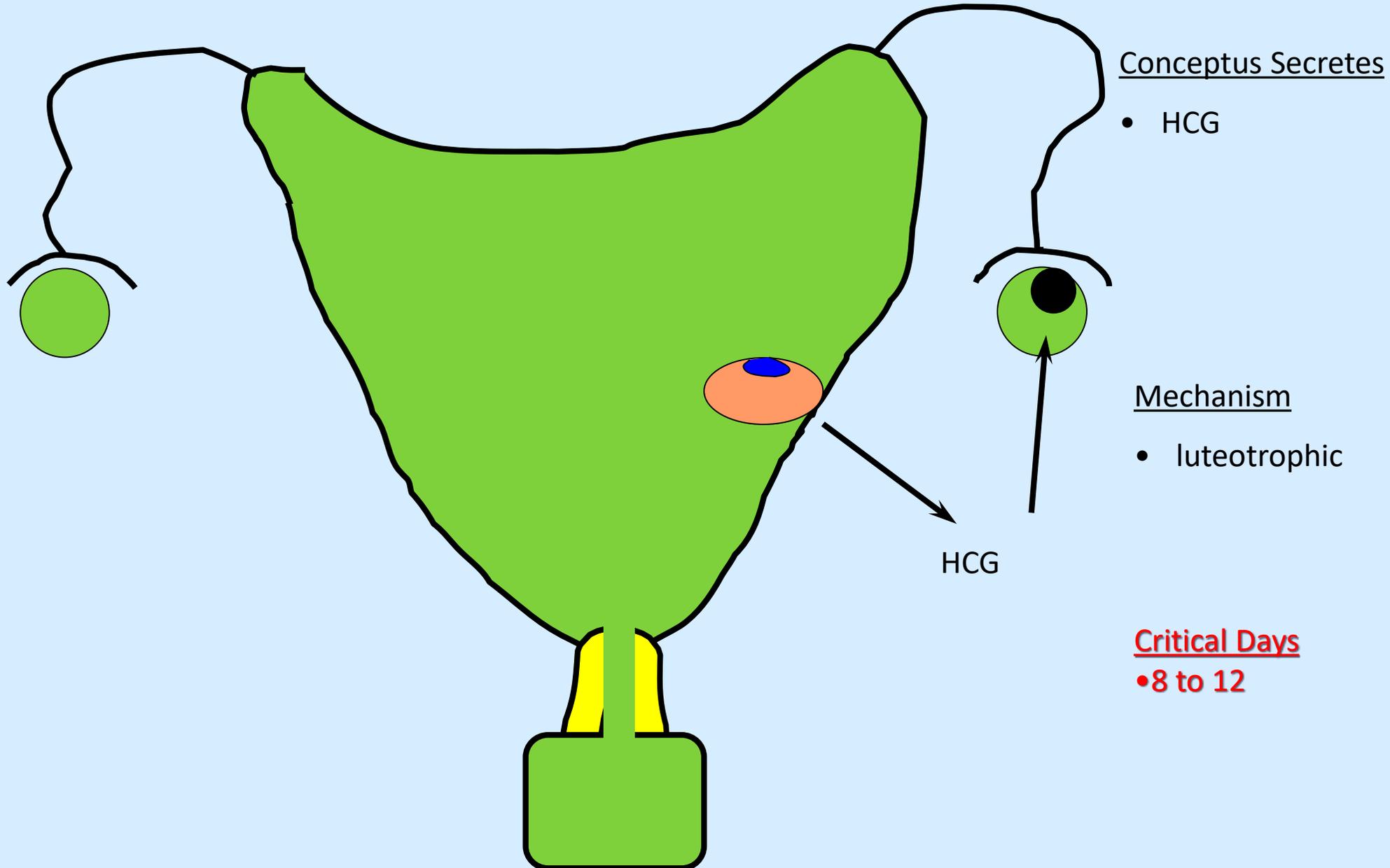
## Mechanism

- Antiluteolytic
  - » Redirect PGF<sub>2α</sub>
  - » Requires 2 embryos per horn

# Recognition of Pregnancy in the Mare



# Recognition of Pregnancy in the Human



# Dog and Cat

- CL does not regress if not pregnant
  - no uterine effect
- Psuedopregnancy
  - CL last similar length as in pregnancy

# Implantation

# Time of Implantation

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## Attachment to Uterus

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Species	Beginning	Completion
pig	13	24
cow	22	40
sheep	15	28
mare	24 - 40	95 - 100
human	7 - 8	30

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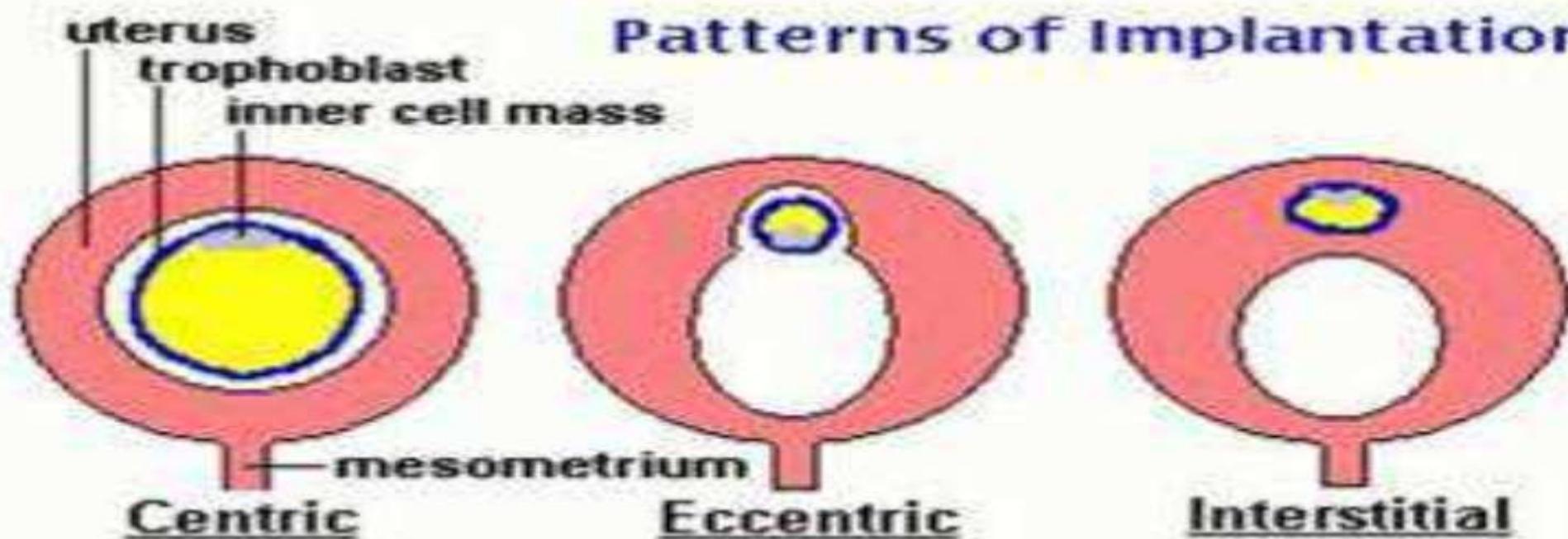
**The time from ovulation, during which implantation occurs in different species.**

Species	Time (days )
Cattle	17 to 35
Sheep	14 to 18
Pigs	12 to 16
Horses	17 to 56
Dogs	14 to 18
Cats	12 to 14
Human	6 to 7

# Type of Implantation

- Centric
  - Chorion lies opposed to uterine wall
  - Farm animals
- Eccentric
  - Chorionic sack in a uterine fold
  - Rodent
- Interstitial
  - Embryo digests part of uterine wall
  - human

## Patterns of Implantation



# Thank You

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