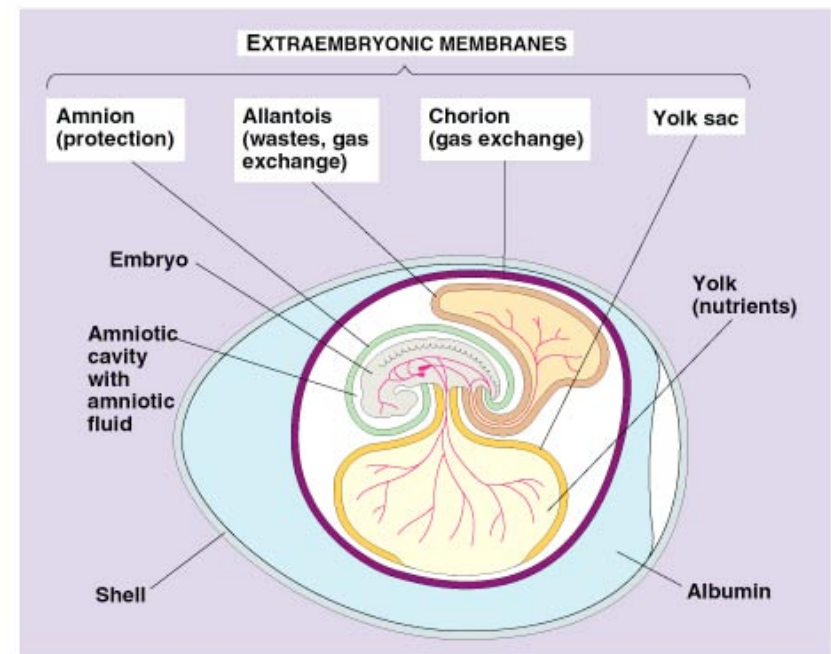


Egg Membranes and Placentae

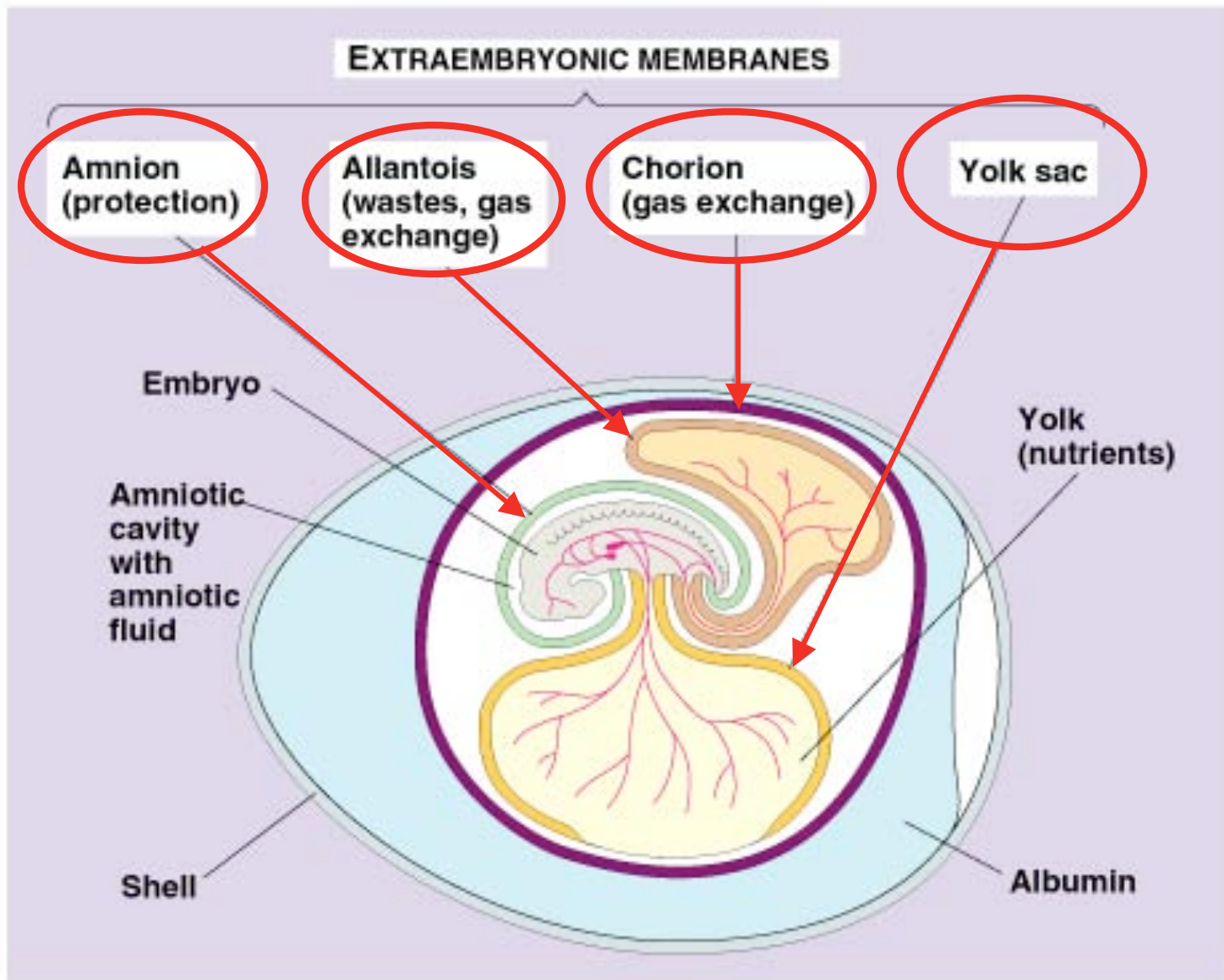


ANAMNIOTES - AMNIOTES

- In vertebrates distinction between those with extra embryonic membranes and those without
 - **ANAMNIOTES** - without (e.g. fish, amphibians)
 - **AMNIOTES** - with (e.g. reptiles, birds, mammals)

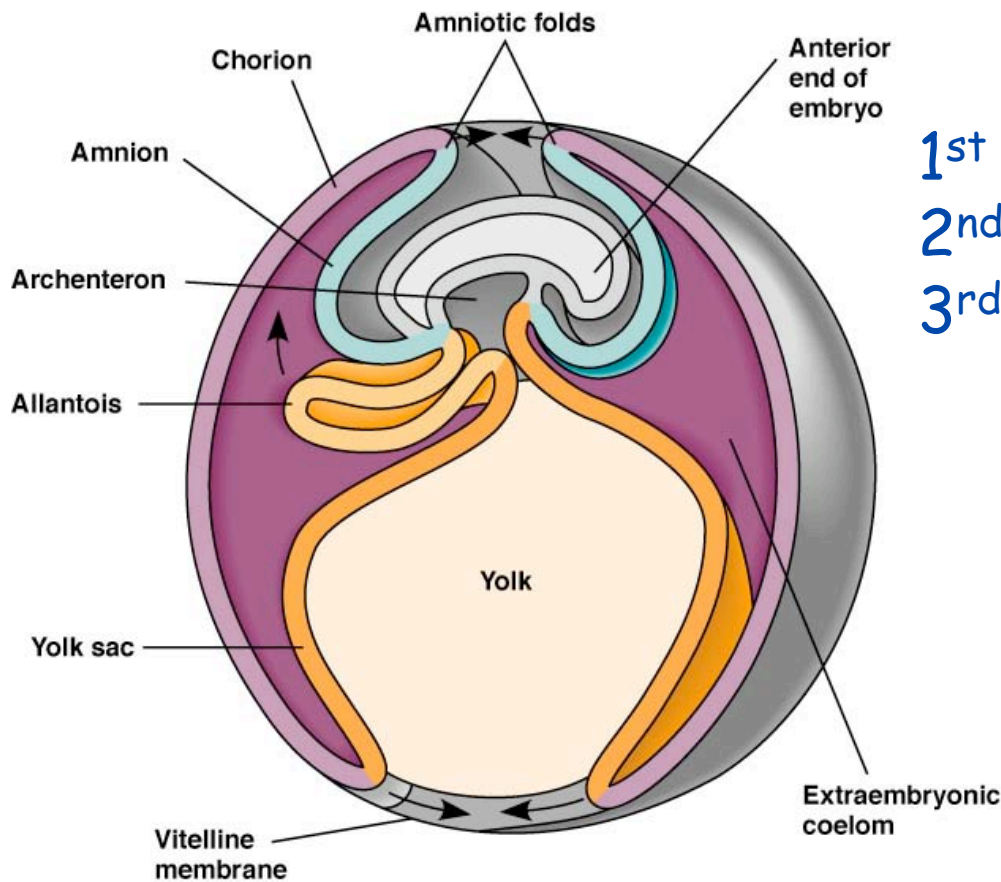
Extraembryonic Membranes

- Found in amniotes
- Evolve with reptilian 'land' egg
 - the amniote egg
- 4 distinct membranes
 - yolk sac
 - amnion
 - allantois
 - chorion



Development of membranes

- Initially - no distinction between embryonic and extraembryonic
- As body forms, border epithelia form folds - **BODY FOLDS**
 - surround embryo and isolate it from yolk

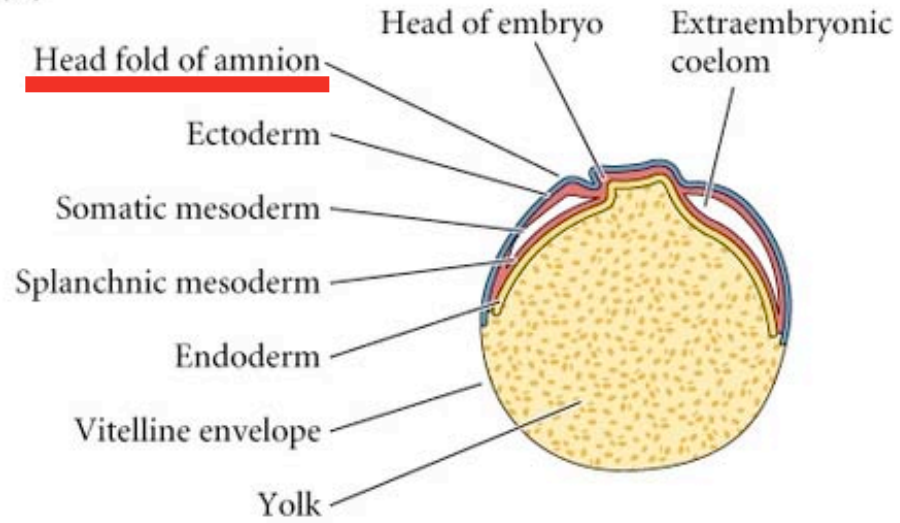


- 1st - head fold
- 2nd - lateral folds both sides
- 3rd - tail fold undercuts tail

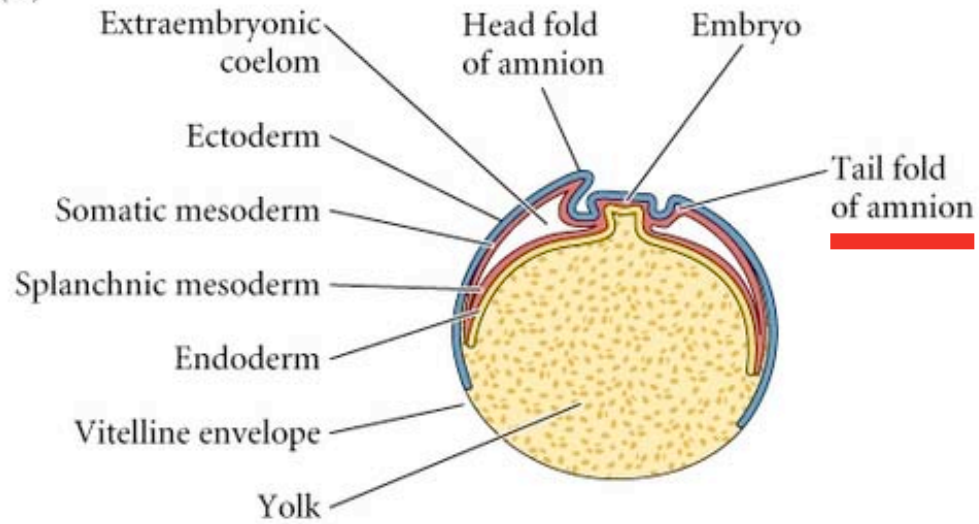
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folds create composite membranes

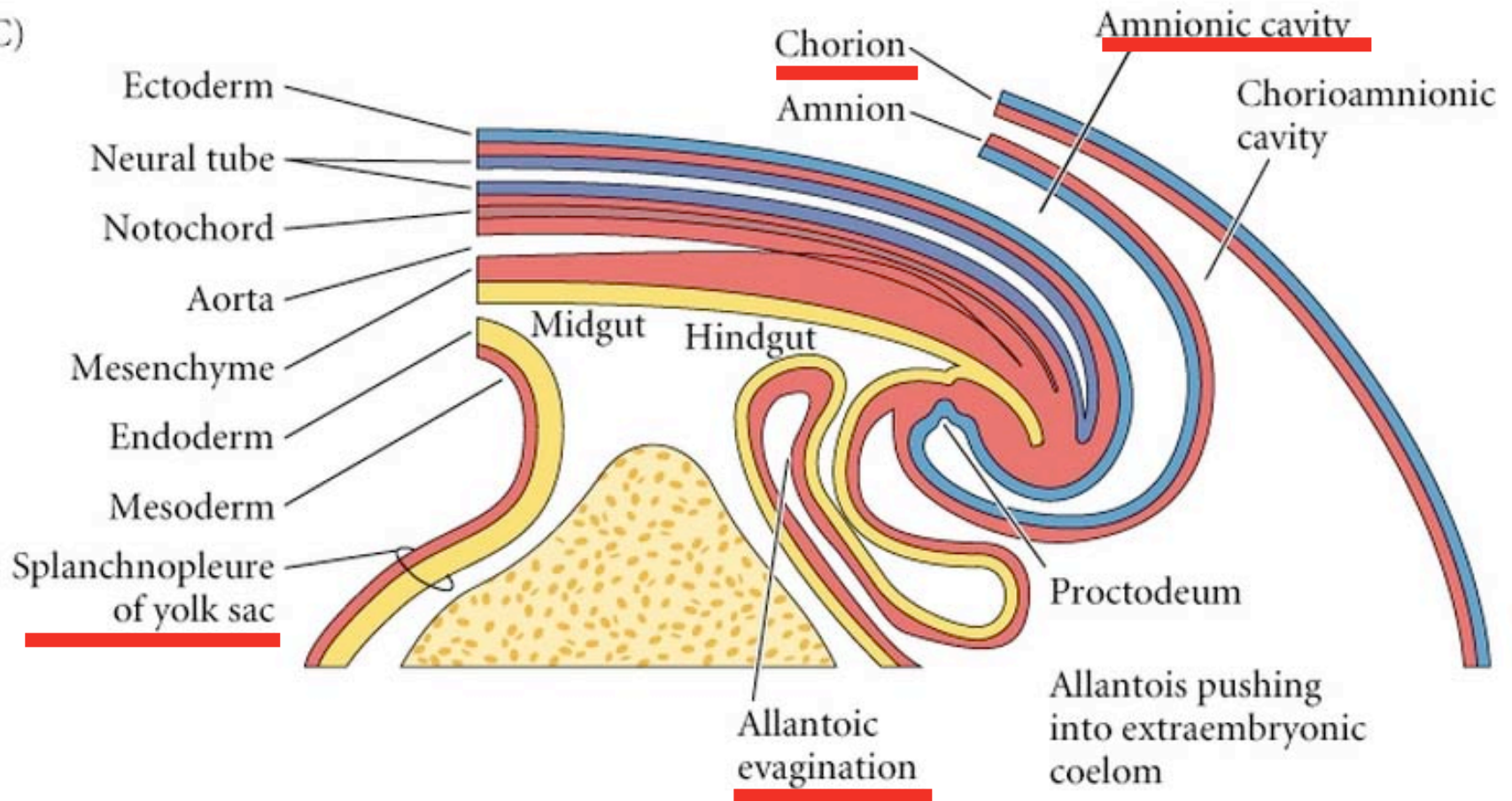
(A)

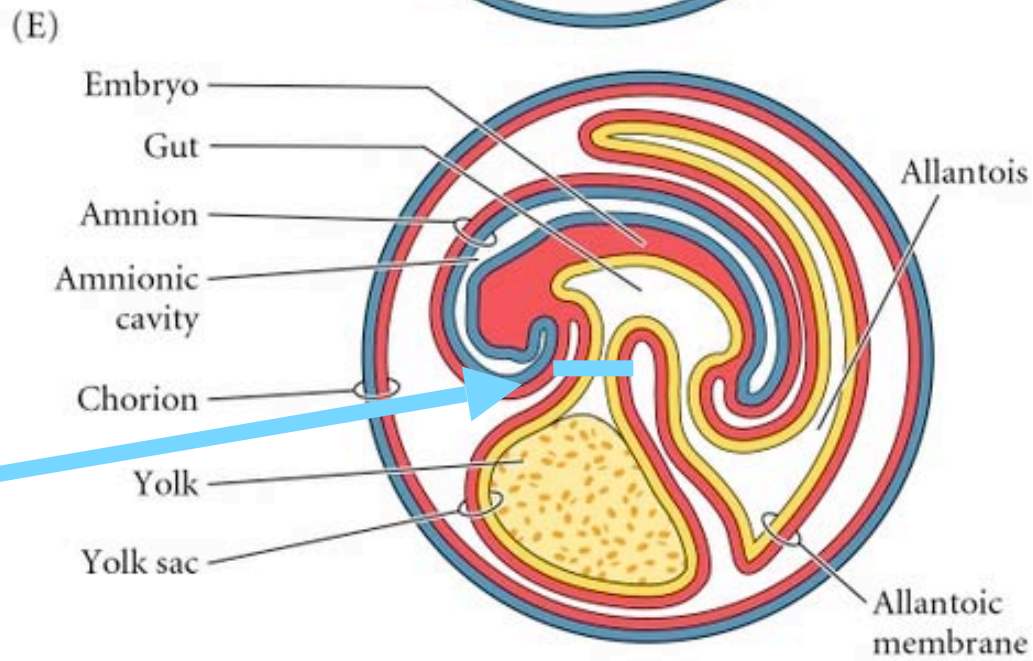
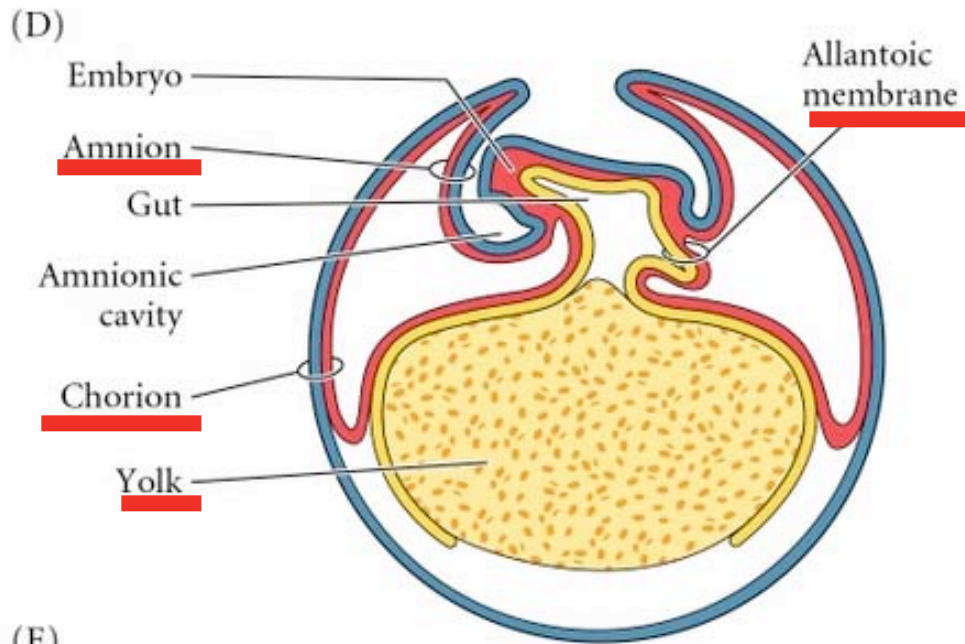


(B)



(C)



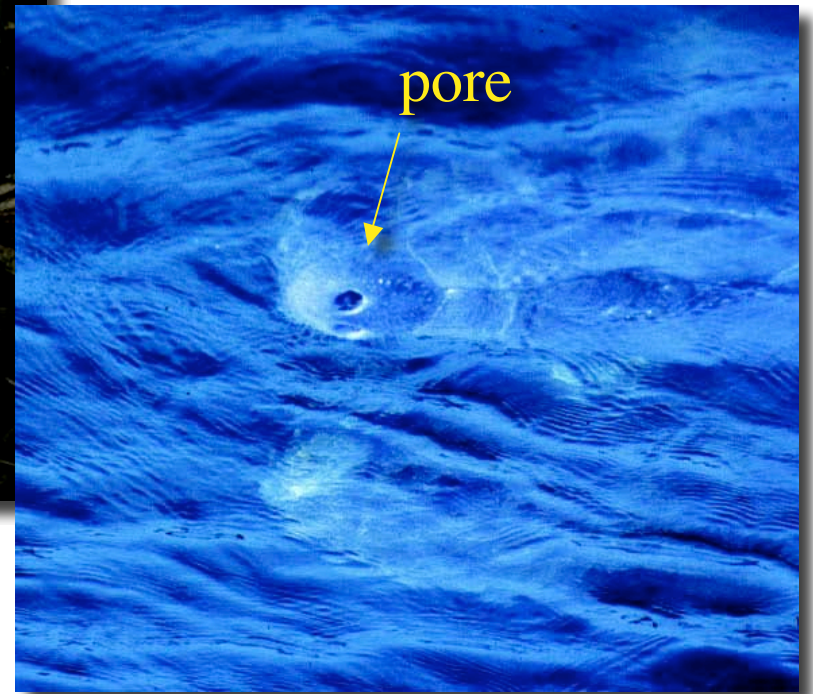


Becomes
umbilical
cord

'Land' Egg



Problem =
desiccation



Amnion = water

- Formation of amnion provides aqueous environment
- Cells of amnion secrete and absorb water
- Formation occurs with formation of chorion



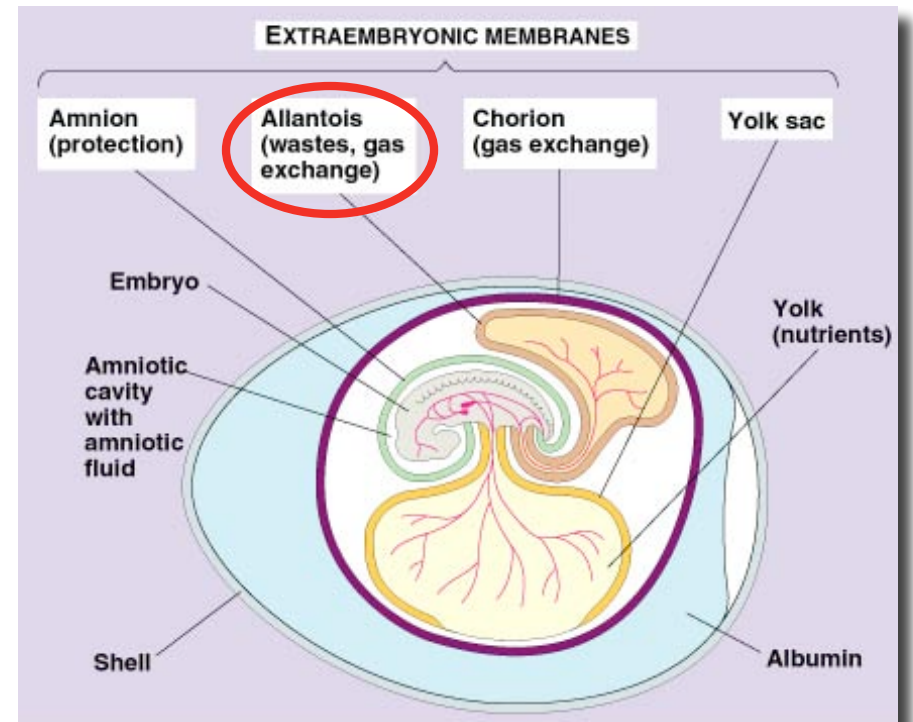
Chorioallantois = Gas Exchange

- Second problem - gas exchange
- Chorioallantoic membrane with shell to maximize gas exchange
- But.....recent work also shows it is an endocrine organ
 - A primitive endocrine placenta?

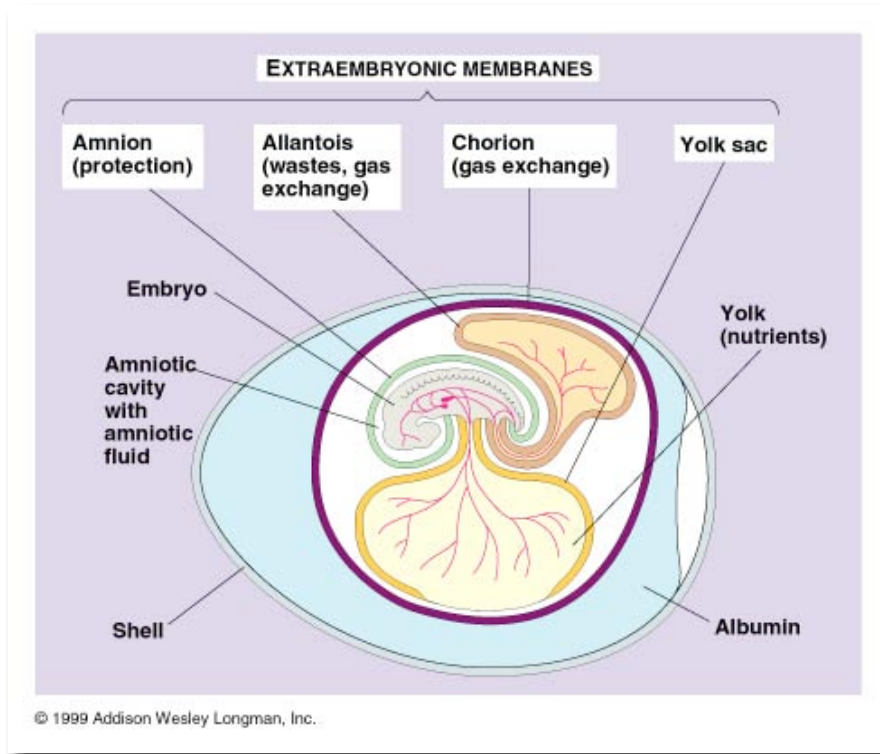


Allantois = waste removal

- 3rd problem
 - store or remove waste
- Reptiles and birds store
 - allantois stores waste
 - Forms as evagination of hindgut
 - attached to hindgut via allantoic stalk
 - highly vascularized and lies next to yolk stalk



Yolk Sac



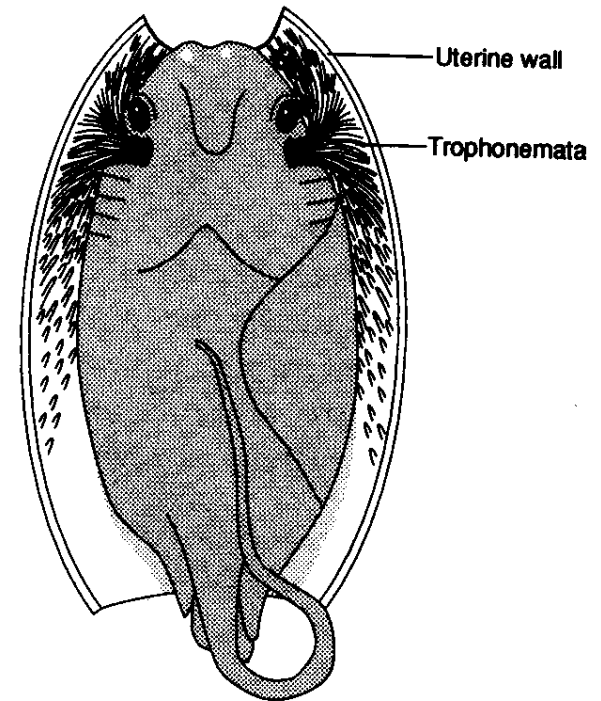
- 1st extra embryonic membrane to form
- mediates nutrition
- derived from endodermal cells that grow over yolk to enclose it

Other Extraembryonic Membranes

- Anamniotes also have 'extraembryonic' membranes

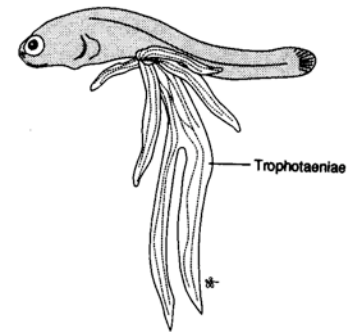
External Gills

- Hypertrophy of gills for gas exchange during development
 - chondrichthyan fishes
 - gymnophione amphibians
 - salamanders



Integumental Modifications

- Pericardial trophoderm
 - highly vascular belly wall for nutrient and gas exchange
- Pericardial sac in teleost fish can form
 - pericardial amnion (pseudoamnion)
 - pericardial chorion (pseudochorion)
- Trophotaeniae - teleost fish
 - modifications of hindgut
 - functions in gas exchange and nutrient transfer



What is a placenta?

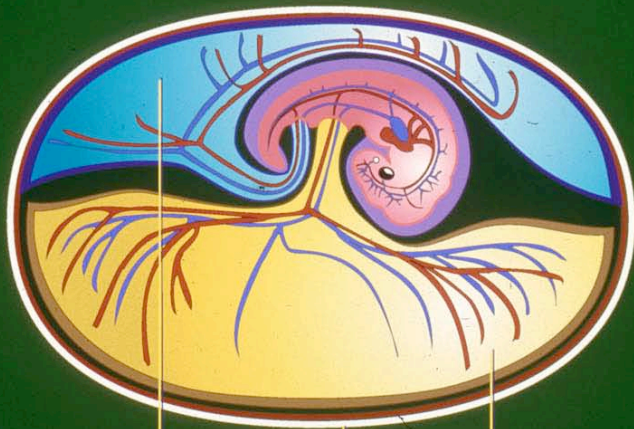
- "Structural modification of the maternal organism and/or embryo that facilitates exchange between them"
- Addresses needs of developing embryo:
 - Gas exchange
 - Waste exchange
 - Nutrients



Why a placenta?

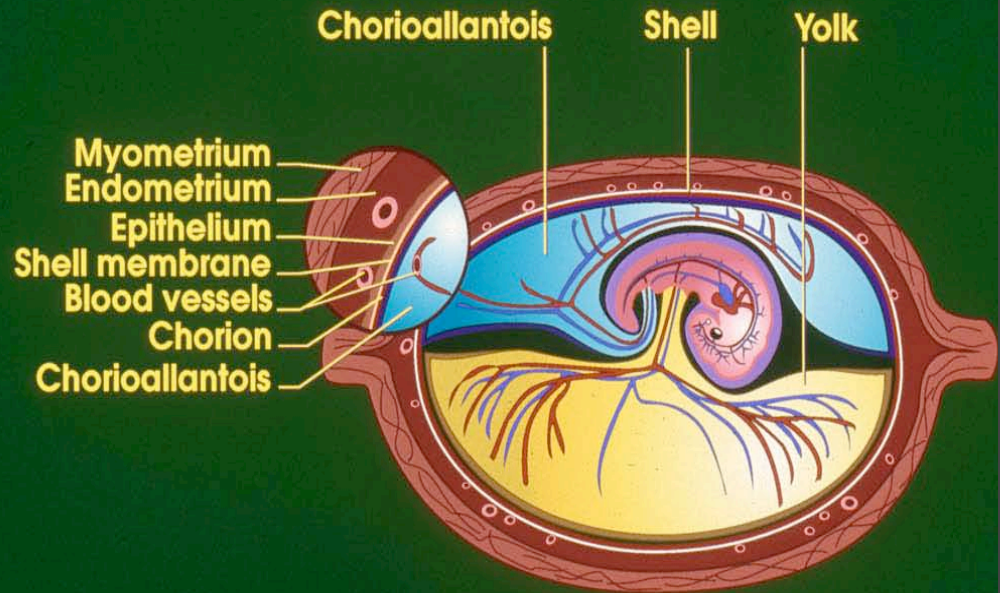
- Oviparous species
 - conduct gas / waste exchange
 - Obtain nutrients from yolk
- Viviparous species
 - Must 'communicate' with external environment via maternal tissues
 - Degree of maternal / embryo separation varies across taxa
 - Evolved independently numerous times

Oviparous Amniote



Chorioallantois Shell Yolk

Viviparous Amniote



Myometrium
Endometrium
Epithelium
Shell membrane
Blood vessels
Chorion
Chorioallantois

Chorioallantois

Shell

Yolk

Embryo Retention

Advantages

- Predator avoidance
- Maternal homeostasis
- Precociality
- Distribute cost of reproduction
- Colonization of new habitats



Embryo Retention

Disadvantages

- Maternal susceptibility to predation
- Reduced fecundity (brood size)
- Maternal requirements increased / offspring
- Reduced # of reproductive opportunities

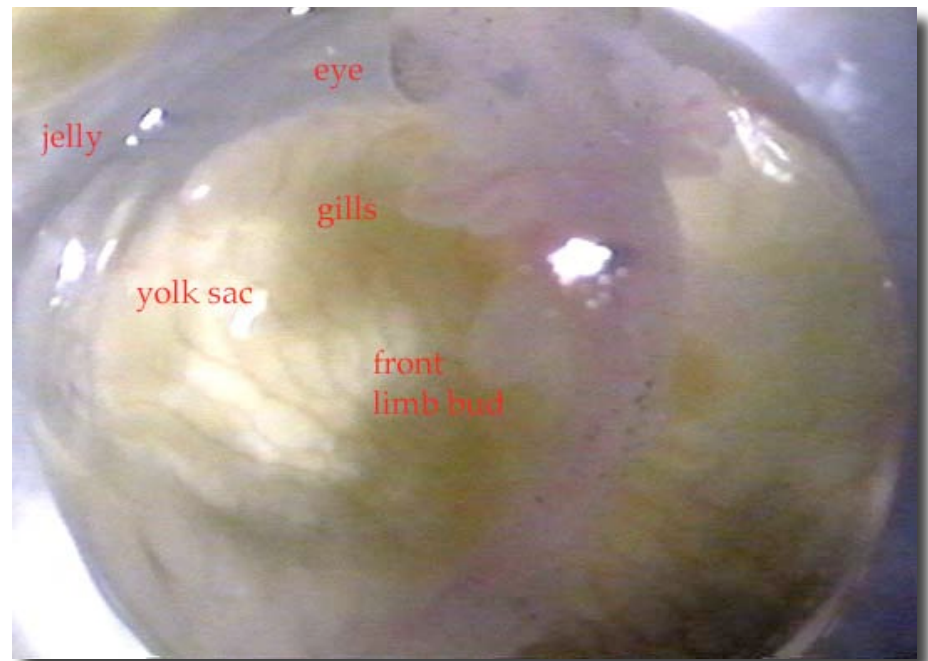
Embryonic Nutrition

- Lecithotrophy - embryo relies on endogenous yolk reserves;
 - Uptake of acellular yolk by inner yolk sac surfaces
 - (e.g., sharks, gymnophiones, reptiles, birds)
 - Uptake of acellular yolk by gut
 - (e.g., sharks)



Embryonic Nutrition

- Lecithotrophy - embryo relies on endogenous yolk reserves;
 - Breakdown of cellular yolk and direct uptake by blood vessels
 - (anurans, urodeles)



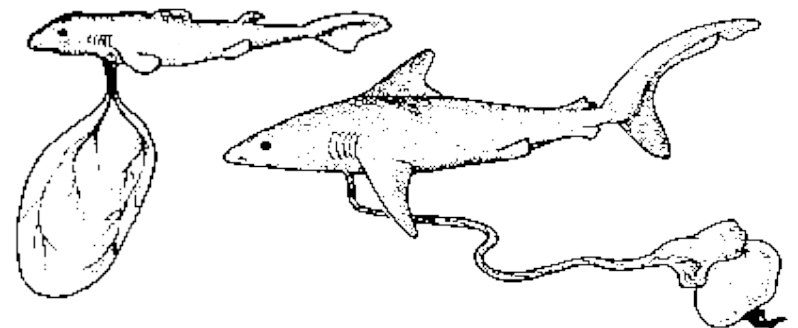
Embryonic Nutrition

- Matrotrophy - nutrients provided by maternal organism as needed
 - Enteric
 - Imbibement of maternal secretions
 - Intrauterine cannibalism
 - Hindgut uptake
 - Integumental
 - Uptake by body surfaces
 - Uptake by extra-embryonic membranes



Lecithotrophy vs. Matrotrophy

- Most ovulparous and zygoparous species are lecithotrophic
- Most embryoparous species are matrotrophic
- Exceptions
 - Lecithotropic: external brooding frogs
 - Matrotrophic: embryoparous sharks
- Determined by % change in embryo organic mass
 - 20-40% loss of organic mass in lecithotrophic



Enteric Exchange

- Uterine secretions - histotroph or uterine milk
- Trophonemata - uterine extensions
- Trophotaeniae - hypertrophy of intestinal lining
- Oophagy, Embryophagy & Uterophagy
 - Some sharks, teleosts, and urodeles



Stingray embryo, with yolk stalk (st) and yolk sac (ys) still attached, resides in the uterus (ut) adorned with secretory trophonemata (t).
From Hamlett et al. 1993.



© Miguel Andrade <http://www.viviparos.com>

www.viviparos.com/Galeria/A%20splendens.htm

Integumental Exchange

- Dermatophy involves hypertrophy of epithelial surfaces
 - Fins, gills, pericardial sac
 - Some sharks, teleosts, & amphibians



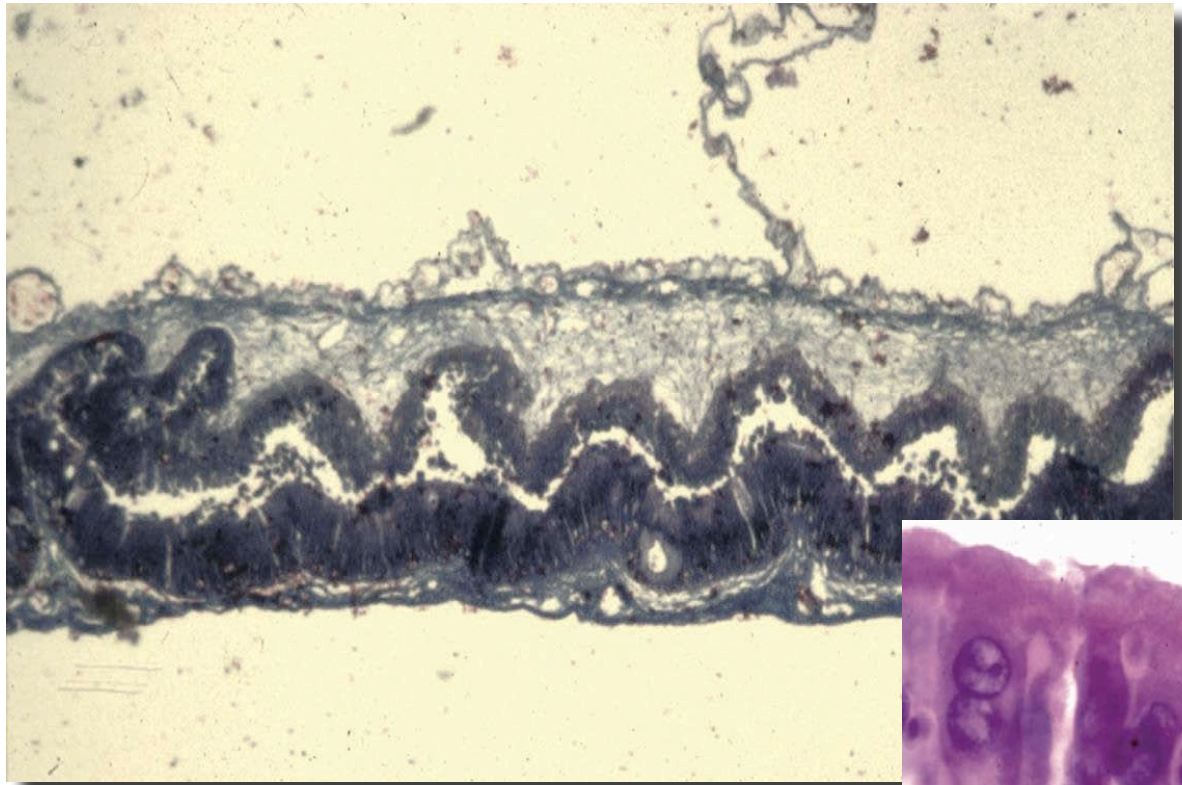
Reptilian Placentation

- **Choriovitelline** -
 - ectoderm, vascular mesoderm & yolk sac endoderm; transitory
- **Omphaloplacenta** -
 - bilaminar layer of ectoderm & yolk sac endoderm; some squamates
- **Omphalallantoic** -
 - omphalopleure associated with expanding allantois; snakes

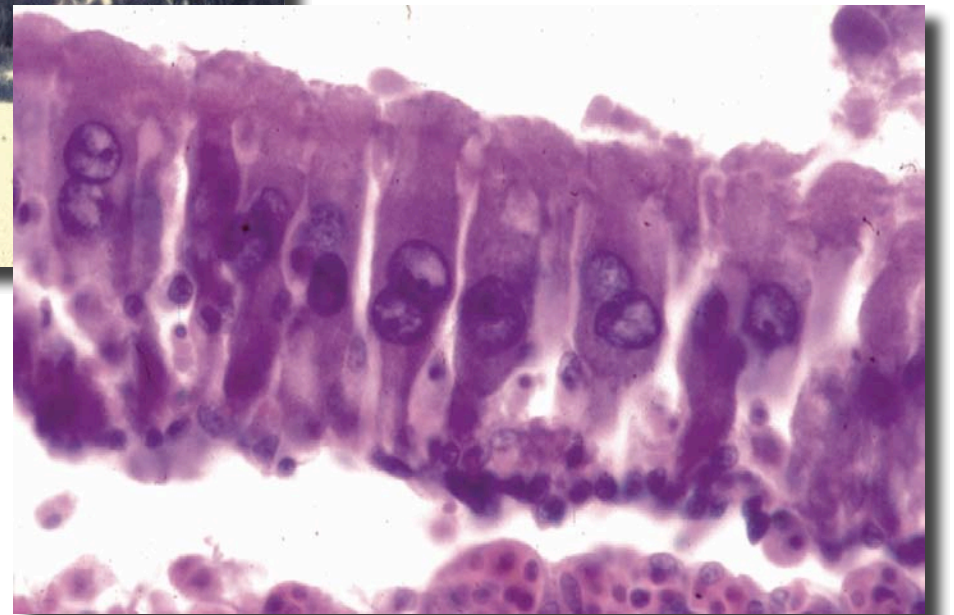
Reptilian Placentation

- Chorioallantoic -
 - fusion of allantoic mesoderm & extraembryonic somatopleure (ectoderm & mesoderm of the chorion)
 - Highly vascularized
 - Used for
 - Gas exchange
 - Waster exchange
 - Steroid synthesis
 - Nutrient exchange
 - Considered homologous to mammalian placenta

Reptilian Chorioallantoic Placenta



Chorioallantoic placenta
of the lizard *Mabuya*

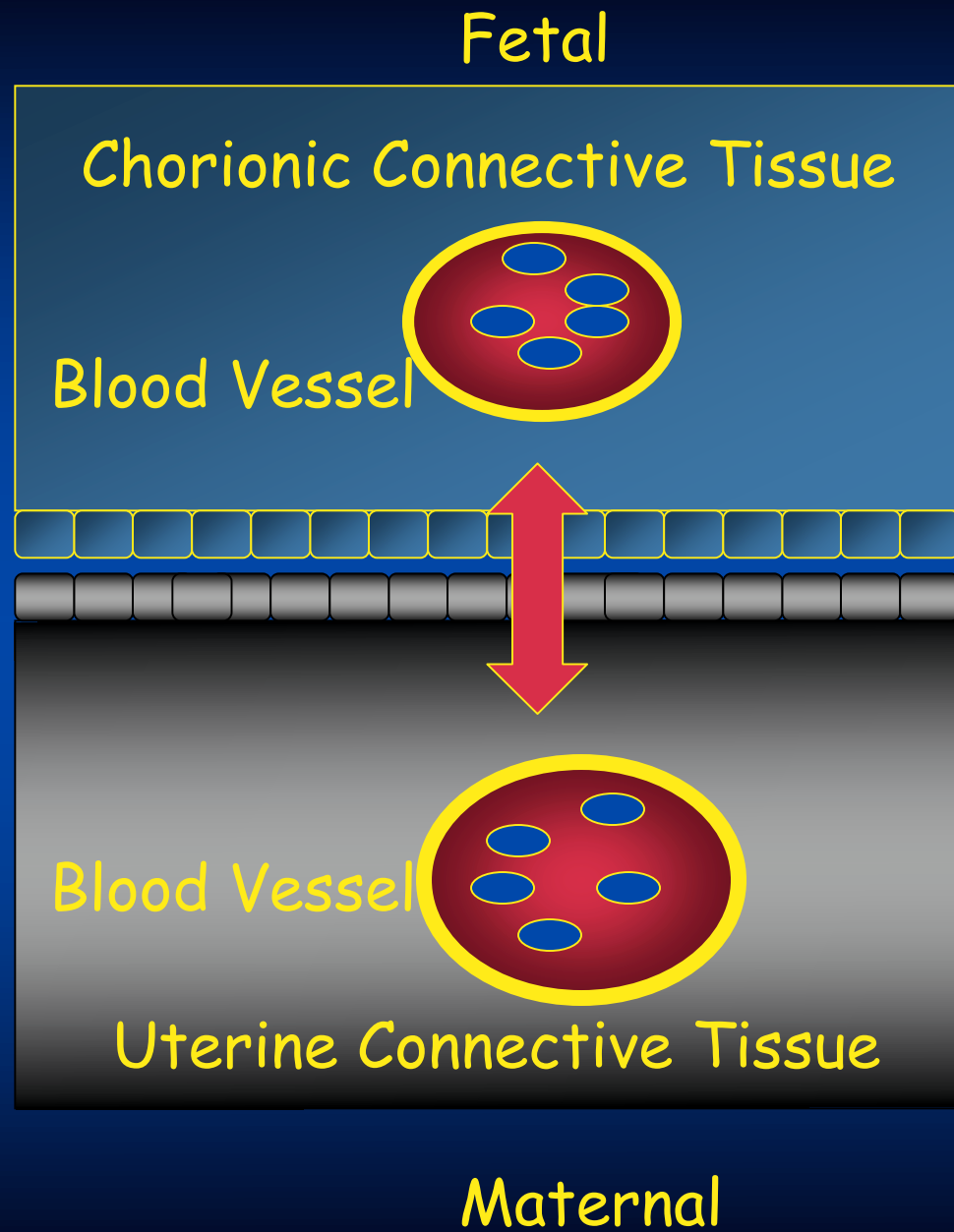


Mammalian Placentation

- Transitory placentae exist in most species
 - Yolk sac
 - Chorionic
 - Chorioamniotic
- Chorioallantoic - formed by chorion, allantois; some marsupials and all eutherians
- Chorioallantoamniotic - final placenta of artiodactyls, great apes, & humans

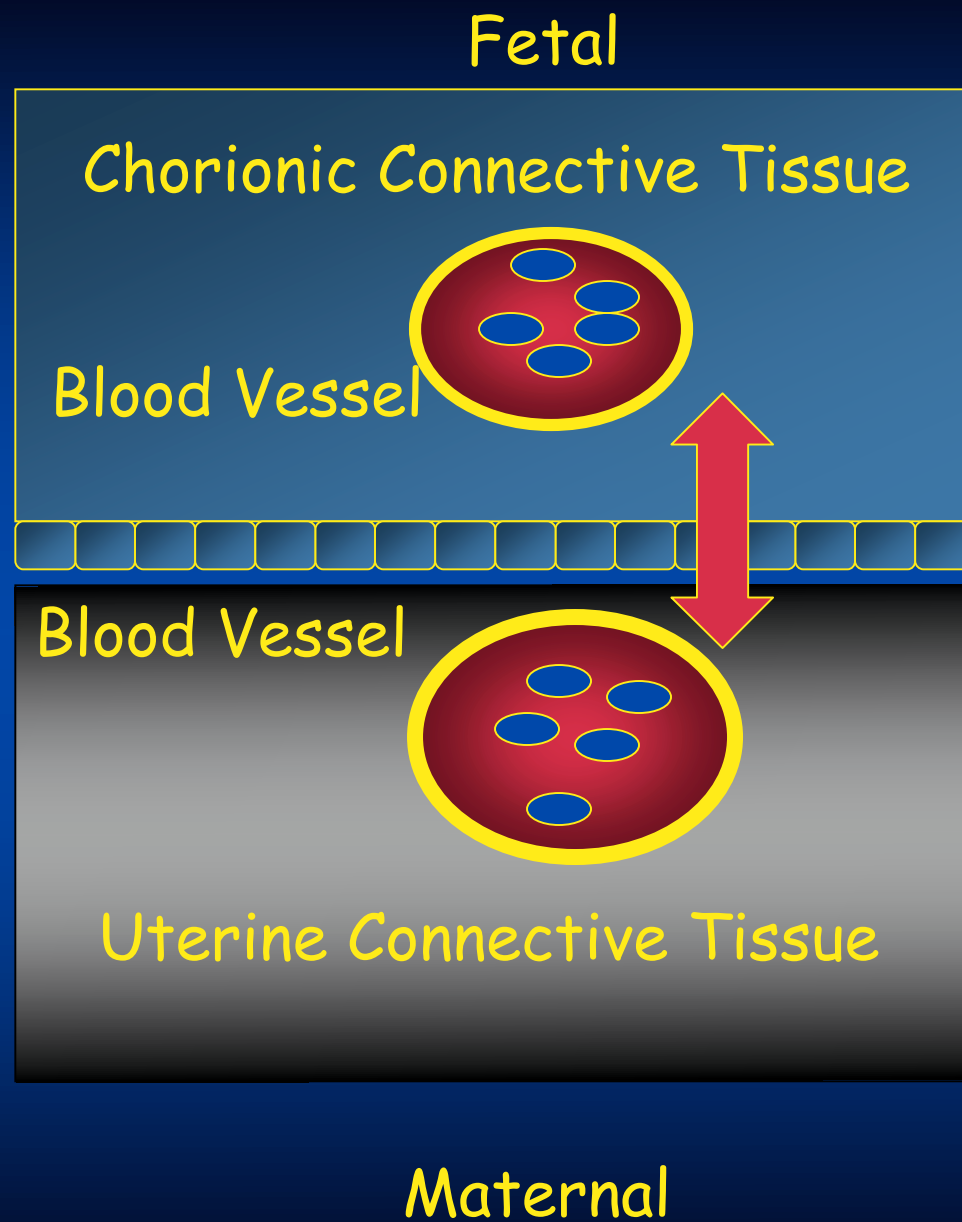
•Epithelialchorial

Chorionic Epithelium
Uterine Epithelium

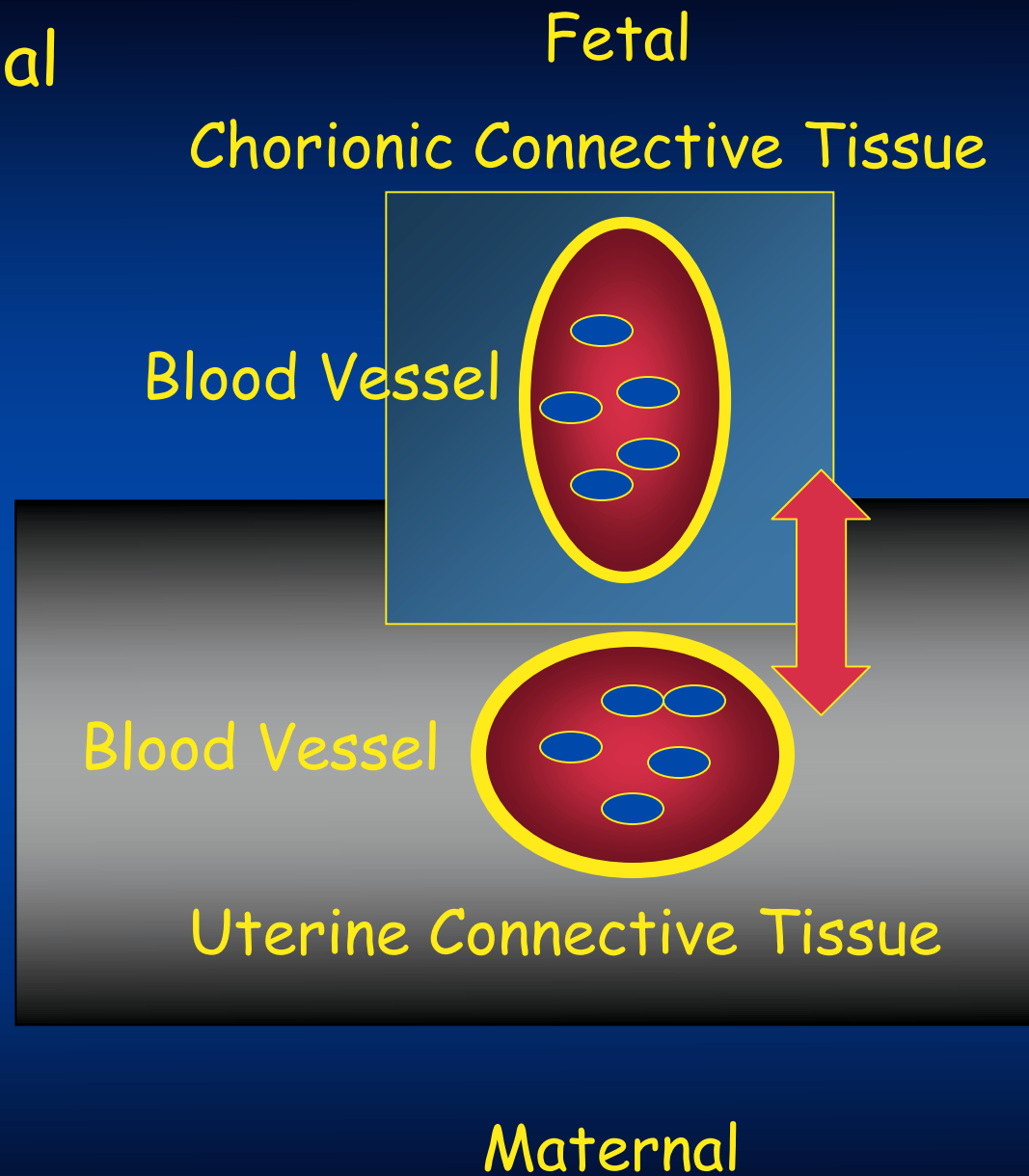


• Syndesmochorial

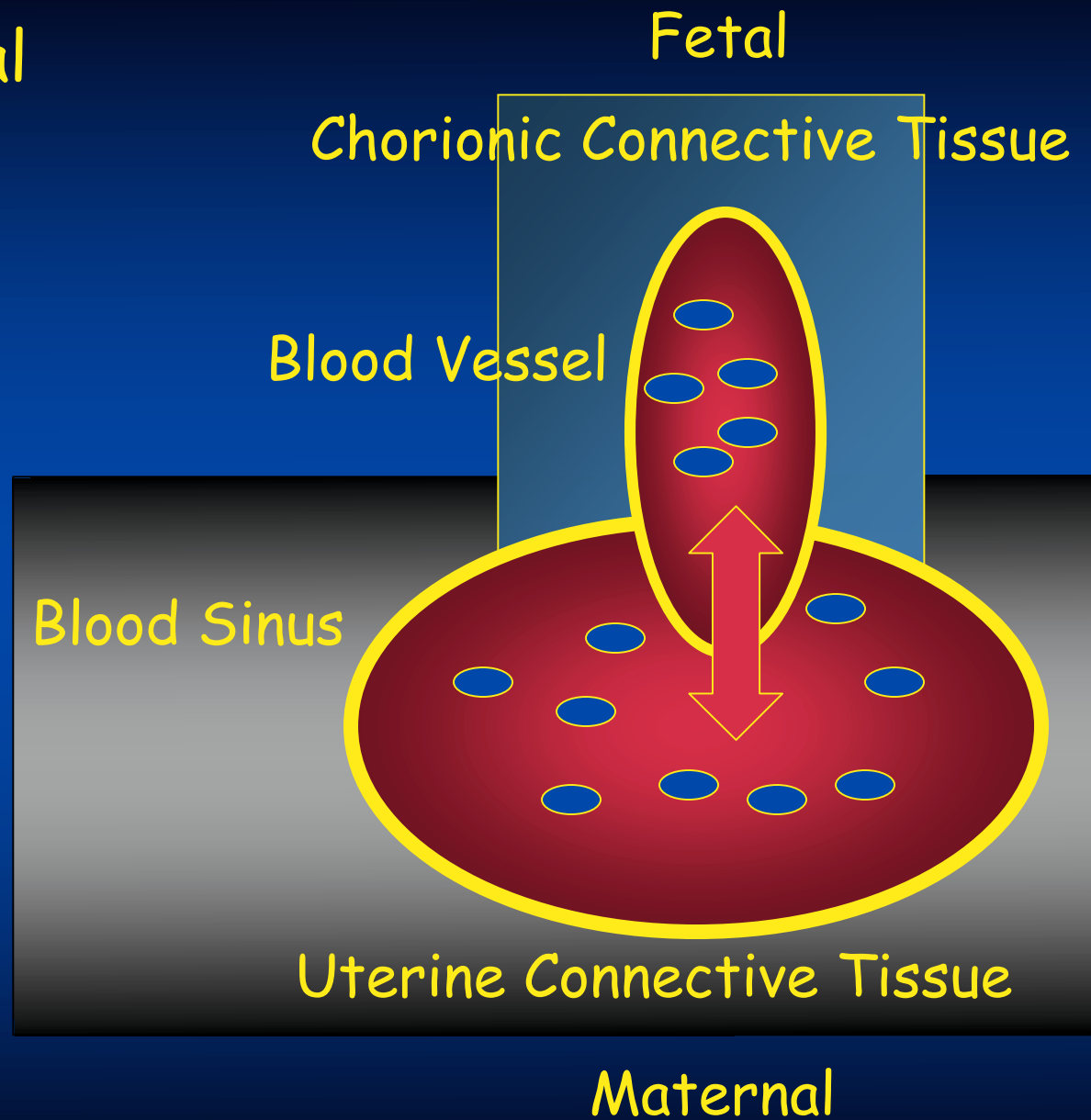
Chorionic Epithelium

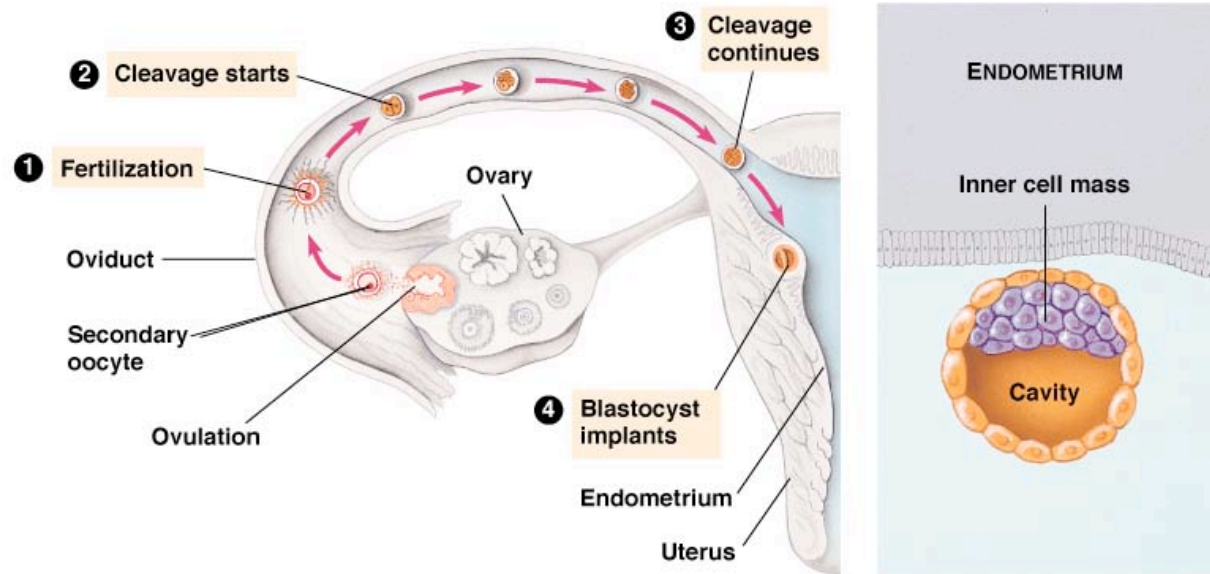


•Endotheliochorial



• Hemochorial





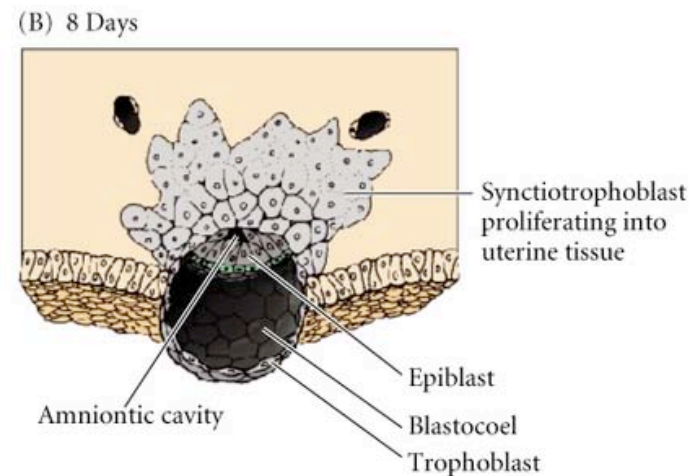
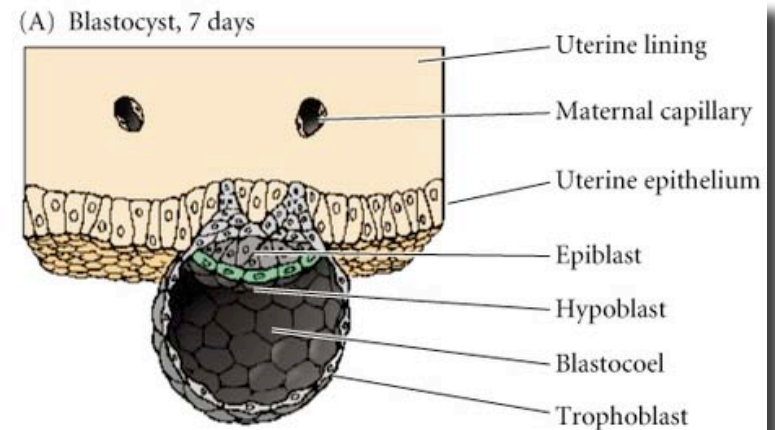
(a) From ovulation to implantation

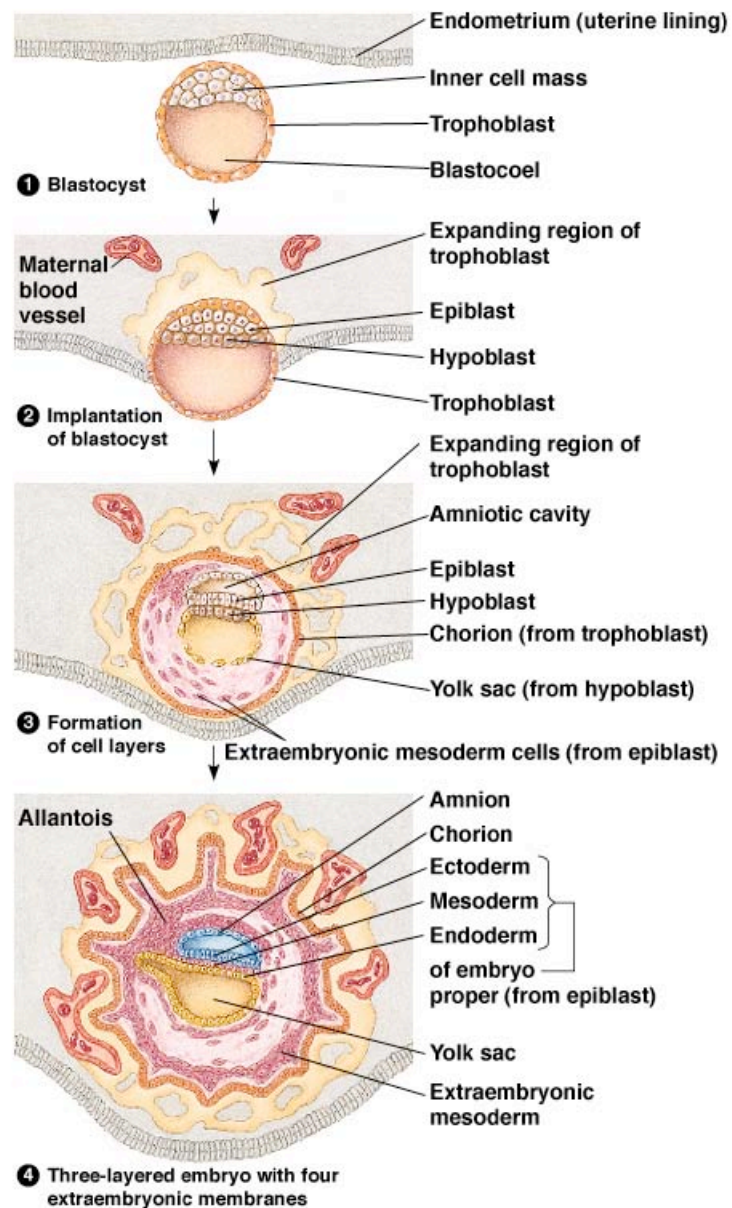
(b) Blastocyst (6 days after conception)

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- Embryo travels down tube and enters uterus
- Embryo interacts with wall of uterus
 - Implantation
 - Maternal recognition of pregnancy

- Trophoblast
 - expands and forms placental tissues
 - 2 types
 - Cytotrophoblast
 - Syncytiotrophoblast
 - Cyto - main region of the placenta
 - Syncytio- invasive tissue
- Uterine Response
 - Decidualization
 - Inflammation response - endometrium overgrows embryo



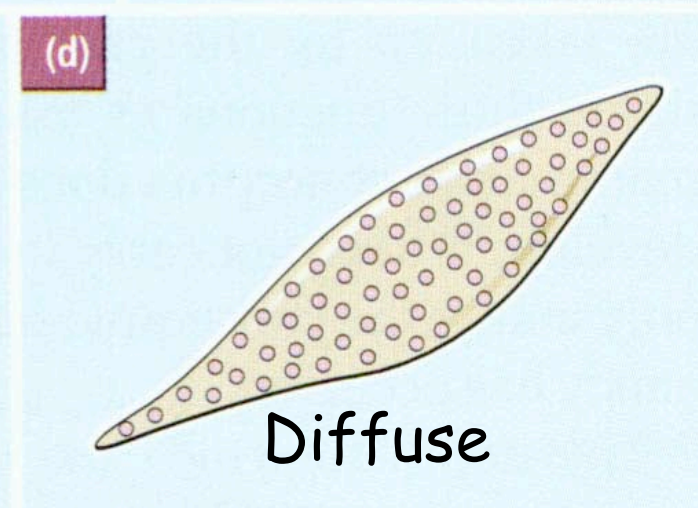
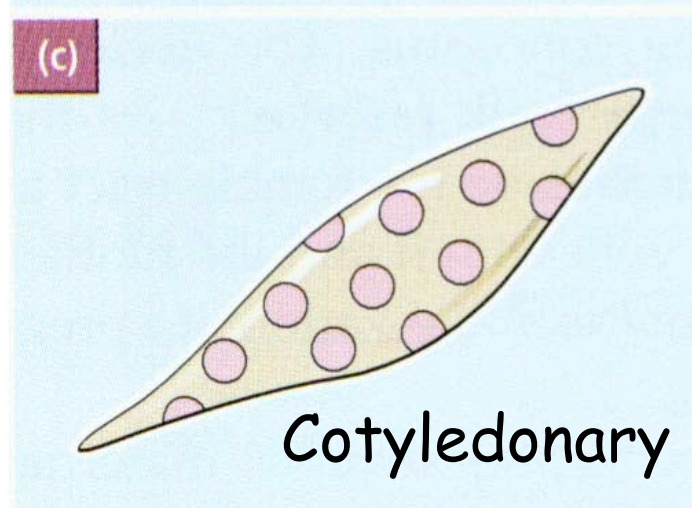
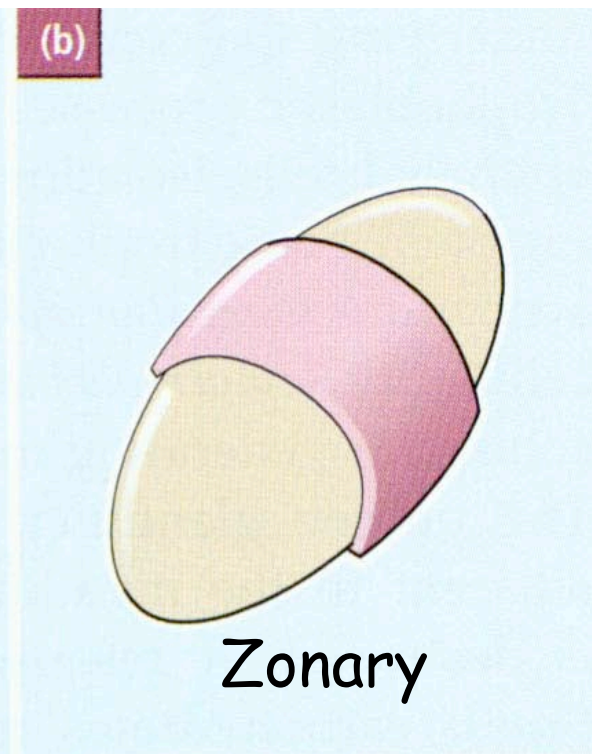
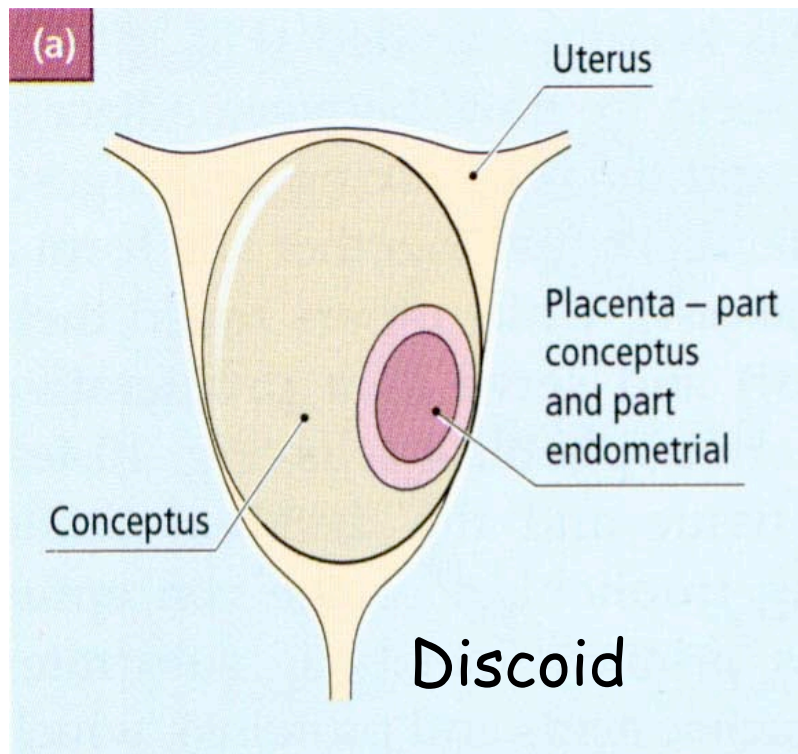


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- Inflammation response
 - endometrium overgrows embryo
 - decidualization

Placental Shapes

- Diffuse
 - Horses, camels, pigs, dolphins, whales
- Zonary
 - Carnivores (raccoon, dog, cat)
- Cotyledonary (placentomes)
 - Cows, sheep
- Discoid
 - Primates, rodents, rabbits, insectivores



Human Hemochorial

