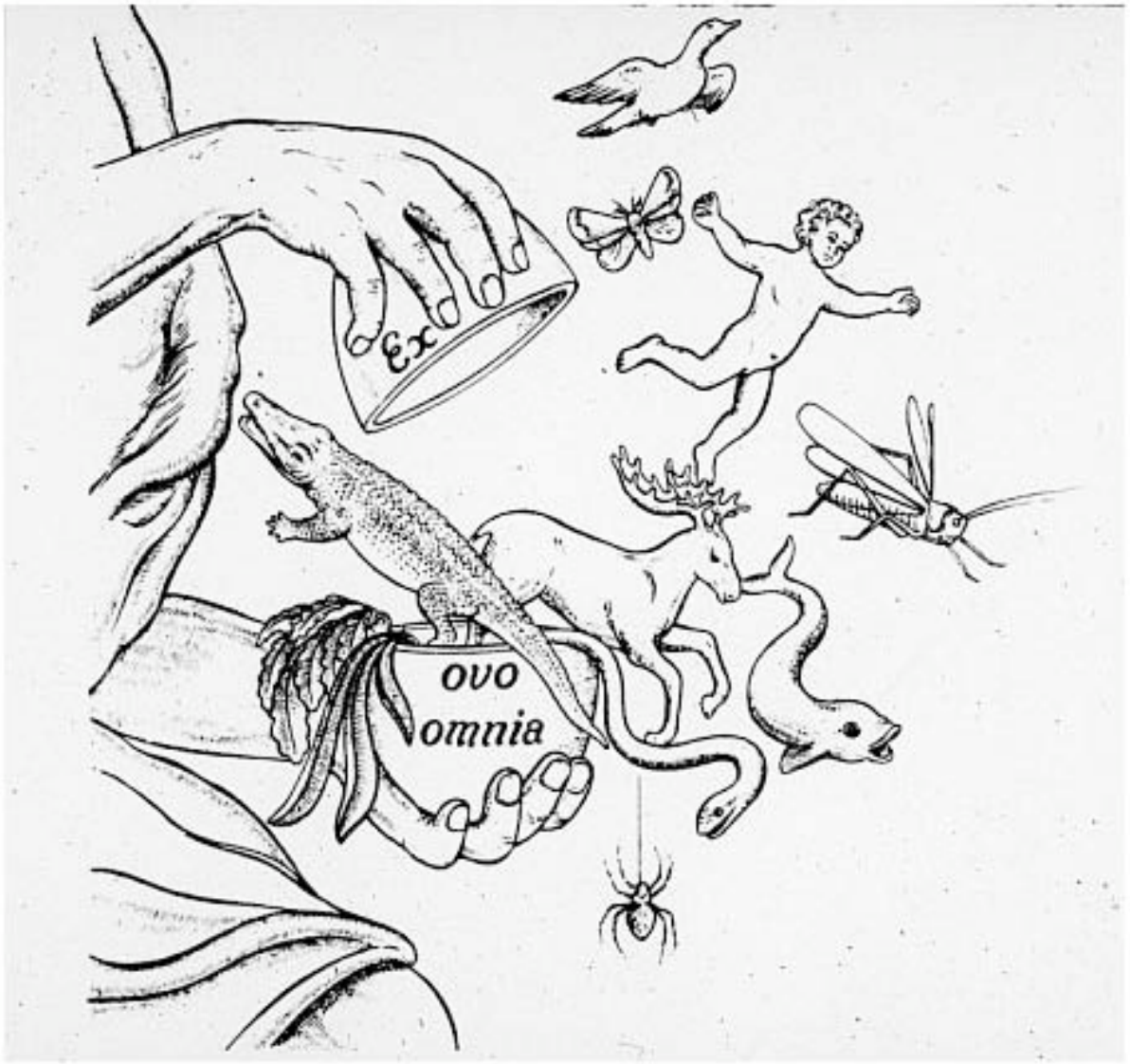
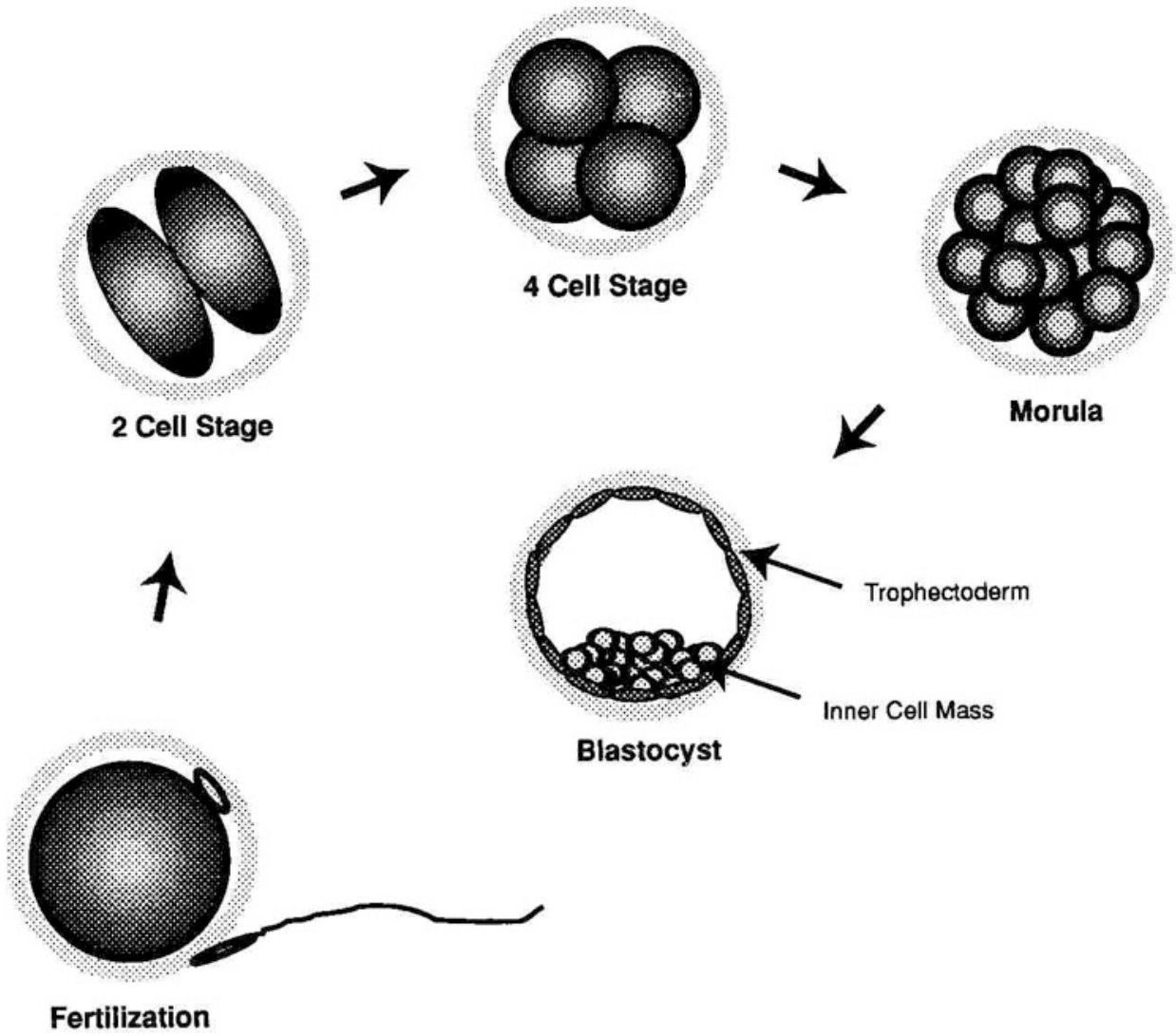
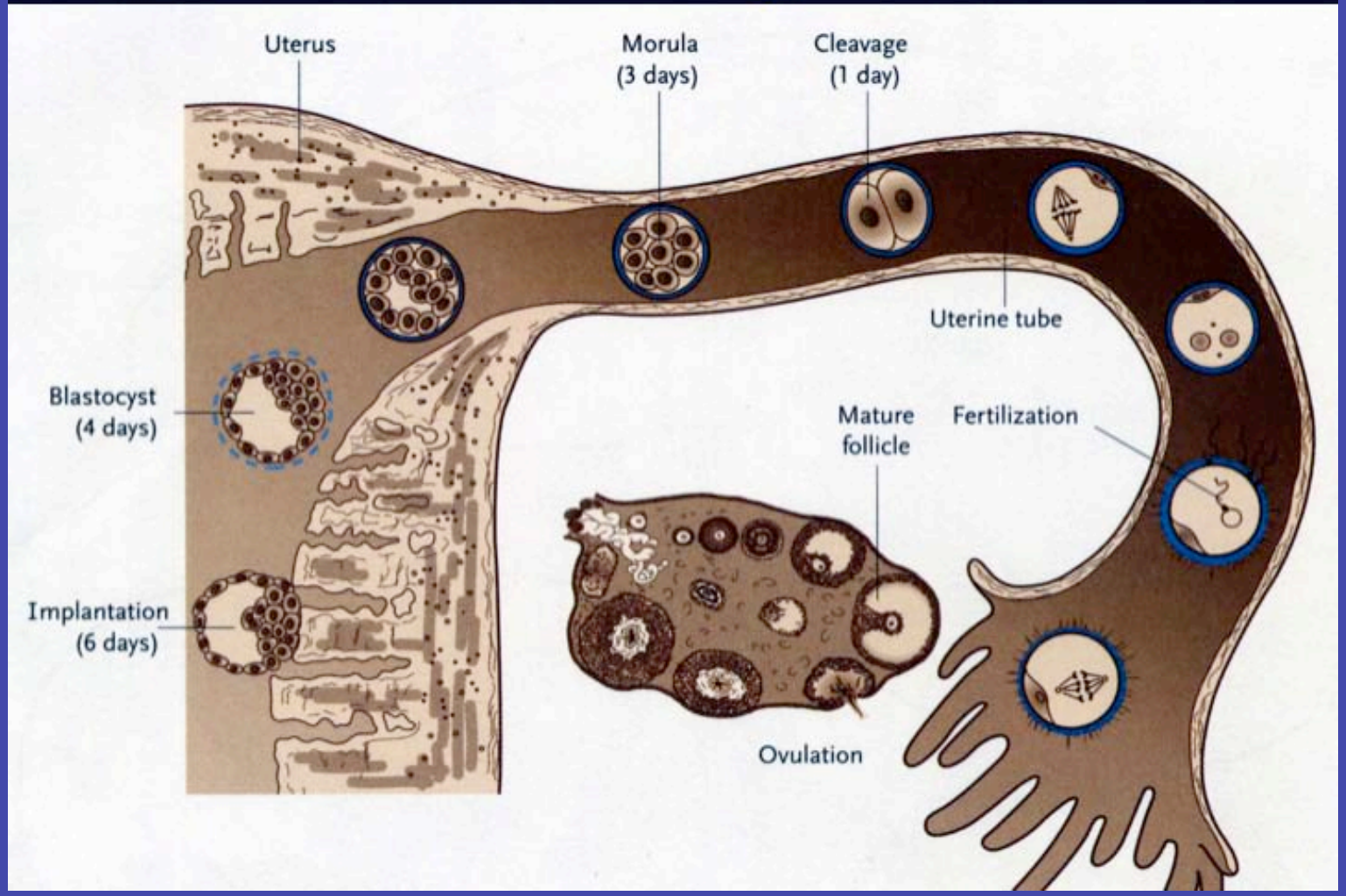
DESARROLLO DE MAMIFEROS

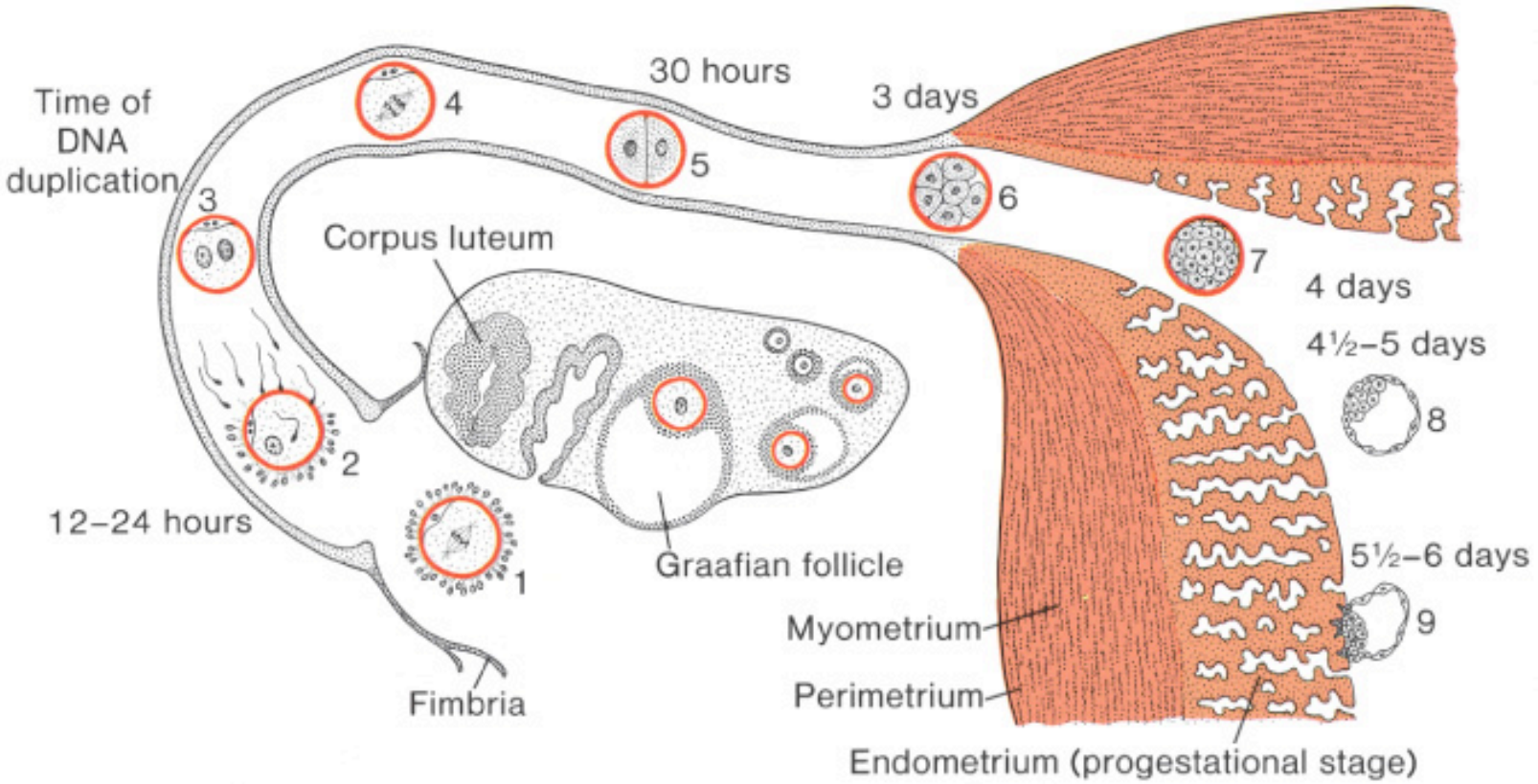
DESARROLLO PREIMPLANTACIONAL Y ANIDACION.

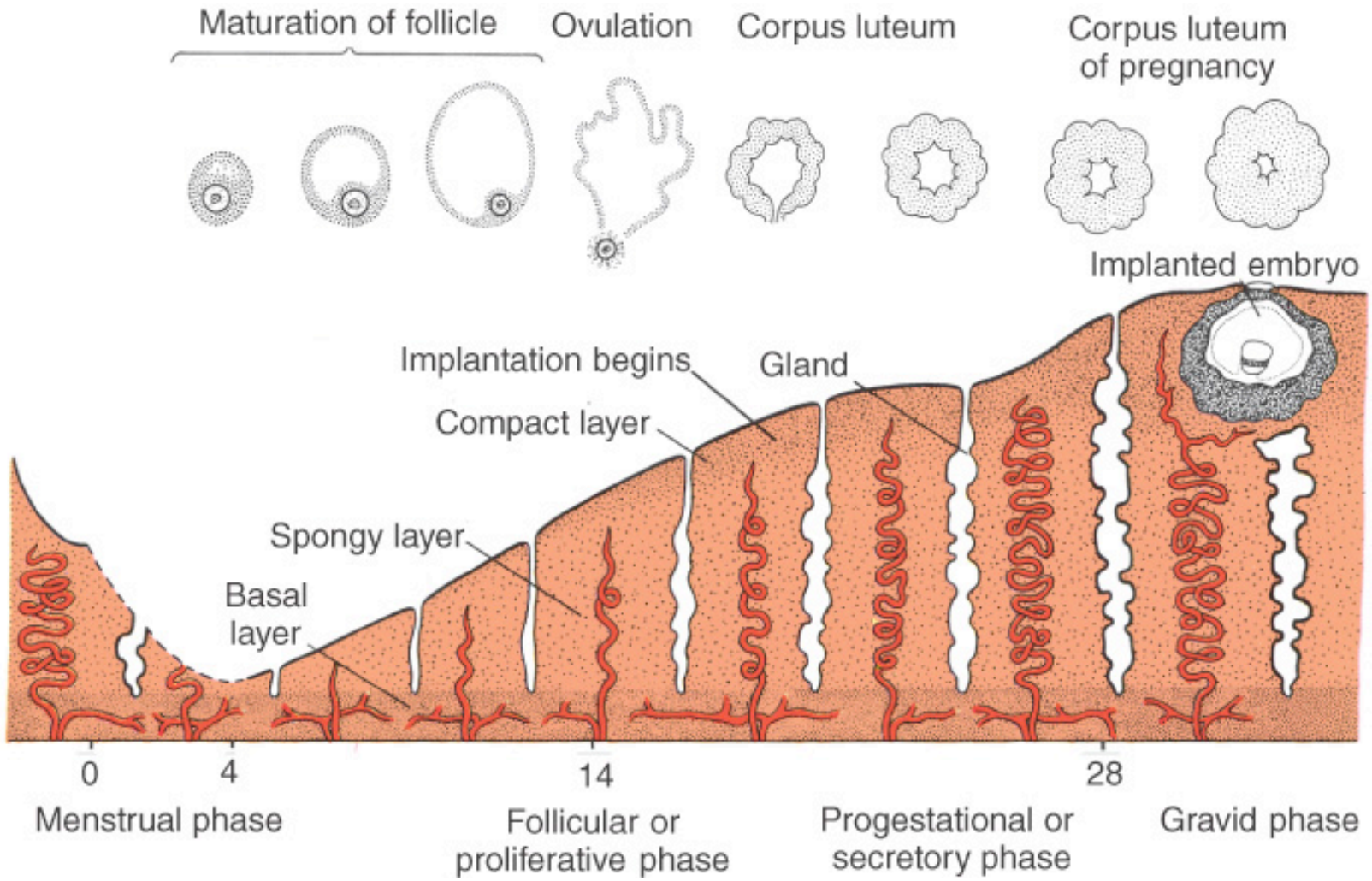

ex
ovo
omnia


2 Cell Stage
4 Cell Stage
Morula
Trophectoderm
Inner Cell Mass
Blastocyst
Fertilization

Cleavage


Uterus
Morula
(3 days)
Cleavage
(1 day)
Uterine tube
Blastocyst
(4 days)
Mature
follicle
Fertilization
Implantation
(6 days)
Ovulation


Time of DNA duplication
30 hours
3 days
4
5
6
7
3
Corpus luteum
4 days
4½–5 days
8
2
12–24 hours
1
Graafian follicle
5½–6 days
9
Myometrium
Perimetrium
Fimbria
Endometrium (progestational stage)


Maturation of follicle
Ovulation
Corpus luteum
Corpus luteum of pregnancy
Implanted embryo
Implantation begins
Gland
Compact layer
Spongy layer
Basal layer
0
4
14
28
Menstrual phase
Follicular or proliferative phase
Progestational or secretory phase
Gravid phase

MADURACIÓN DE LOS FOLÍCULOS

FSH

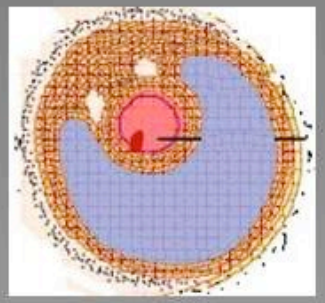
LH

FOLÍCULO PRIMARIO DE CÉLULAS PLANAS

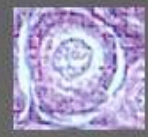
FOLÍCULO PRIMARIO DE CÉLULAS CÚBICAS

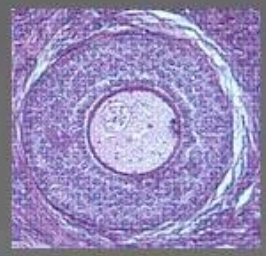
FOLÍCULO PRIMARIO PSEUDOESTRATIFICADO

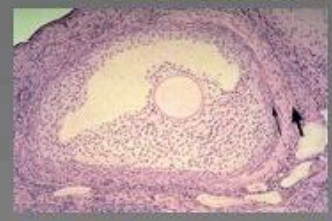
FOLÍCULO SECUNDARIO

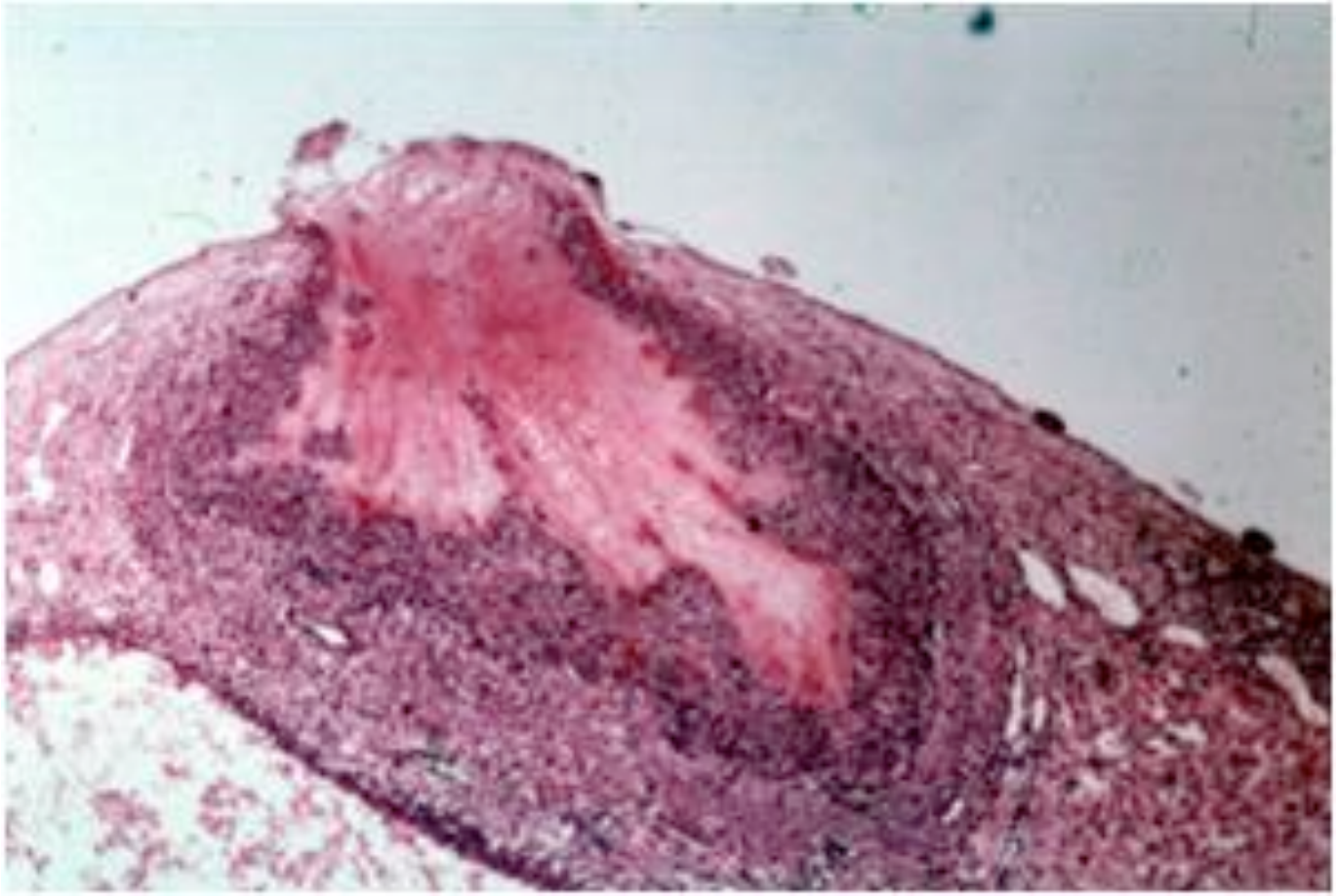


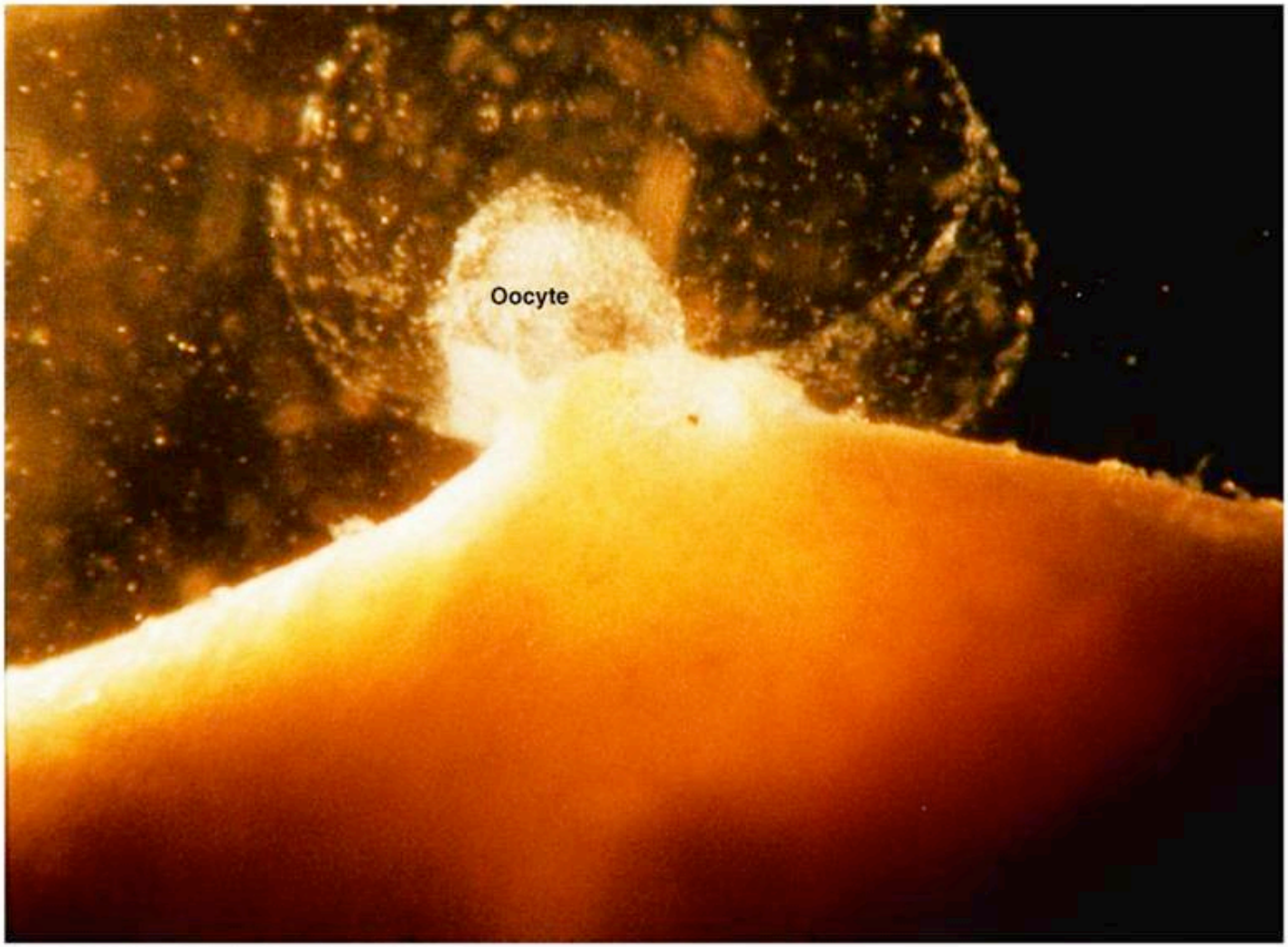
FOLÍCULO MADURO O DE DEGRAFF

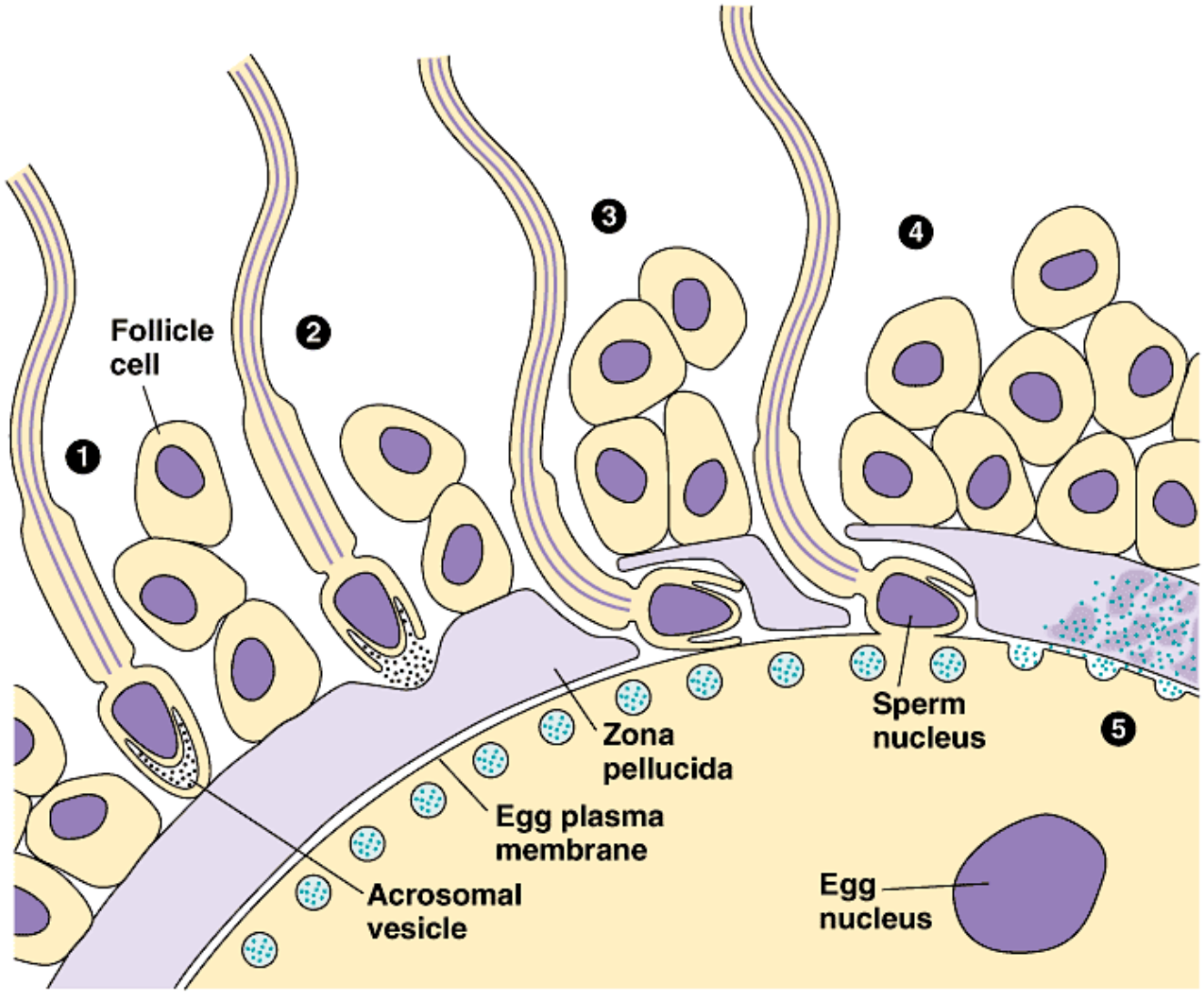


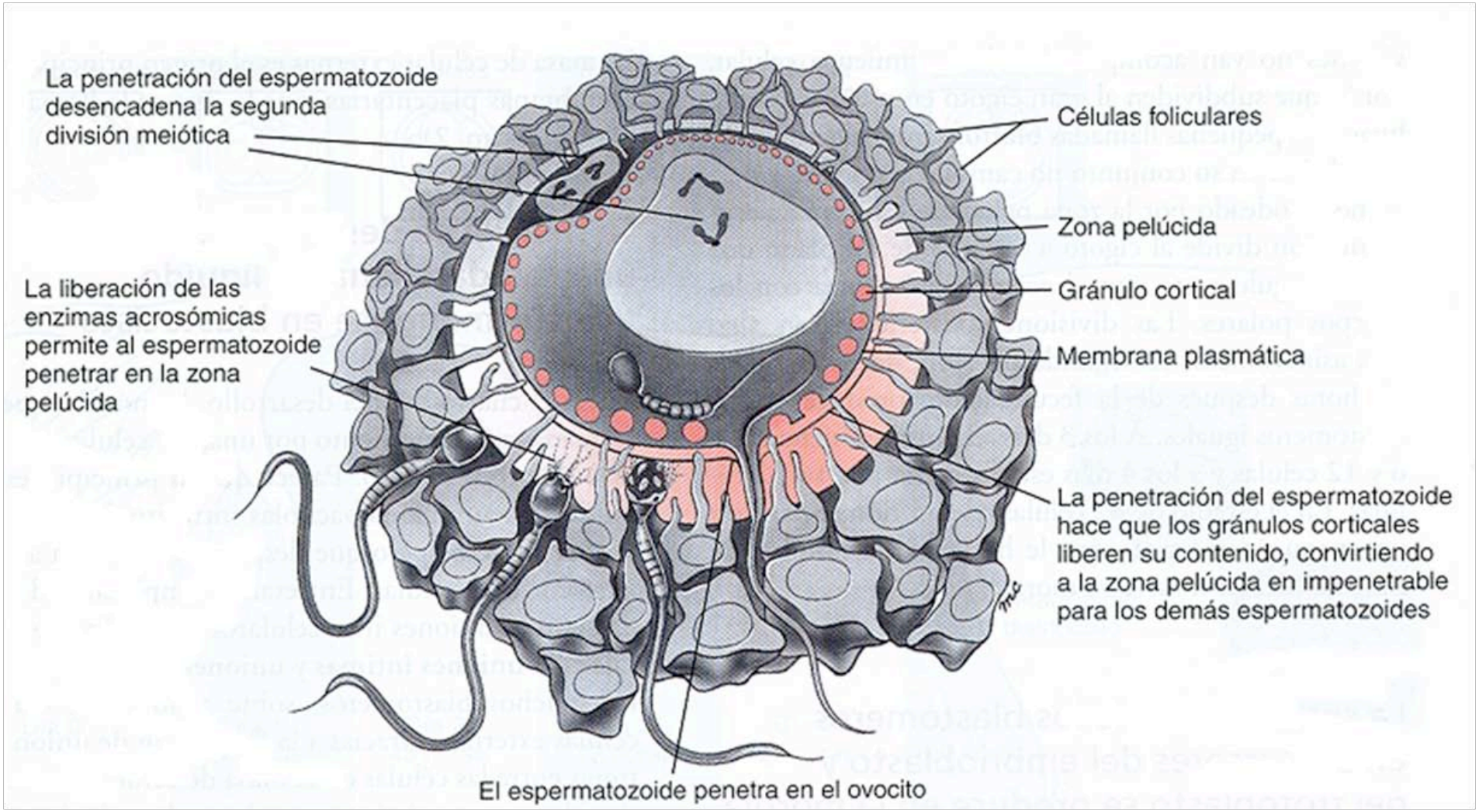




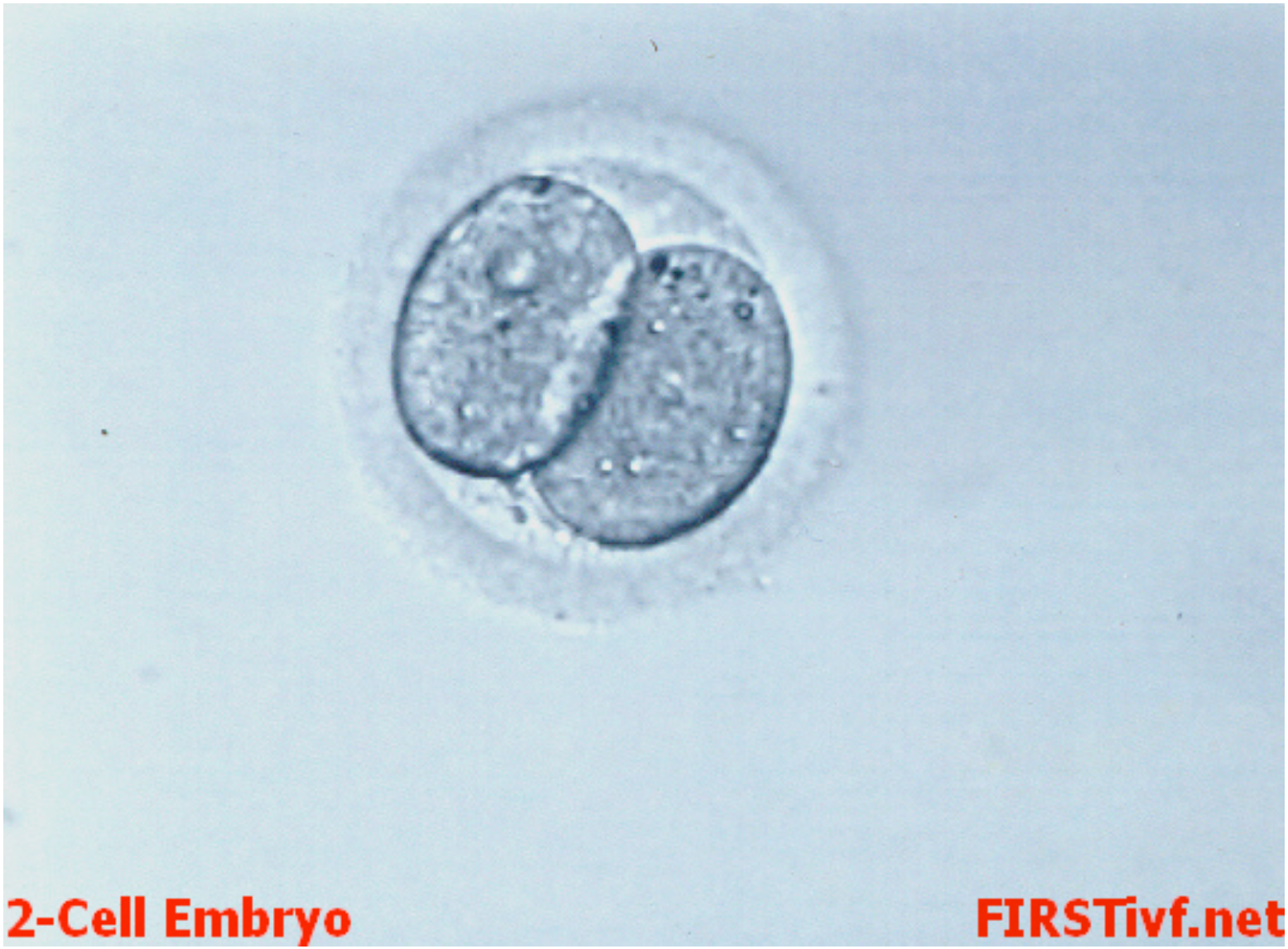


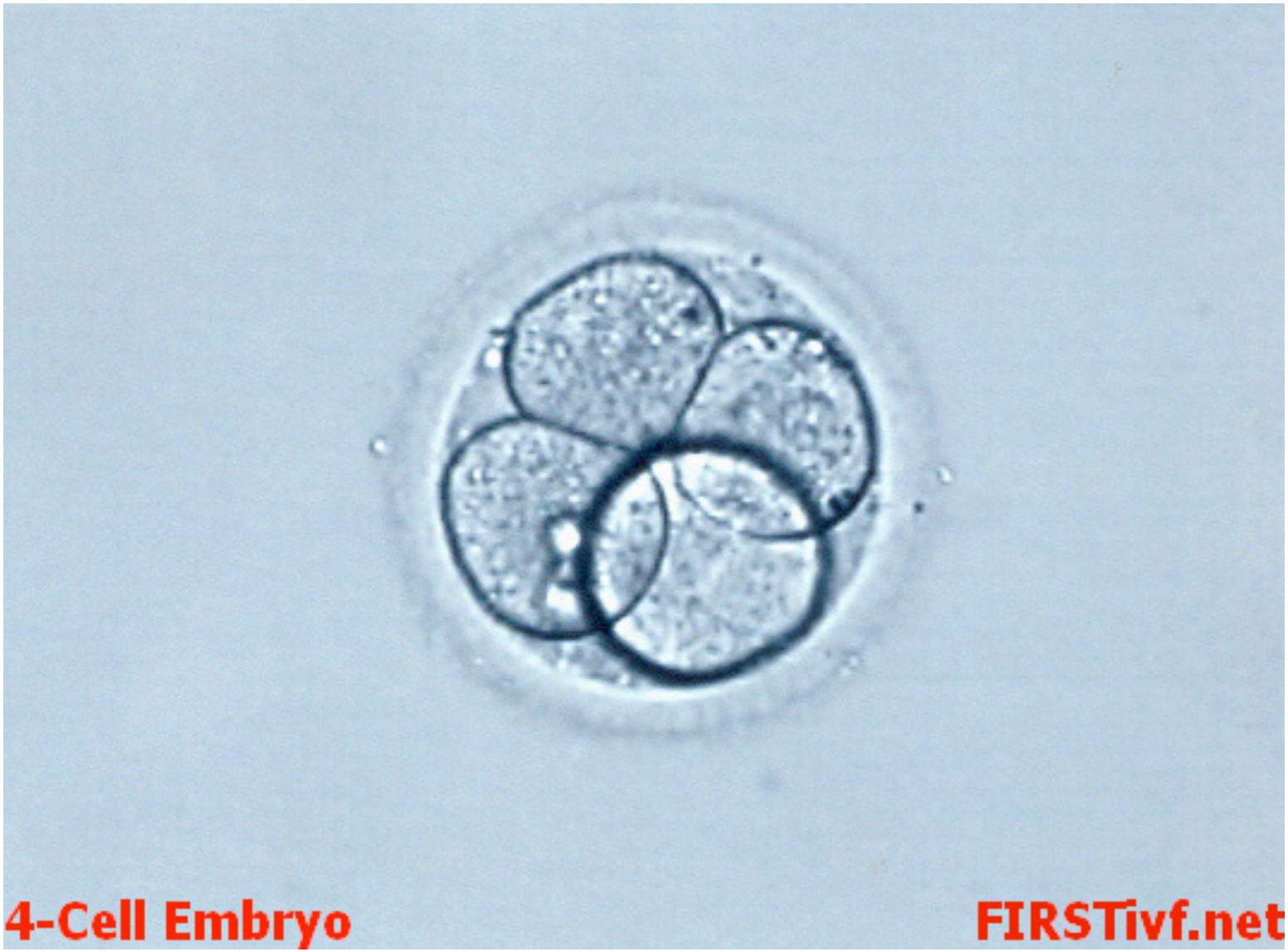


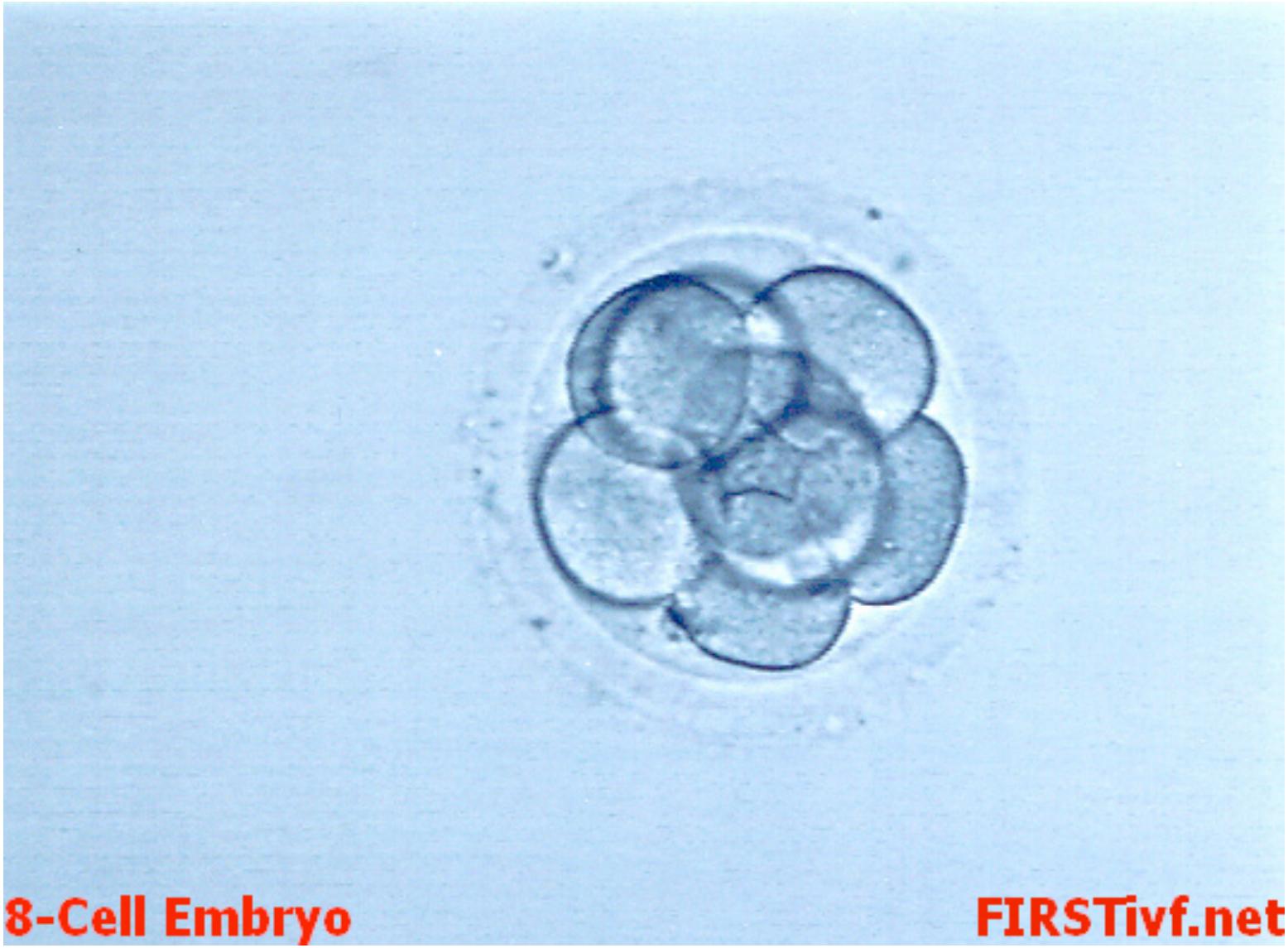


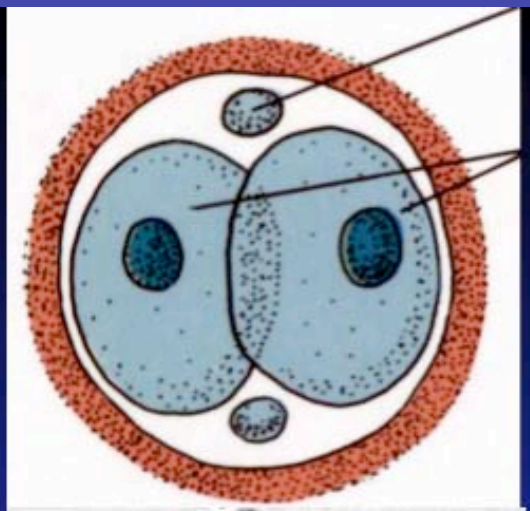

La penetración del espermatozoide desencadena la segunda división meiótica
Células foliculares
Zona pelúcida
Gránulo cortical
Membrana plasmática
La liberación de las enzimas acrosómicas permite al espermatozoide penetrar en la zona pelúcida
La penetración del espermatozoide hace que los gránulos corticales liberen su contenido, convirtiendo a la zona pelúcida en impenetrable para los demás espermatozoides
El espermatozoide penetra en el ovocito

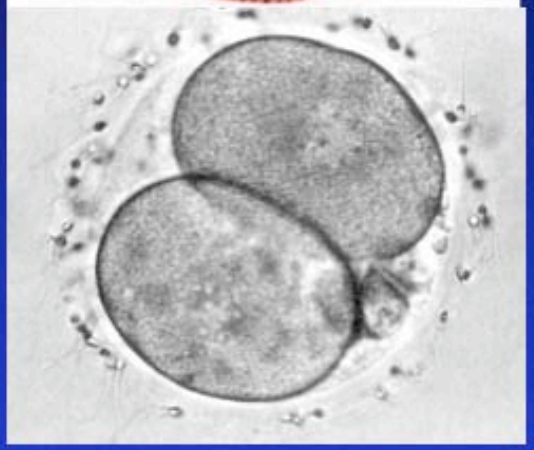

Fertilized Egg
FIRSTivf.net


2-Cell Embryo
FIRSTivf.net


4-Cell Embryo
FIRSTivf.net


8-Cell Embryo
FIRSTivf.net





Cleavage

Blastomere

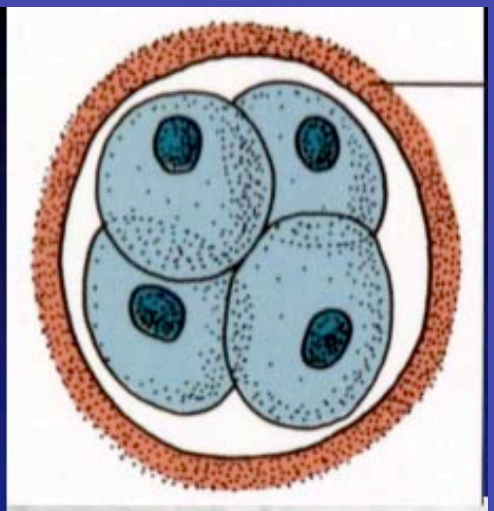
Equal

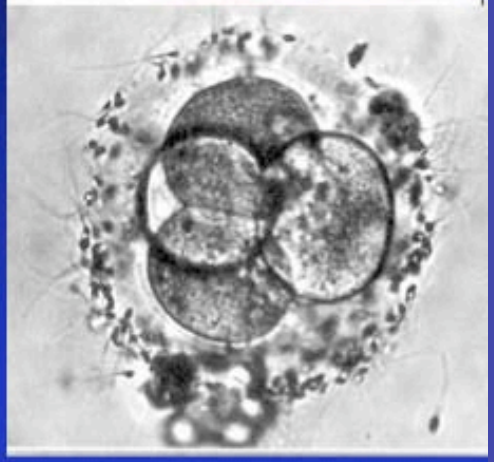
Asynchronous

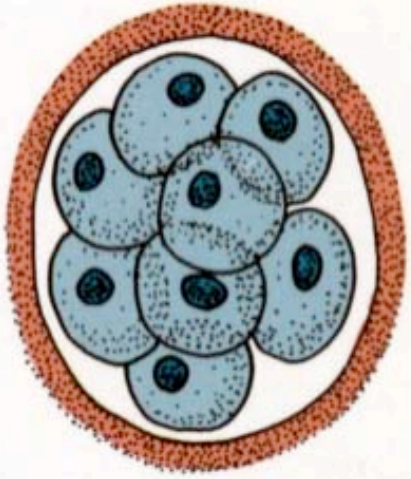
40 hours – 4 cells

72 hours – 6-12 cells

96 hours – 16-32 cells

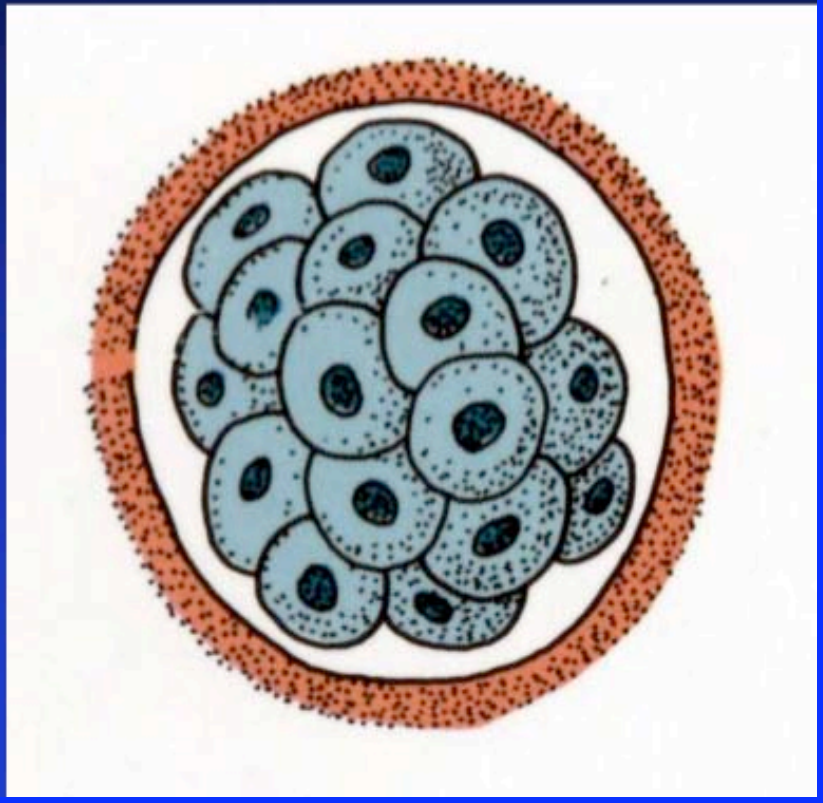


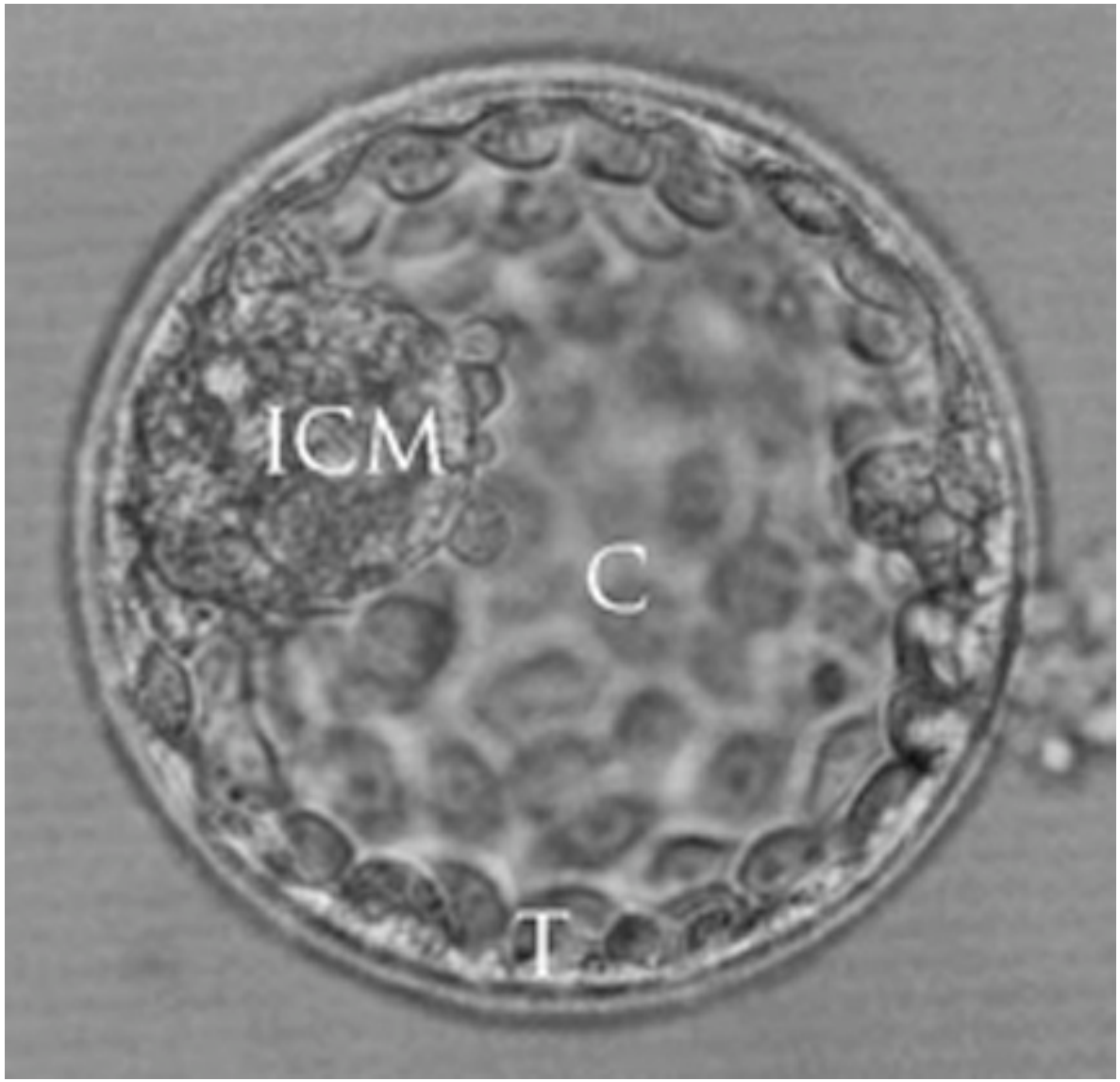


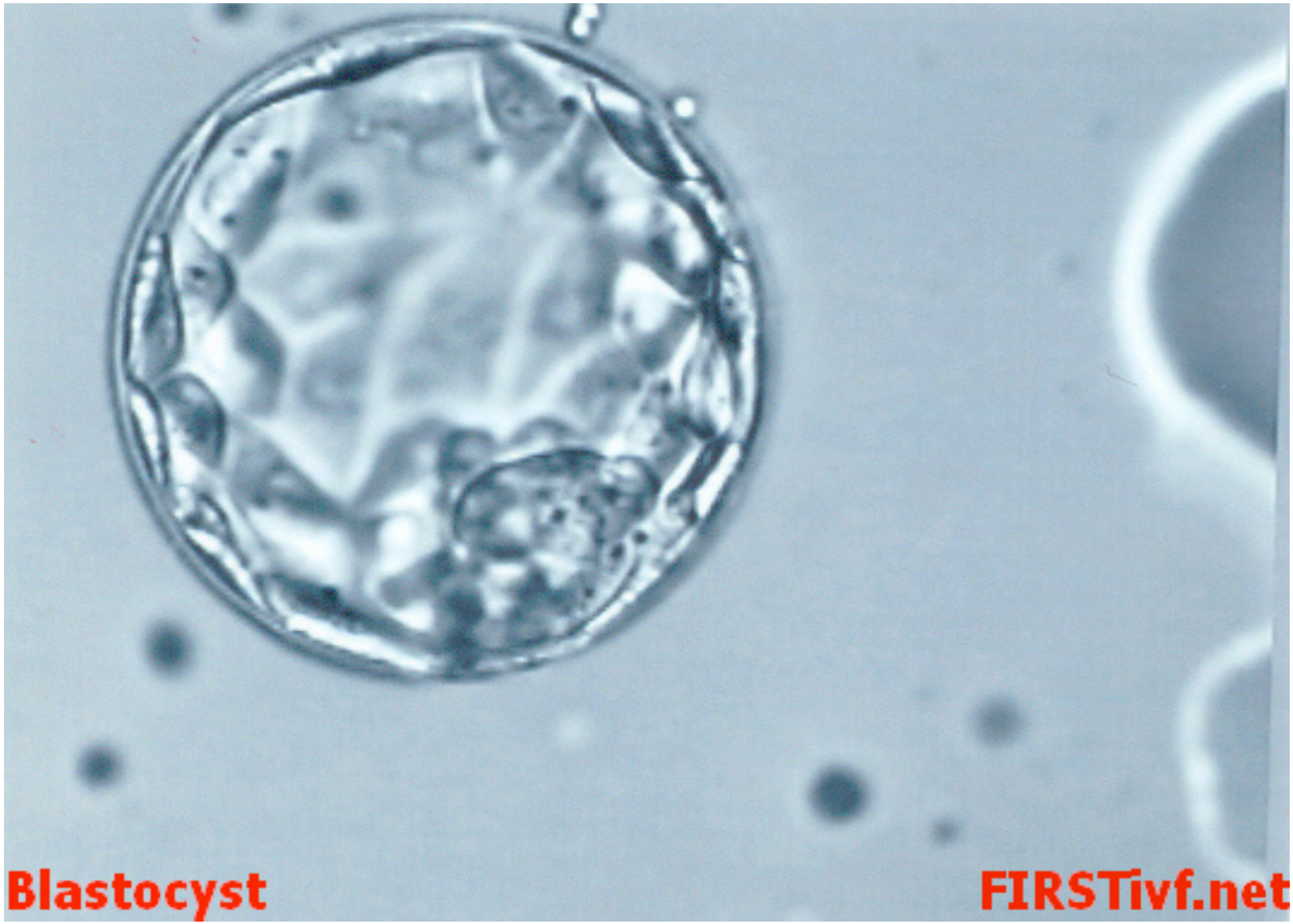


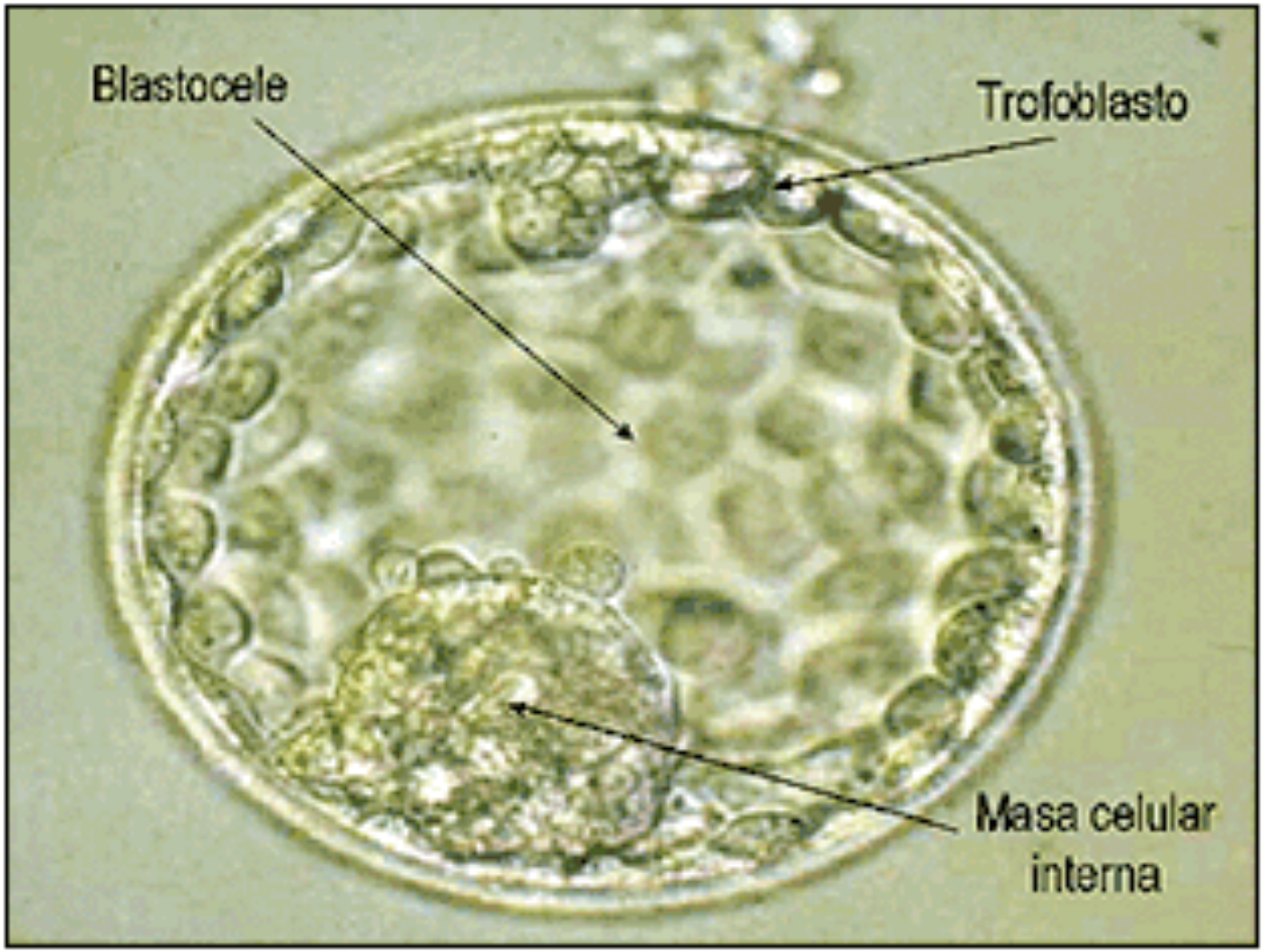
Morula

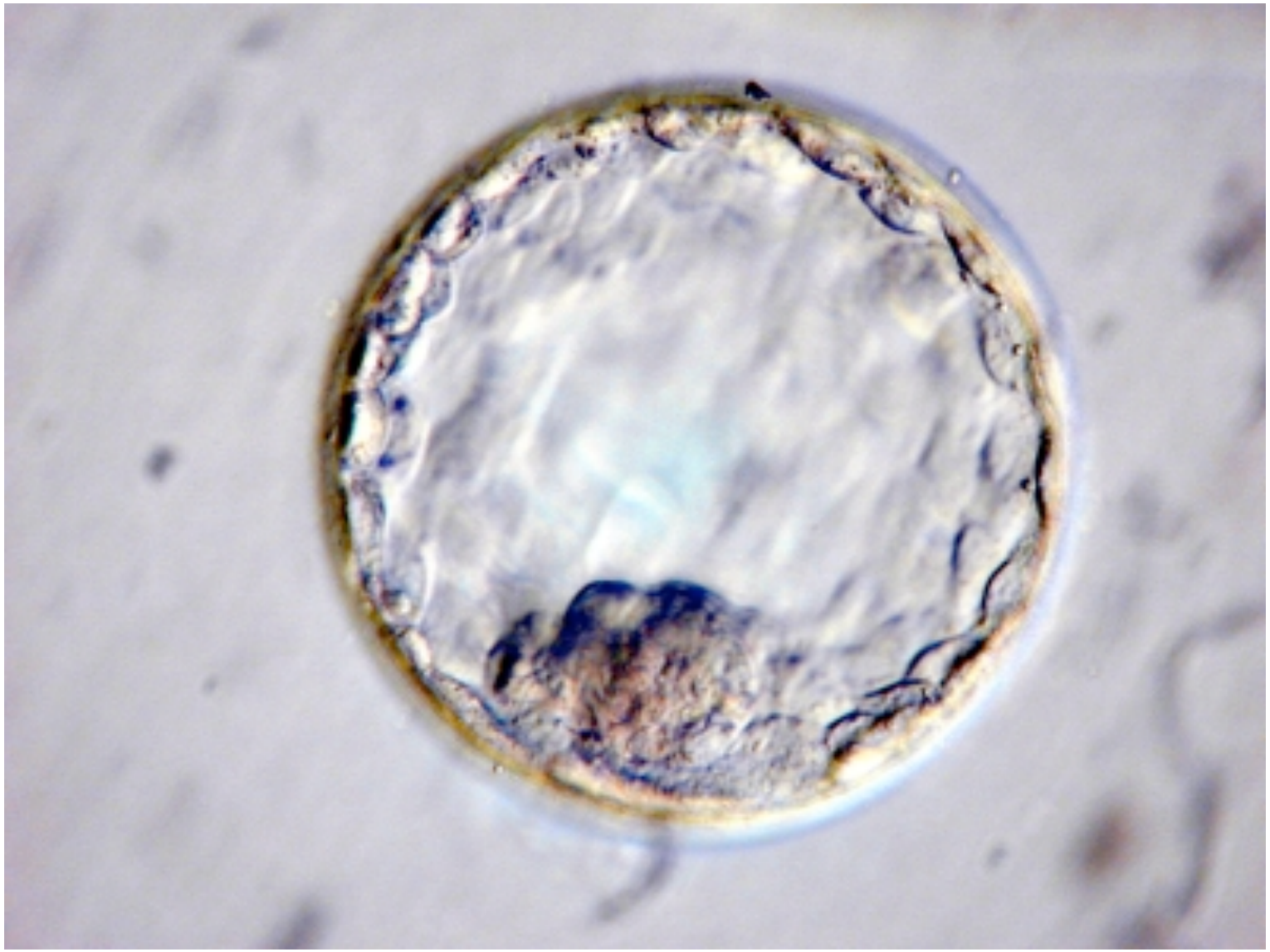
32 cell stage
'Berry' - appearance




ICM
C
T


Blastocyst
FIRSTivf.net


Blastocele
Trofoblasto
Masa celular
interna



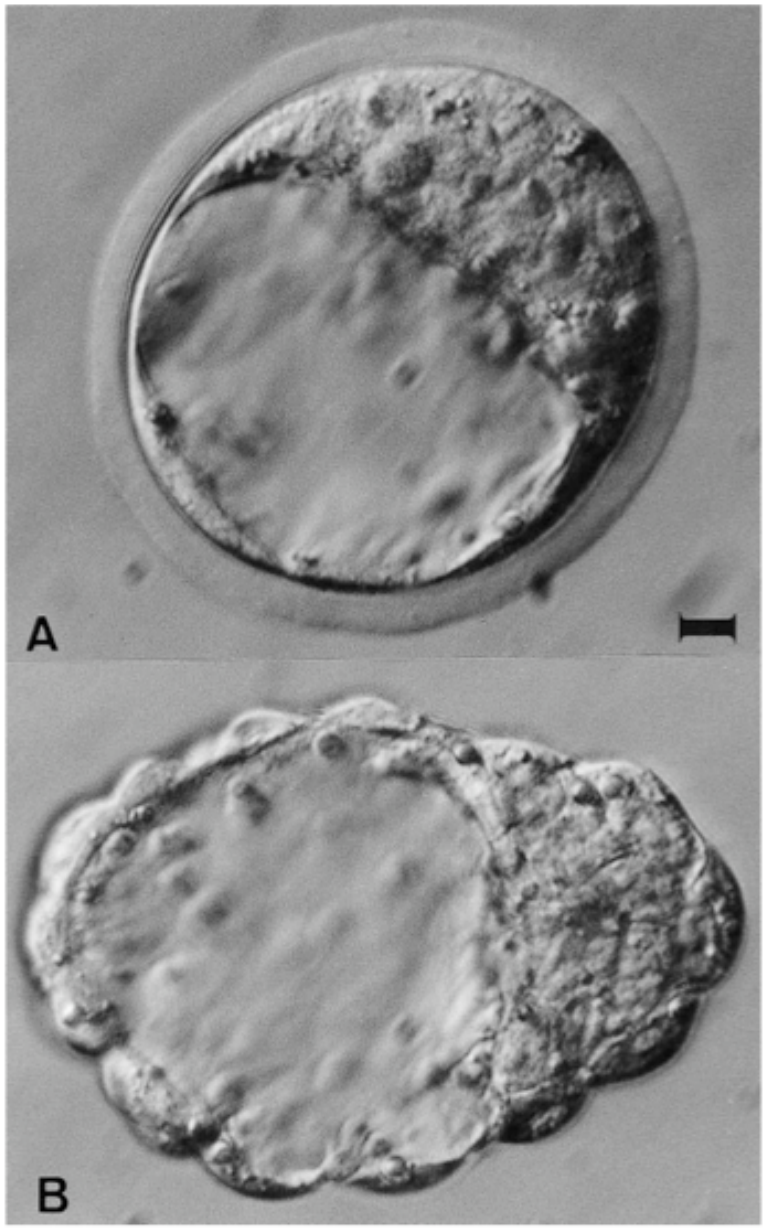
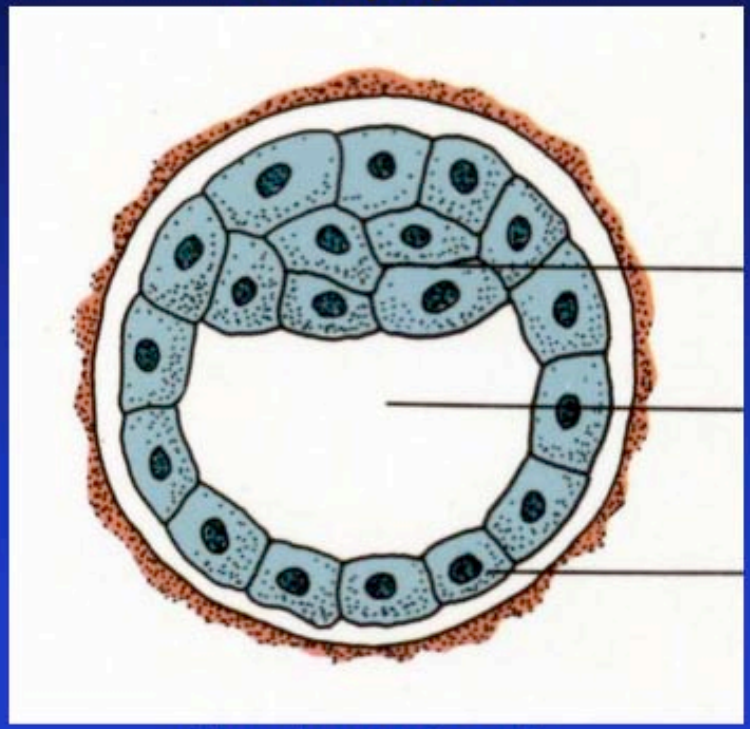


FIG. 3. In vivo-grown embryo flushed at Day 4 at 10 AM (**A**) or at 2 PM (**B**). Bar in A is 15 μm for A and B.

Blastocyst

Embryo pole

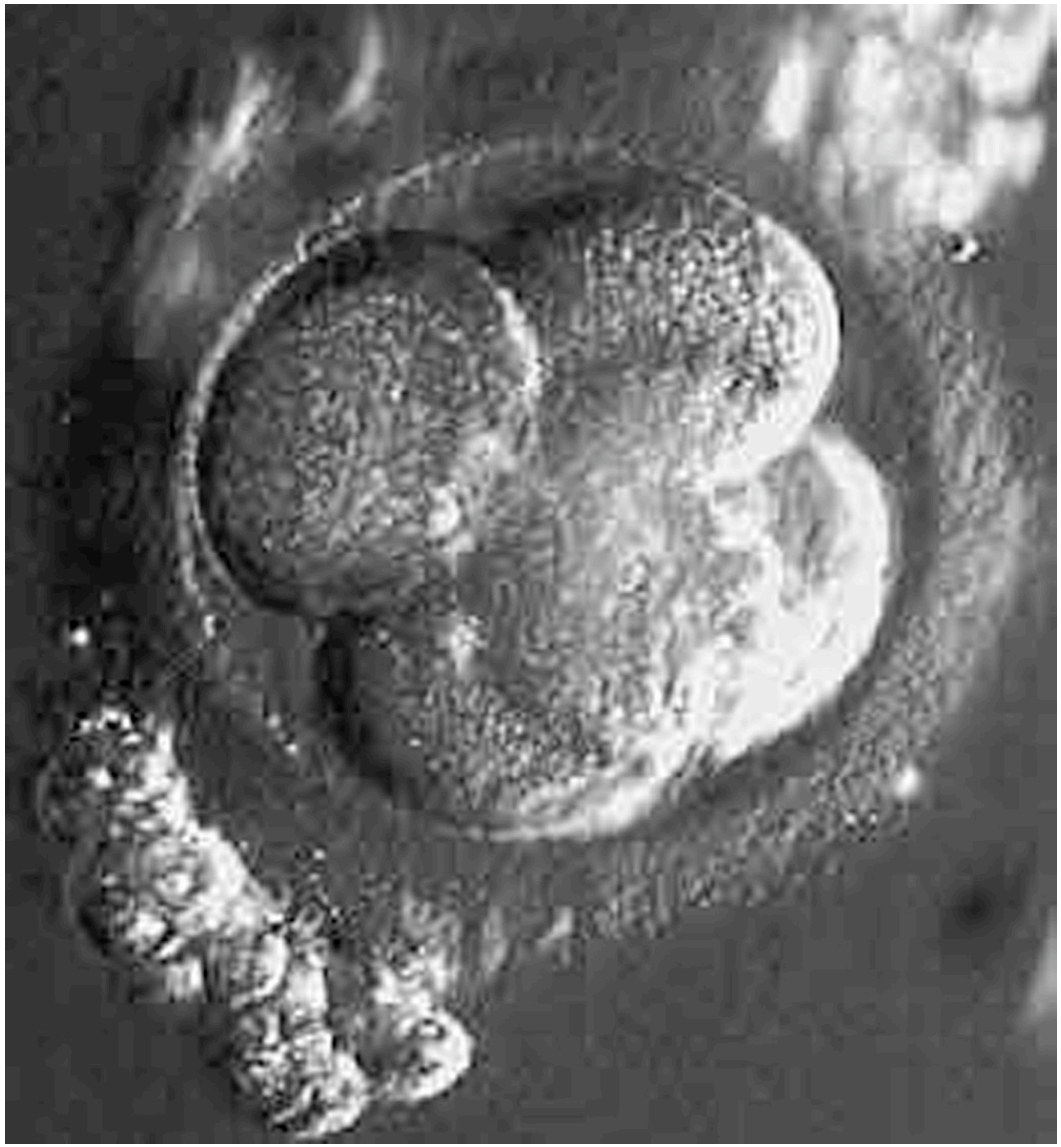


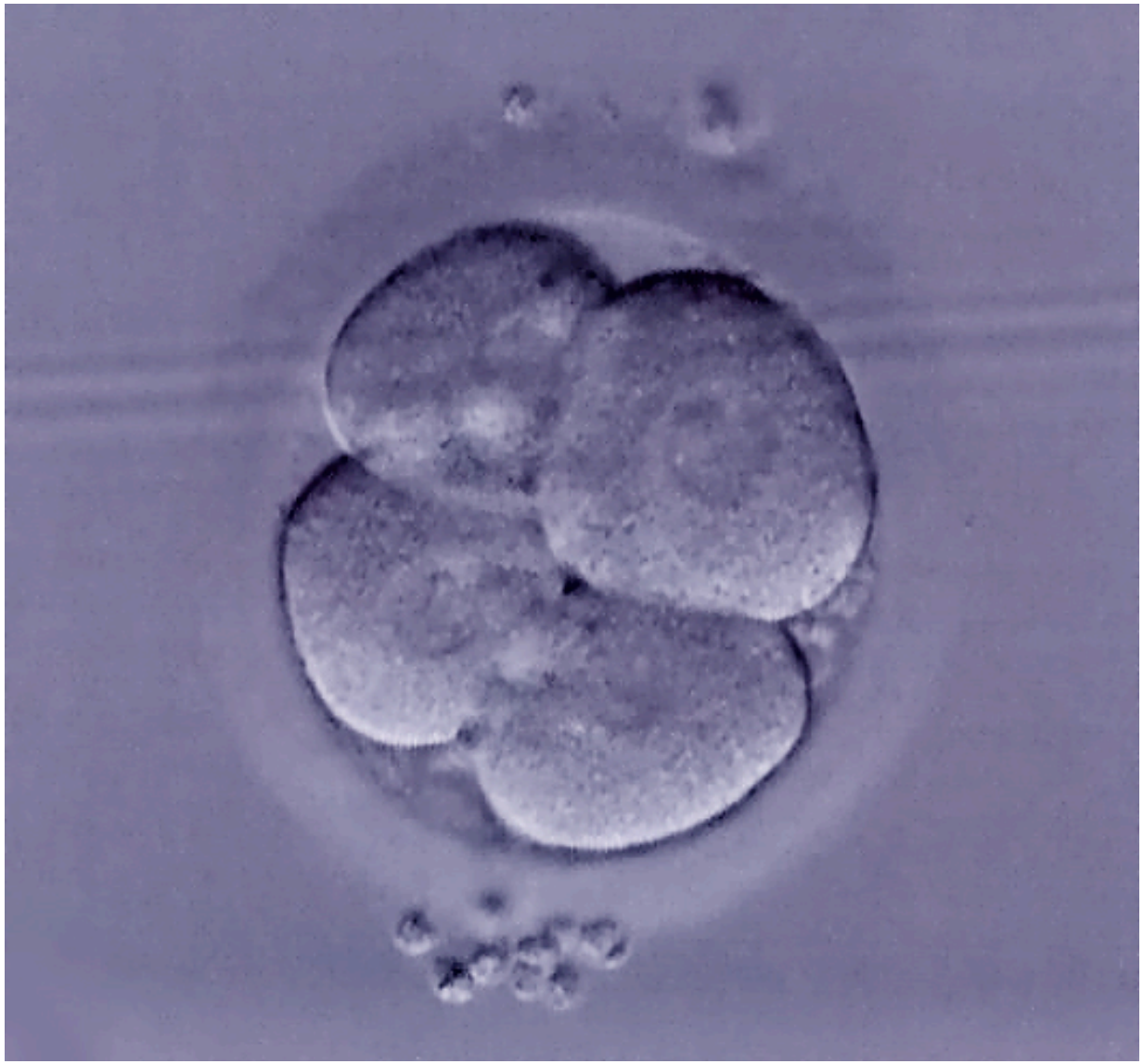
Inner cell mass
(**embryoblast**)

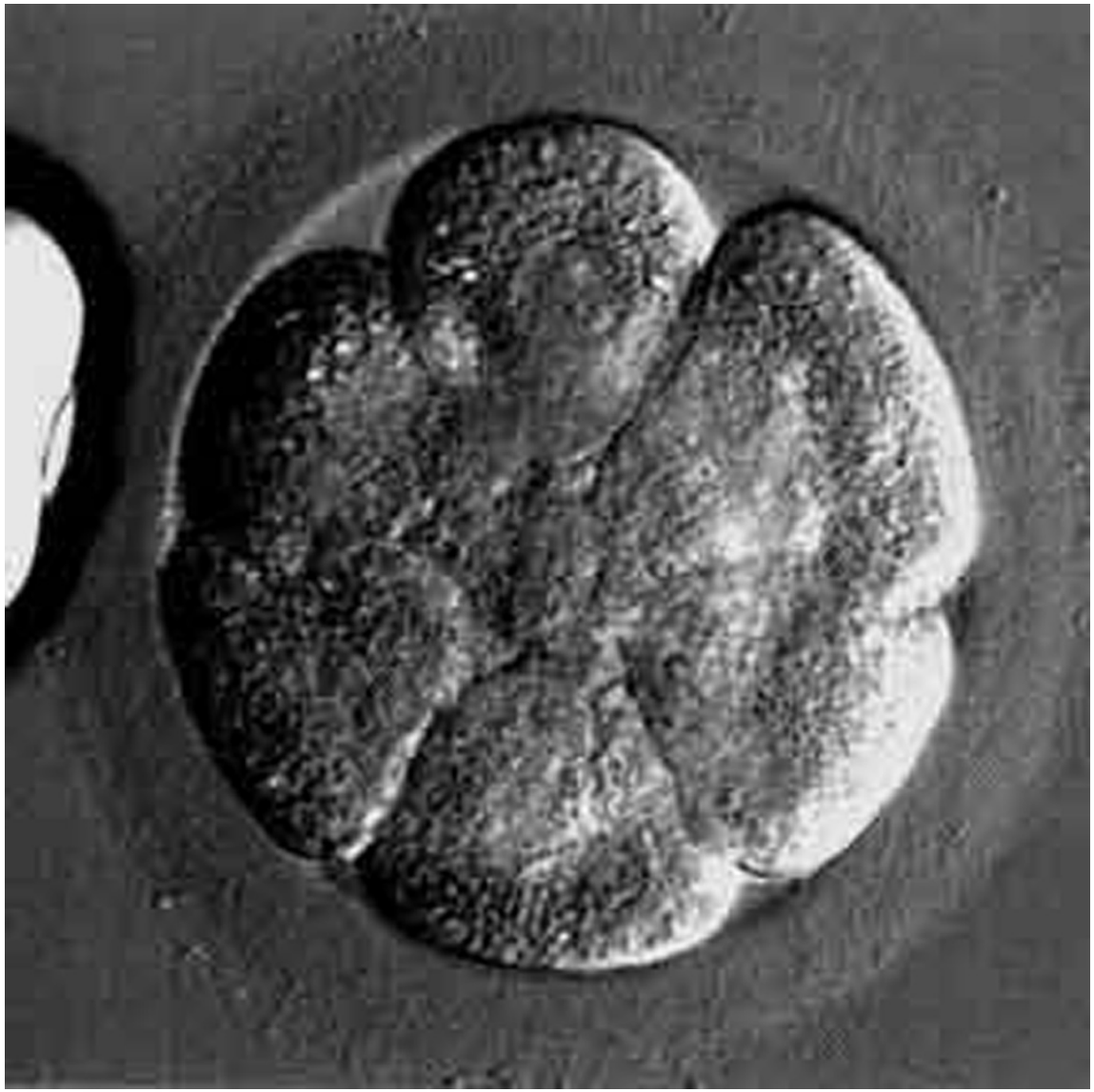
Blastocoel

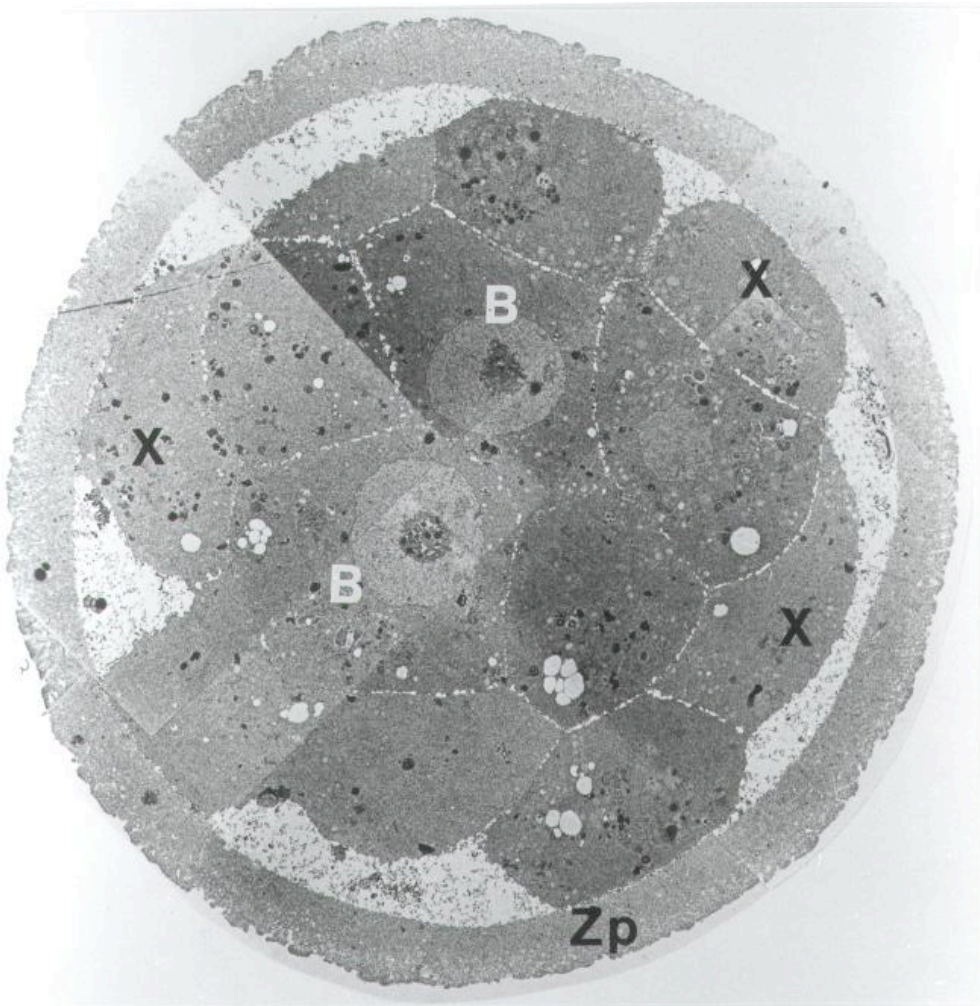
Outer cell mass
(**trophoblast**)

abembryonic pole

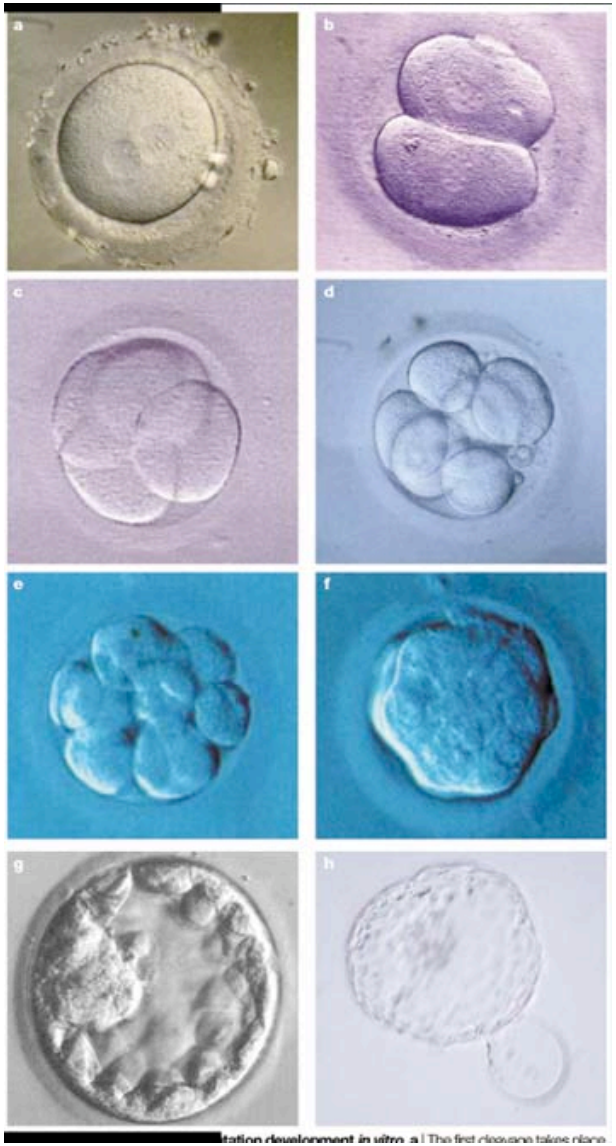








Kompaktierte **Morula** im 16-Zellstadium am 2. bis 3. Tag der Schwangerschaft; mit Zona pellucida (Zp), Blastomereren (B) und abgeflachten Blastomeren (X), aus denen die Trophblastenbildung erfolgt.

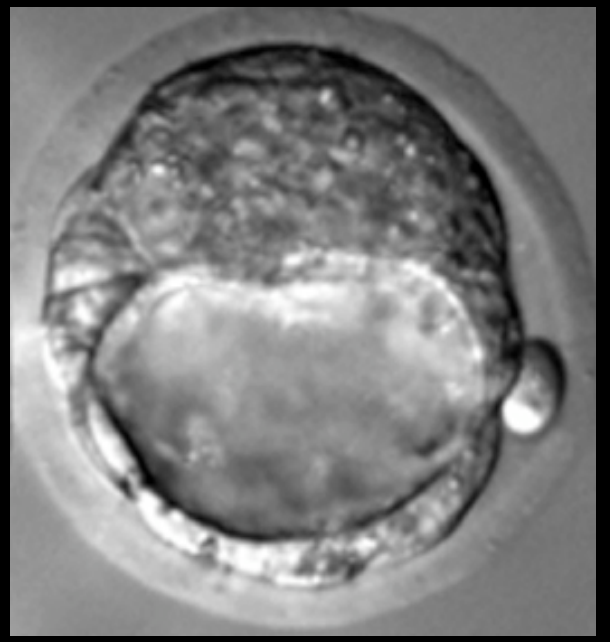


tation development in vitro. a | The first cleavage takes place

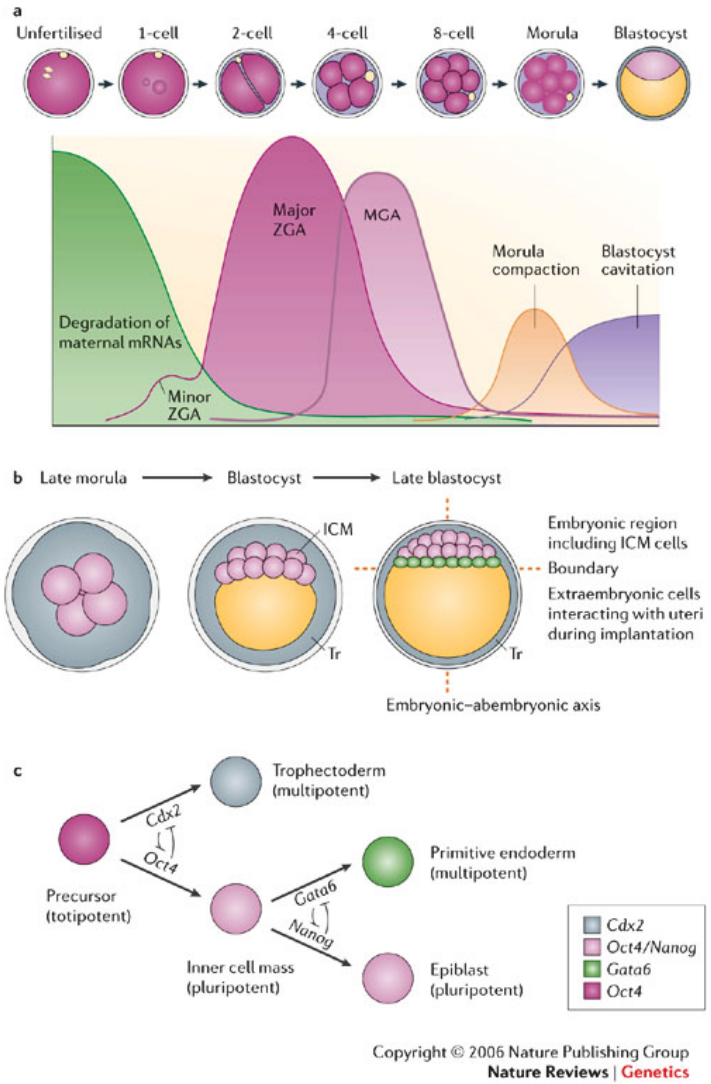
Preimplantation mouse development

Fertilised egg

8 cell

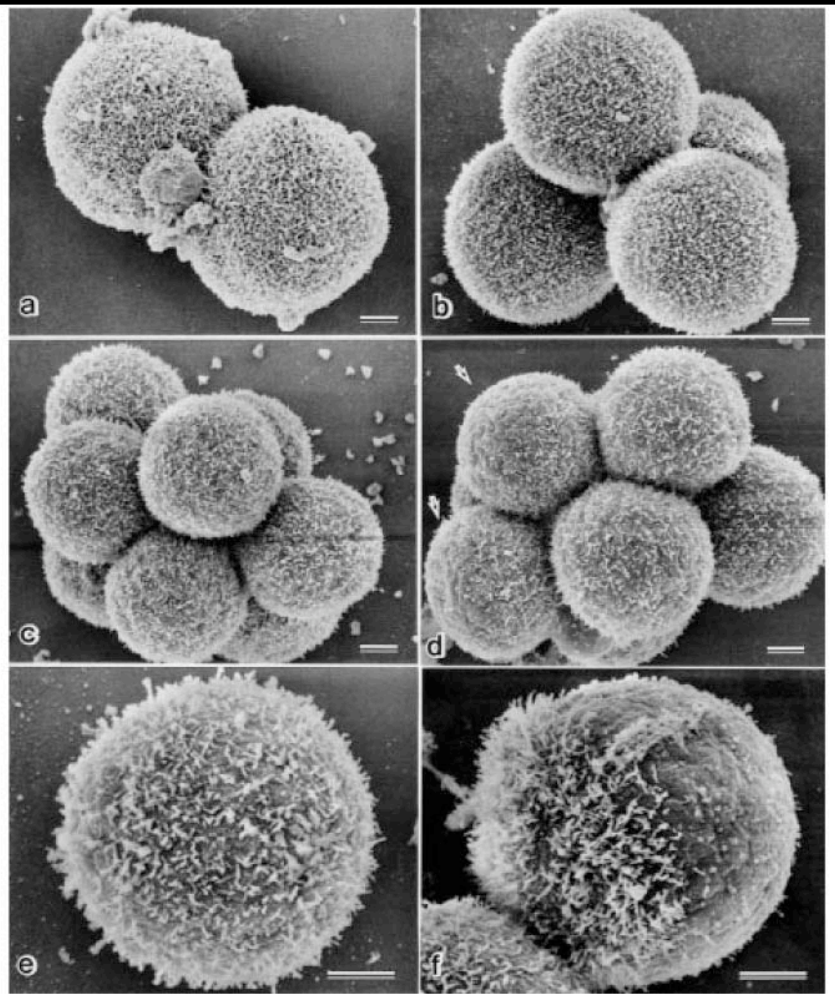


Blastocyst



Wang *et al. Nature Reviews Genetics* **7**, 185–199 (March 2006) | doi:10.1038/nrg1808

nature REVIEWS GENETICS



G. 1. Surface ultrastructure of hamster embryos examined by SEM. Bar represents 5 μm. **a**) An intact 2-cell embryo; **b**) 4-cell embryo; **c**) an earl
cell embryo. Note a uniform distribution of microvilli for 2- to early 8-cell embryos and a decreased number of microvilli in the 8-cell embryo relativ
2- and 4-cell embryos. **d**) A late 8-cell embryo (decompacted in Ca-free DPBS). Notice polarized blastomeres (arrows), which show nonmicrovillou
as on the outside of the embryo and a microvillous pole appearing adjacent to regions of cell apposition. **e**) A nonpolar dissociated blastomere c
ate 8-cell embryo; **f**) a polar blastomere of a late 8-cell embryo; notice a natural couplet (2/8) of a late 8-cell embryo showing microvillous pol
cated in the regions of basal, cell-cell contacts.

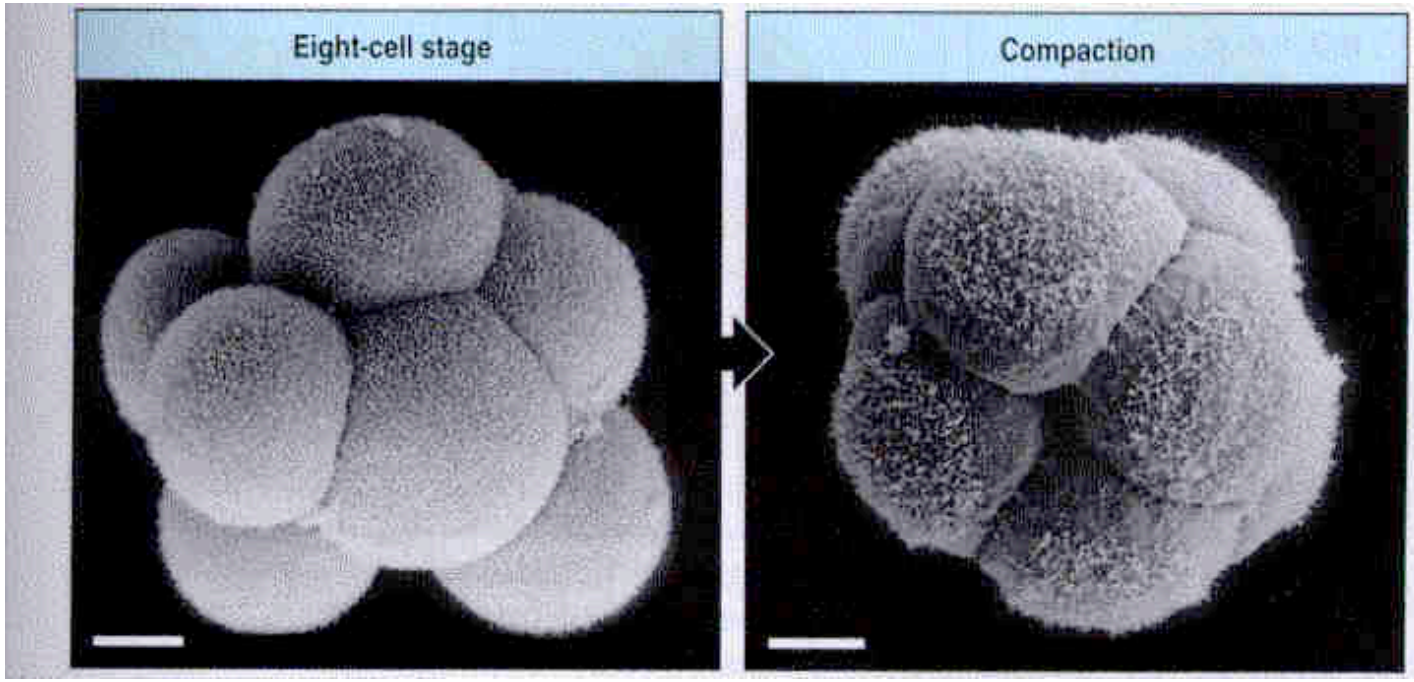
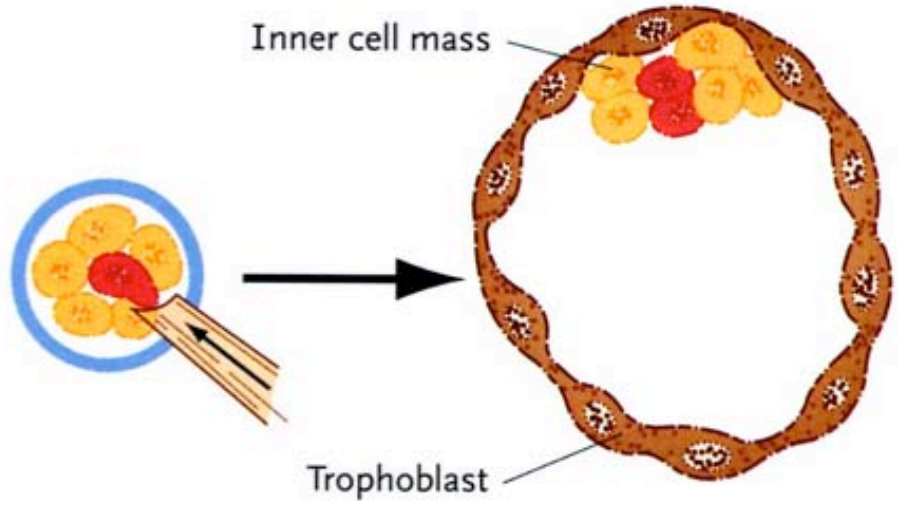


Fig. 8.9
embryo.
have sm
microvilli
and cells
another.
courtesy
1989.

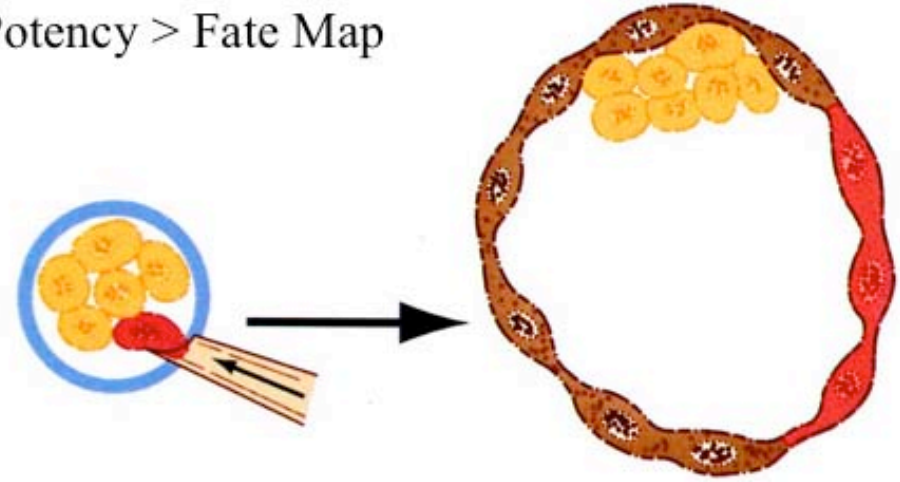
Position-Specific Differentiation

Inside-Outside Hypothesis

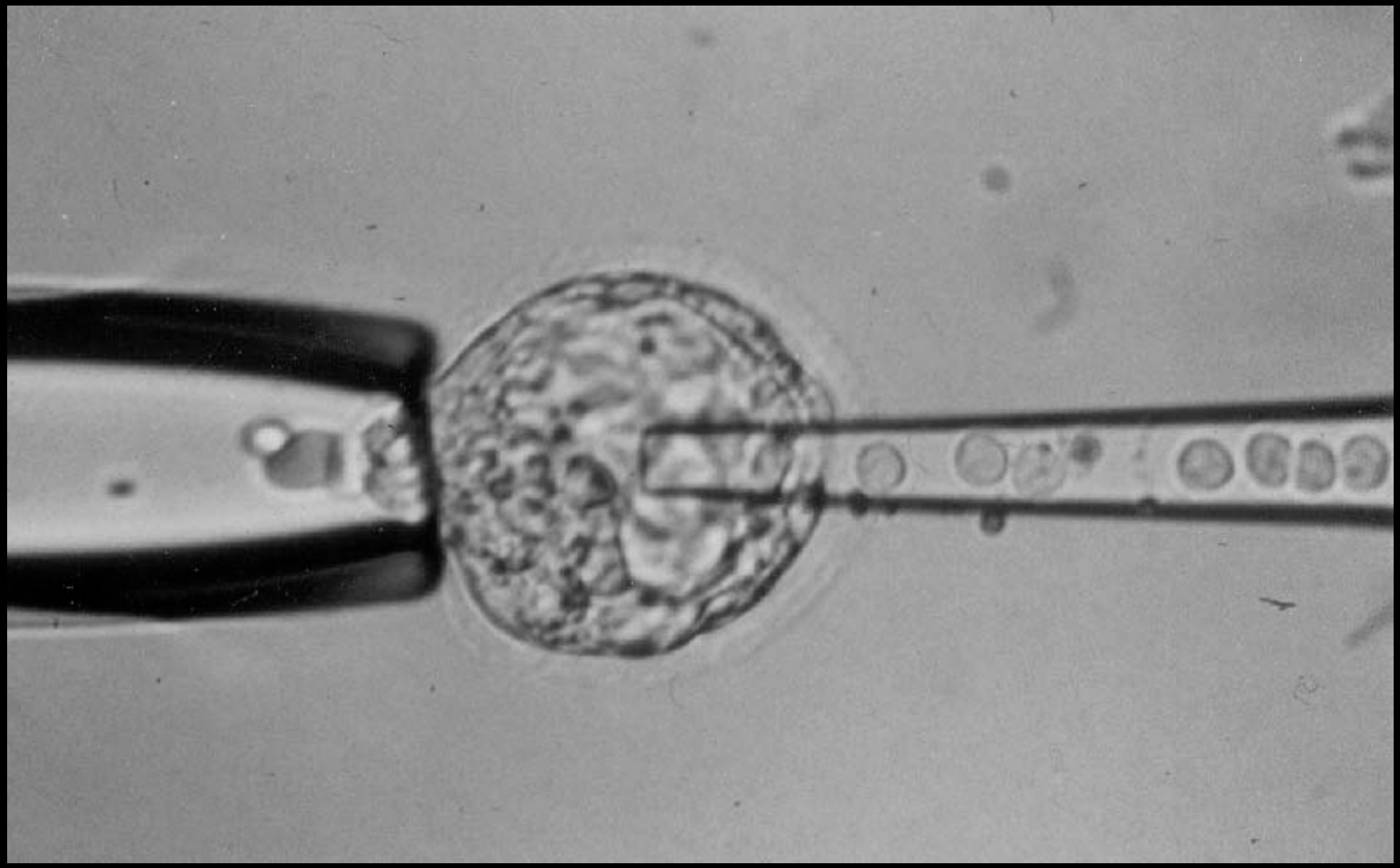
8-16 Cell Stage - Totipotent

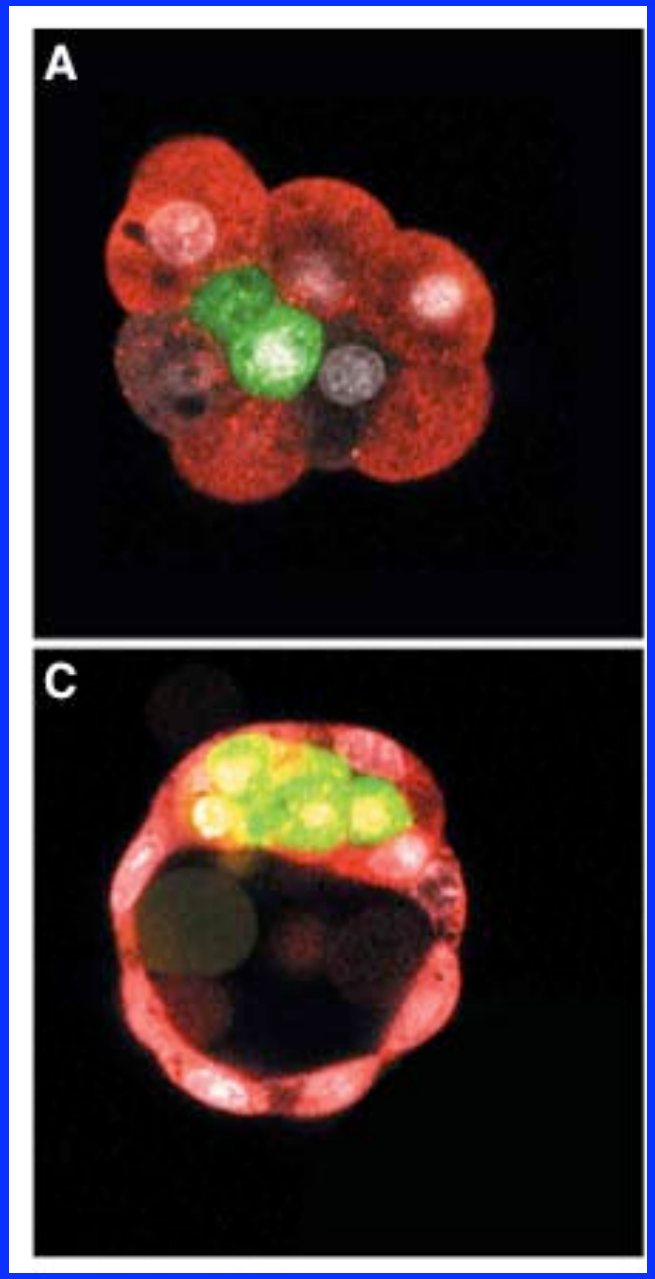


Potency > Fate Map



Injection of ES cells into a host blastocyst




A
C

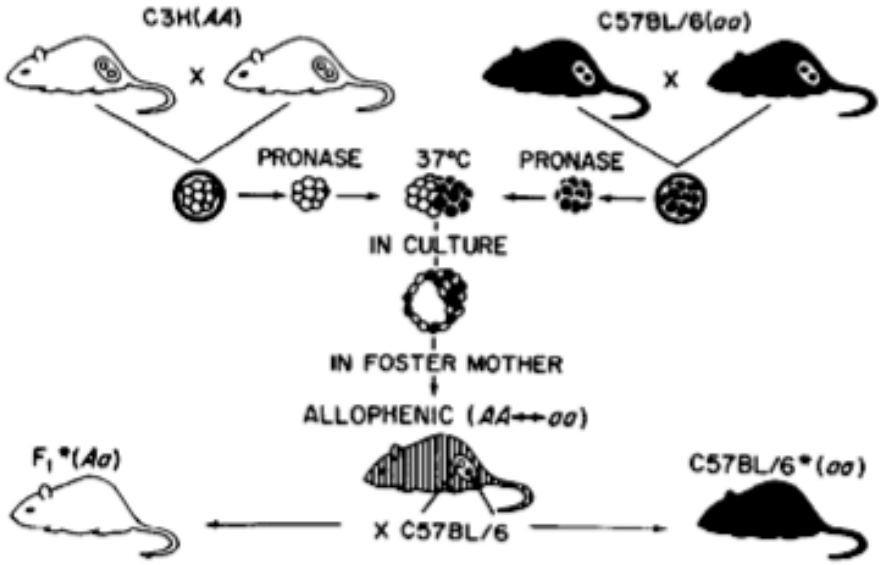
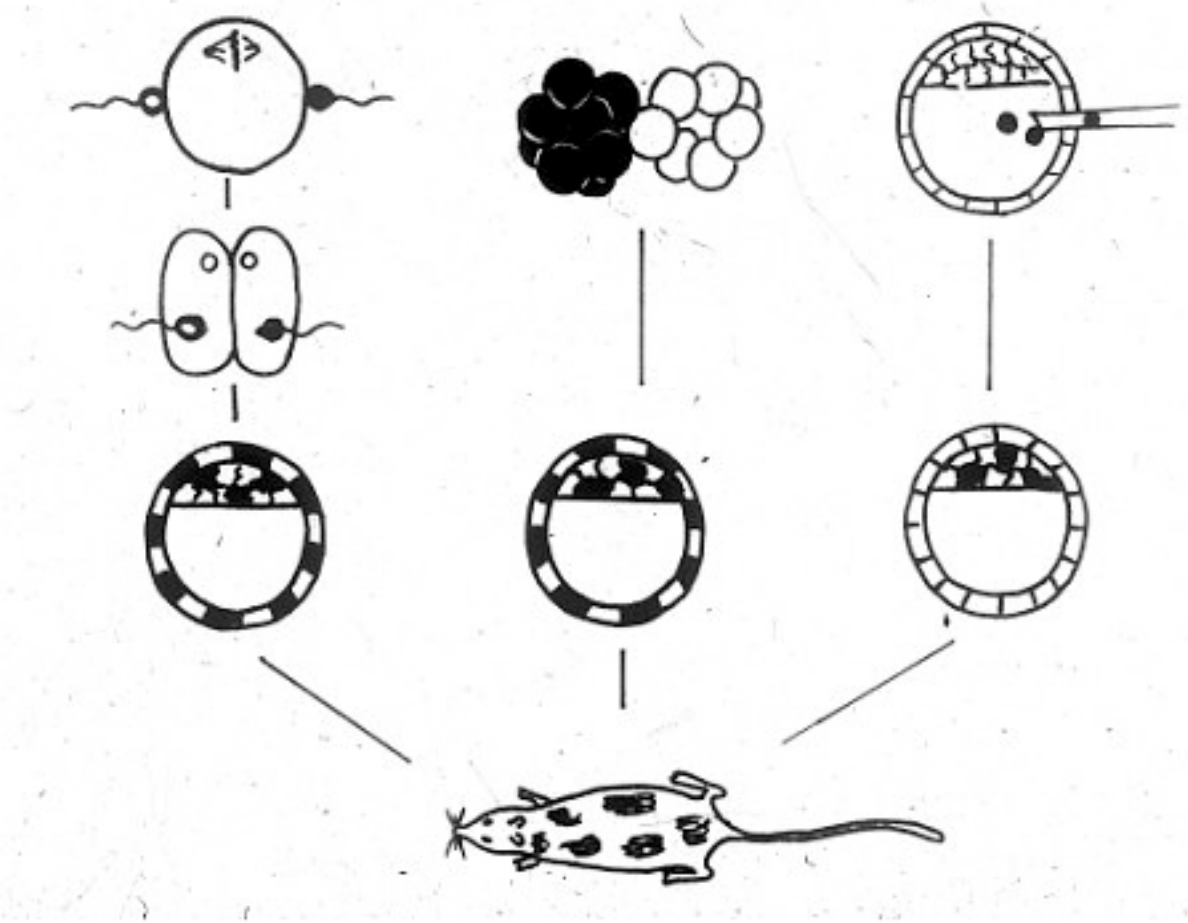
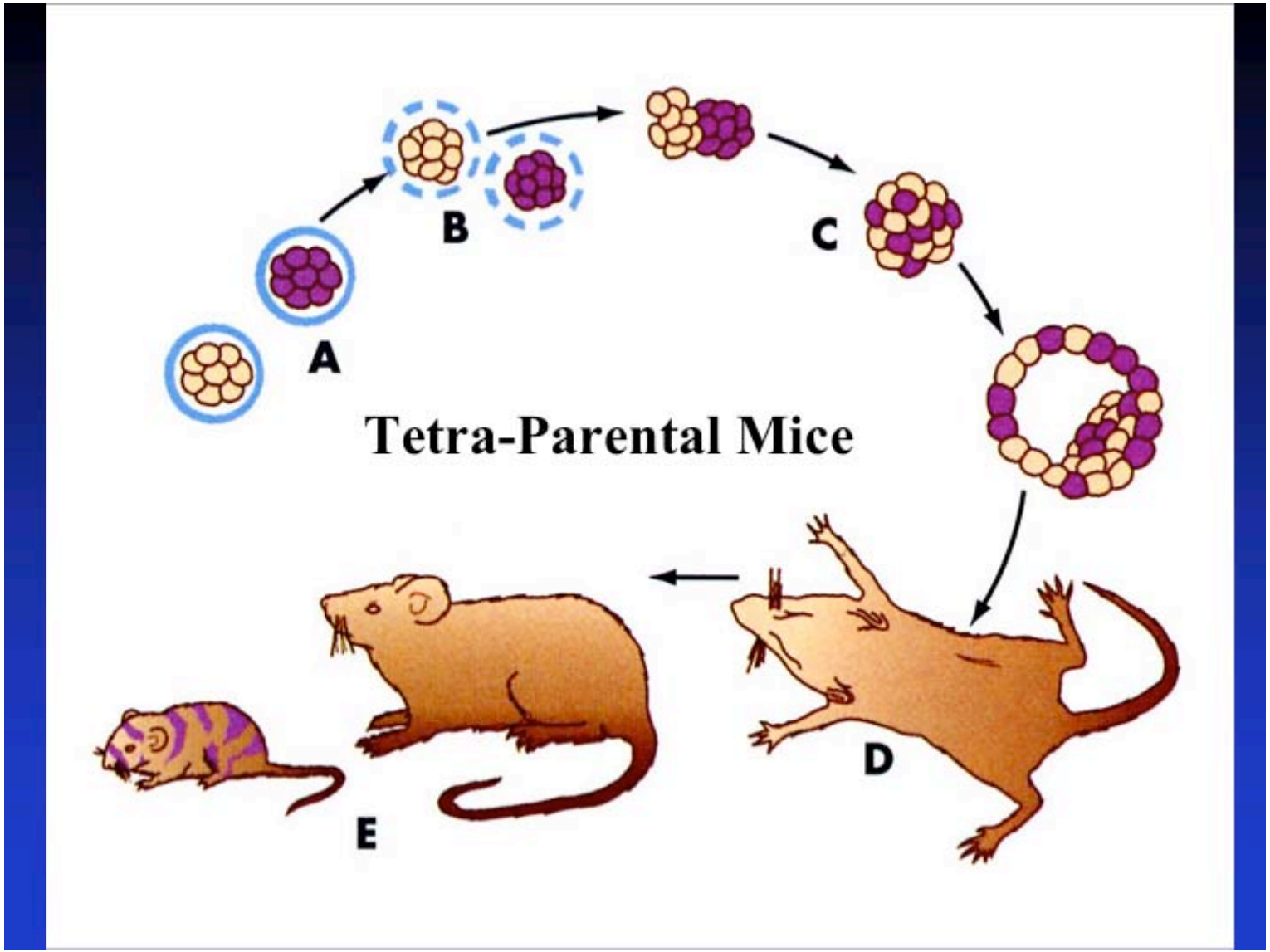
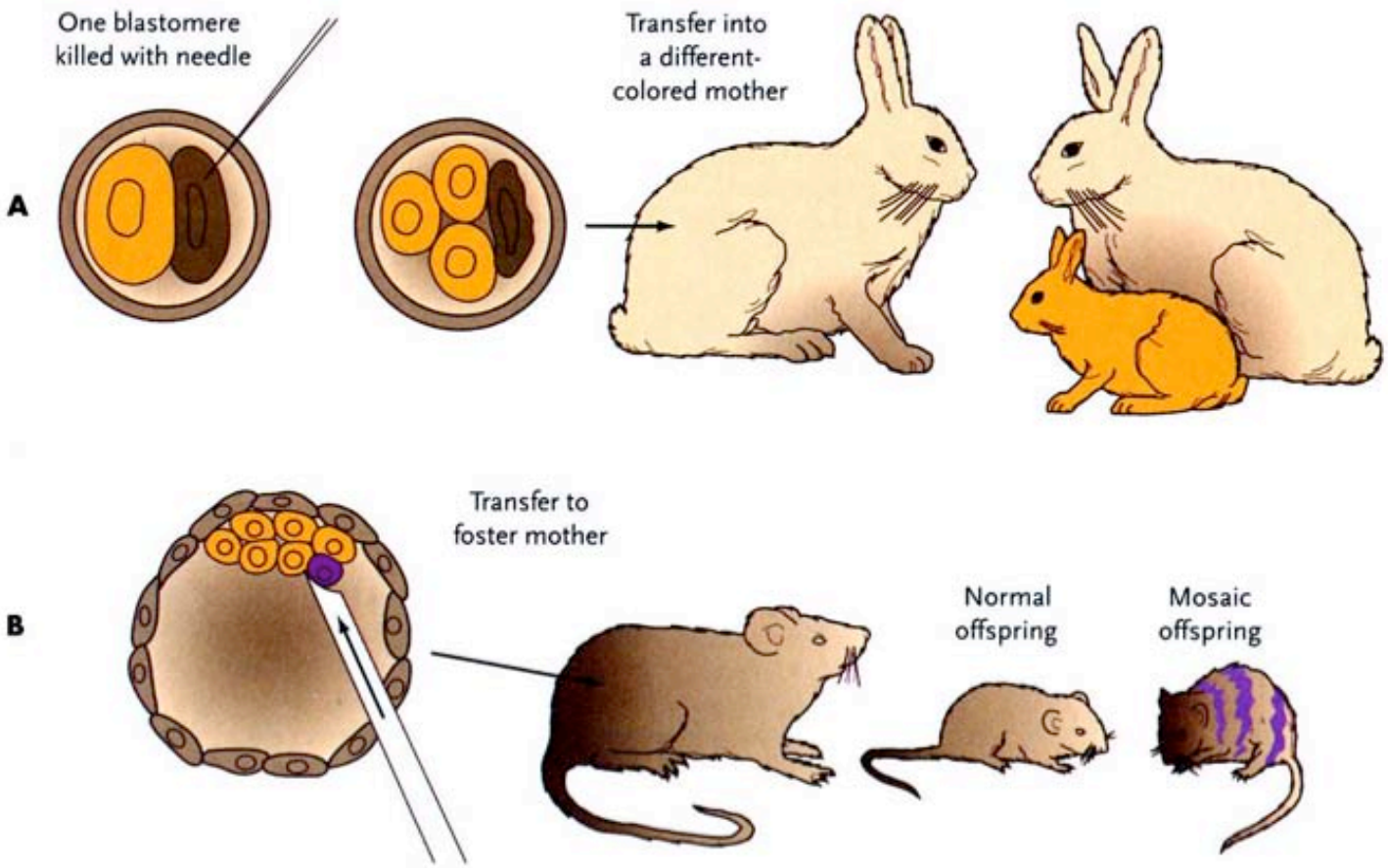


Figure 1 Experimental production of allophenic mice by the methods of Mintz (reviewed in 122). The example shows two cleavage-stage embryos derived, respectively, from gametes of a pair of C3H and a pair of C57BL/6 inbred-strain parents. The enveloping zona pellucida of each explanted embryo is lysed in pronase and the embryos are aggregated by incubation at 37°C (or by exposure to phytohemagglutinin, as described in 134) and cultured for a day. The resultant composite double-size blastocyst is then surgically transferred to the uterus of a pseudopregnant recipient previously mated with a sterile vasectomized male. Embryo size regulation occurs soon after implantation, and development continues normally to birth. If both cell strains are adequately represented in the coat of the C3H↔C57BL/6 allophenic animal, a pattern of fine transverse bands, representing the component *agouti (A/A)* and *nonagouti (a/a)* hair follicle clones, is seen. Other tissues, including the germ line (diagrammatically shown), may also comprise both cell strains. Each cell, except for skeletal myoblasts, retains its individuality. This is especially striking in the germ line: breeding tests with ordinary animals of the recessive color strain yield C57BL/6 and F_1 progeny differing(*) from ordinary animals only in their strange history and in the possibility of effects of the original foster mother or of the allophenic environment.

ORIGIN OF SPONTANEOUS AND EXPERIMENTAL PRIMARY CHIMAERISM




A
B
C
Tetra-Parental Mice
D
E


A
One blastomere killed with needle
Transfer into a different-colored mother
B
Transfer to foster mother
Normal offspring
Mosaic offspring

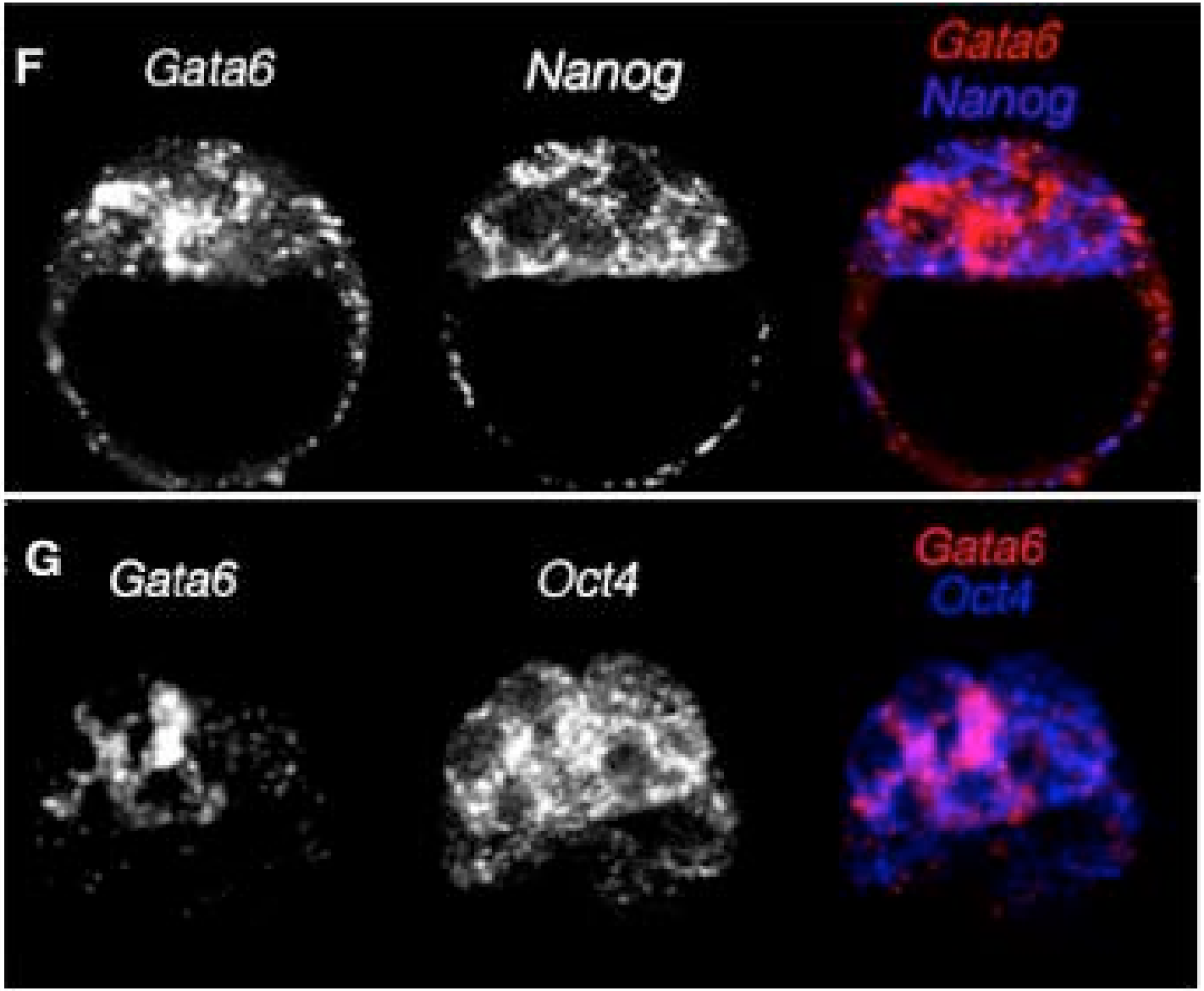
Initiation of mouse development

- Up until the 8 cell stage all blastomeres can contribute to all tissues
- At compaction at the 8 cell stage each blastomere becomes polar
- At subsequent cell divisions the daughter cells may be internalised or externalised
- Until at least the 16 cell stage cells can be moved from inside to outside and vice versa and will adapt to their new positions
- ICM cells can regenerate trophectoderm until expansion

Pluripotency and the early embryo

- The pluripotent (embryonic) lineage expands rapidly and flexibly to generate the foetus
- Several transcription factors are required for establishing the pluripotent lineage in the early embryo
- Embryonic stem cells are derived from the pluripotent population of the early embryo
- Oct-4 *(Nichols et al., 1998)*

In situs, E3.5



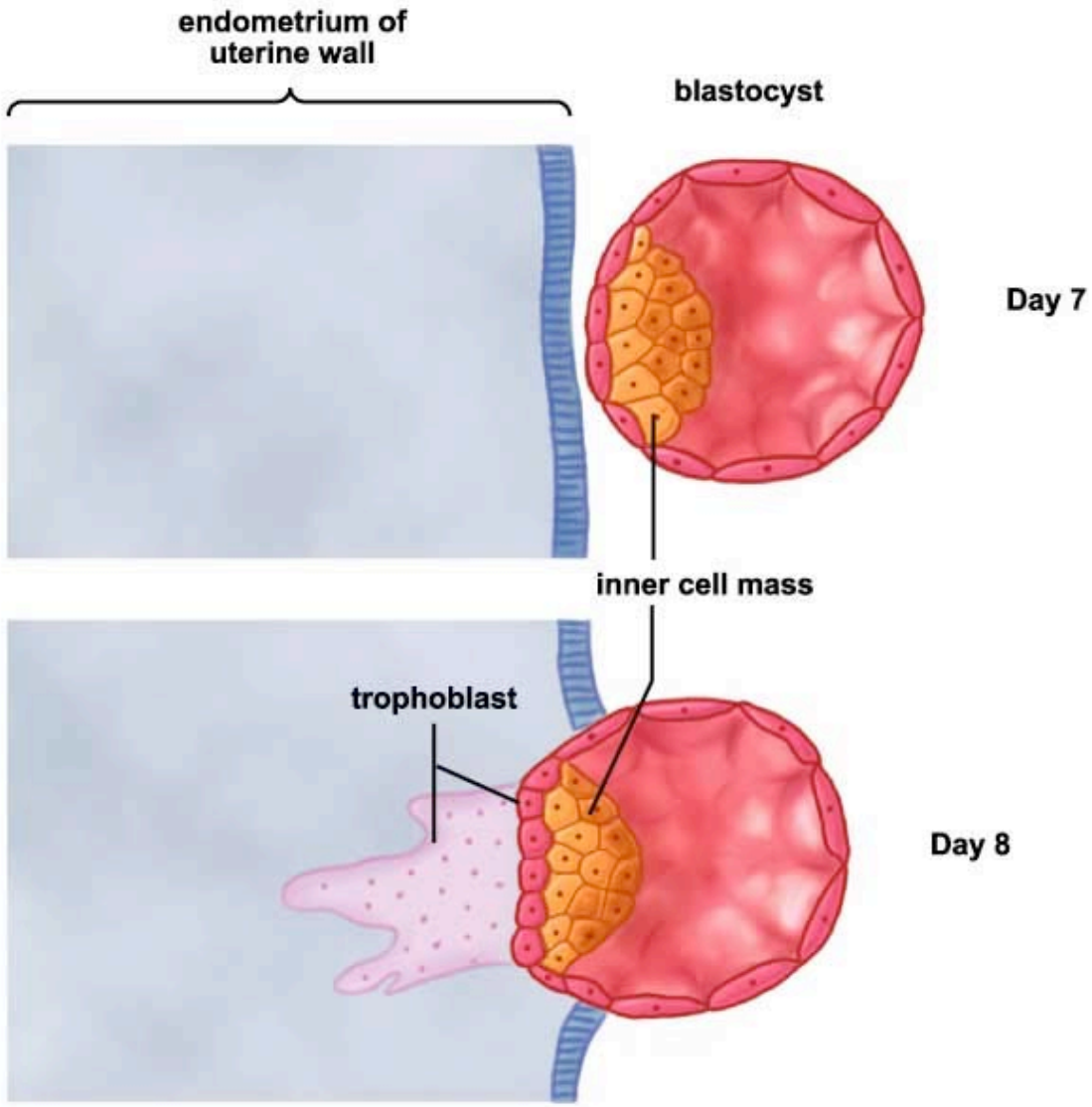
Nanog and Gata6 are mainly exclusive and randomly positioned

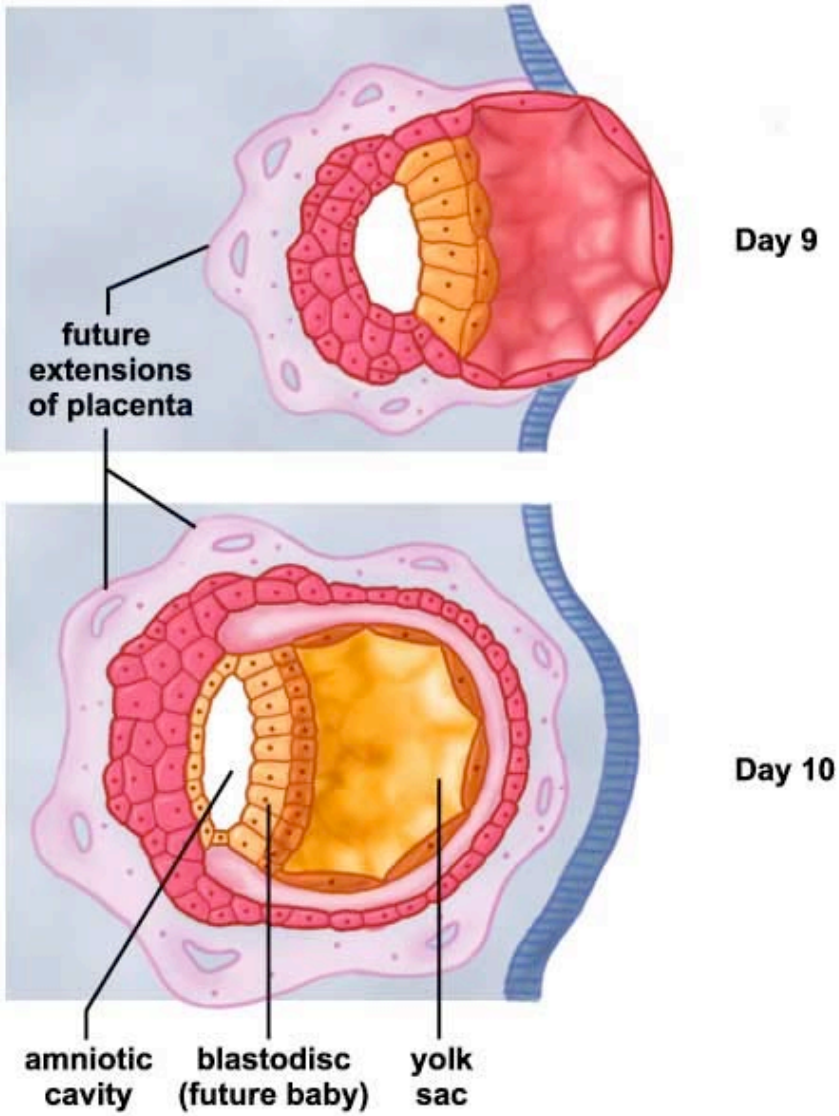
Oct4 is expressed in all cells of the ICM; Gata6 in only a few

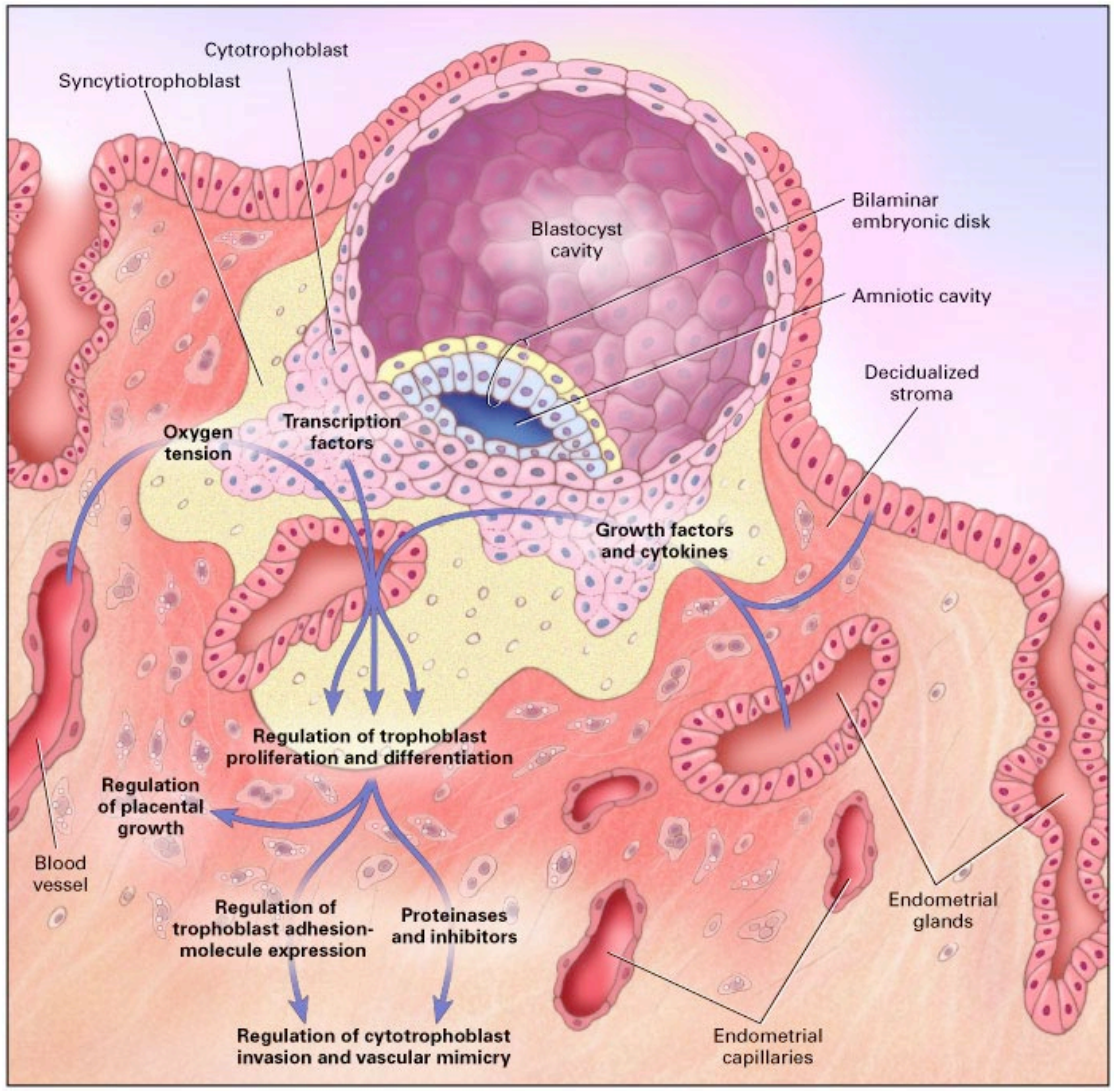
Hatching

(from zona pellucida)

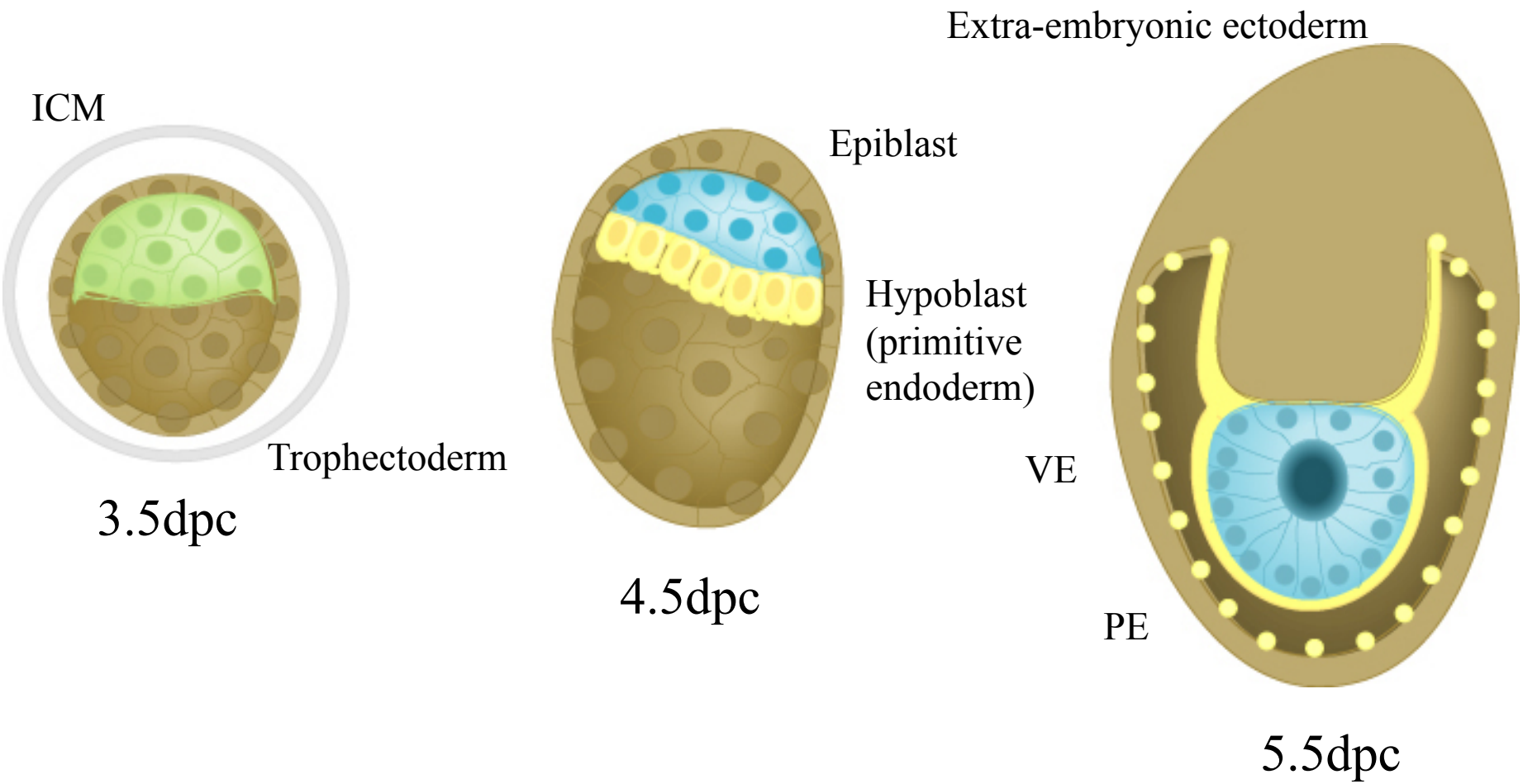
Hatching: Enzymatic production by Trophoblasts - digestion of the Zona Pellucida


endometrium of
uterine wall
blastocyst
Day 7
inner cell mass
trophoblast
Day 8


Day 9
future extensions of placenta
Day 10
amniotic cavity
blastodisc (future baby)
yolk sac


Cytotrophoblast
Syncytiotrophoblast
Blastocyst cavity
Bilaminar embryonic disk
Amniotic cavity
Decidualized stroma
Oxygen tension
Transcription factors
Growth factors and cytokines
Regulation of trophoblast proliferation and differentiation
Regulation of placental growth
Blood vessel
Regulation of trophoblast adhesion-molecule expression
Proteinases and inhibitors
Regulation of cytotrophoblast invasion and vascular mimicry
Endometrial glands
Endometrial capillaries

Peri-implantation development



Implantation

Days 6 –12

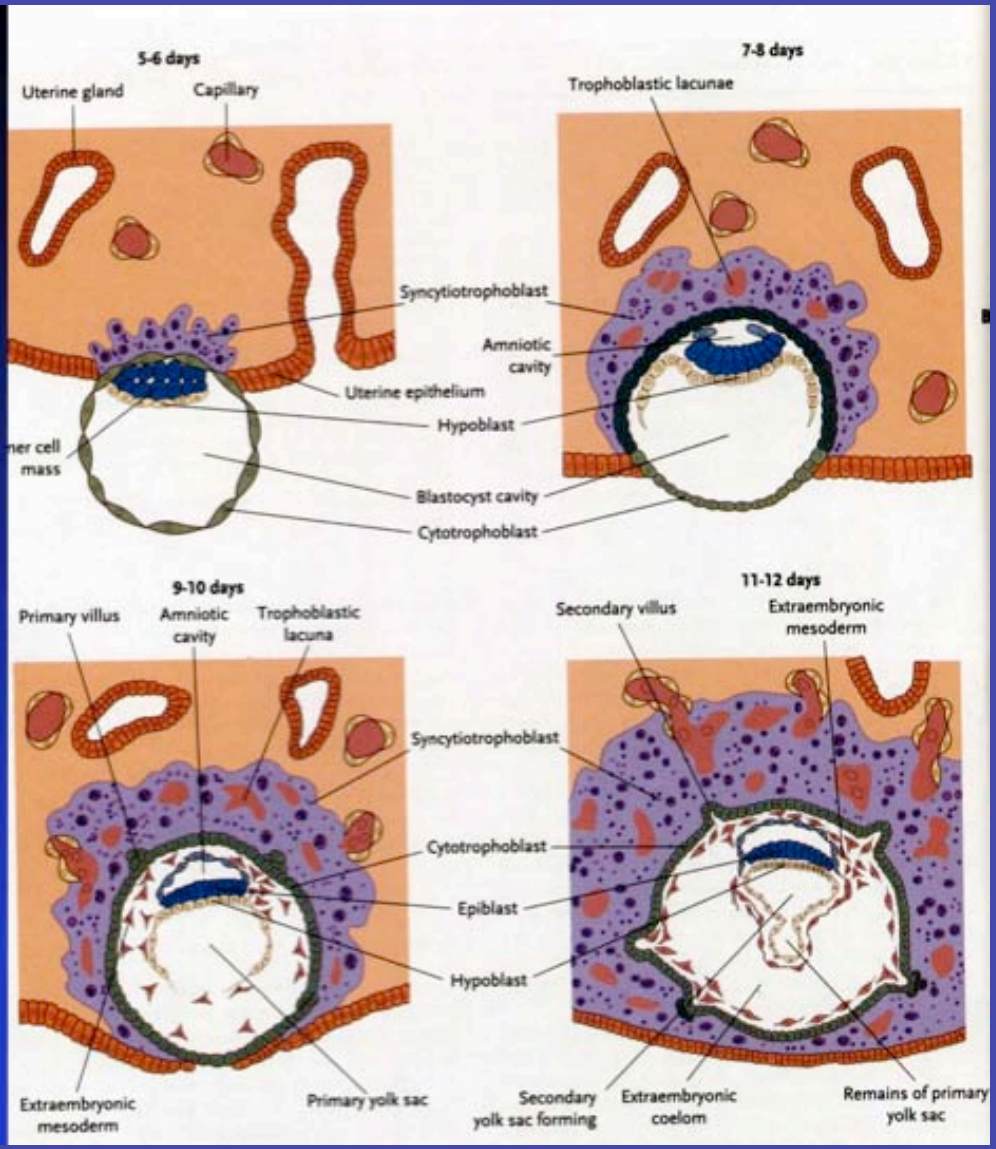
Adhesion, blastocyst to endometrium

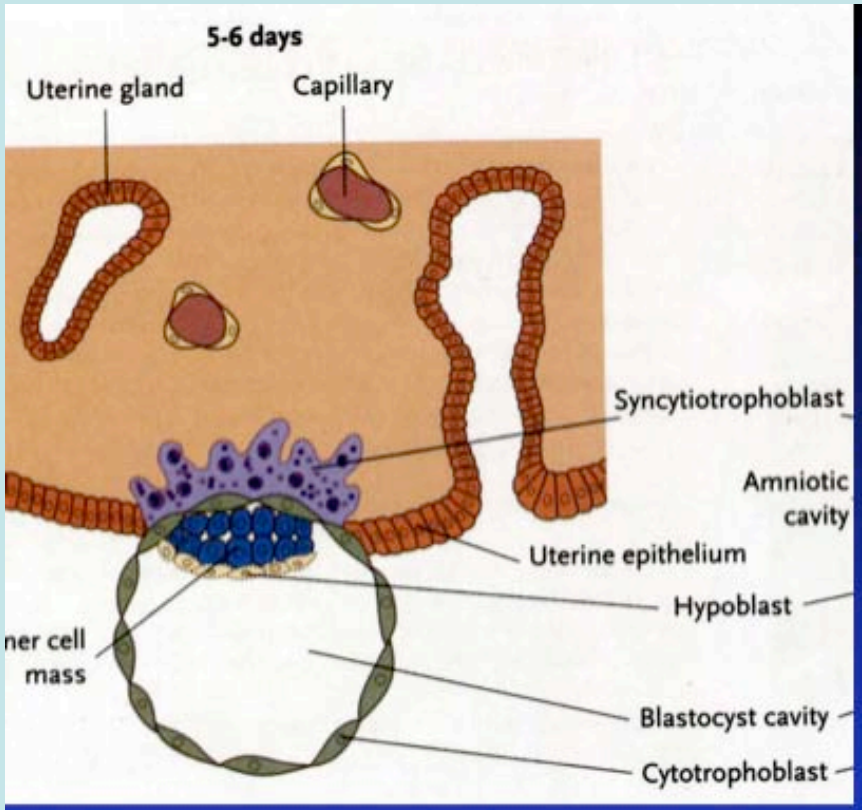
Trophoblast proliferation

Syncytiotrophoblast

Secretion of hydrolytic enzymes

Breakdown of endometrium





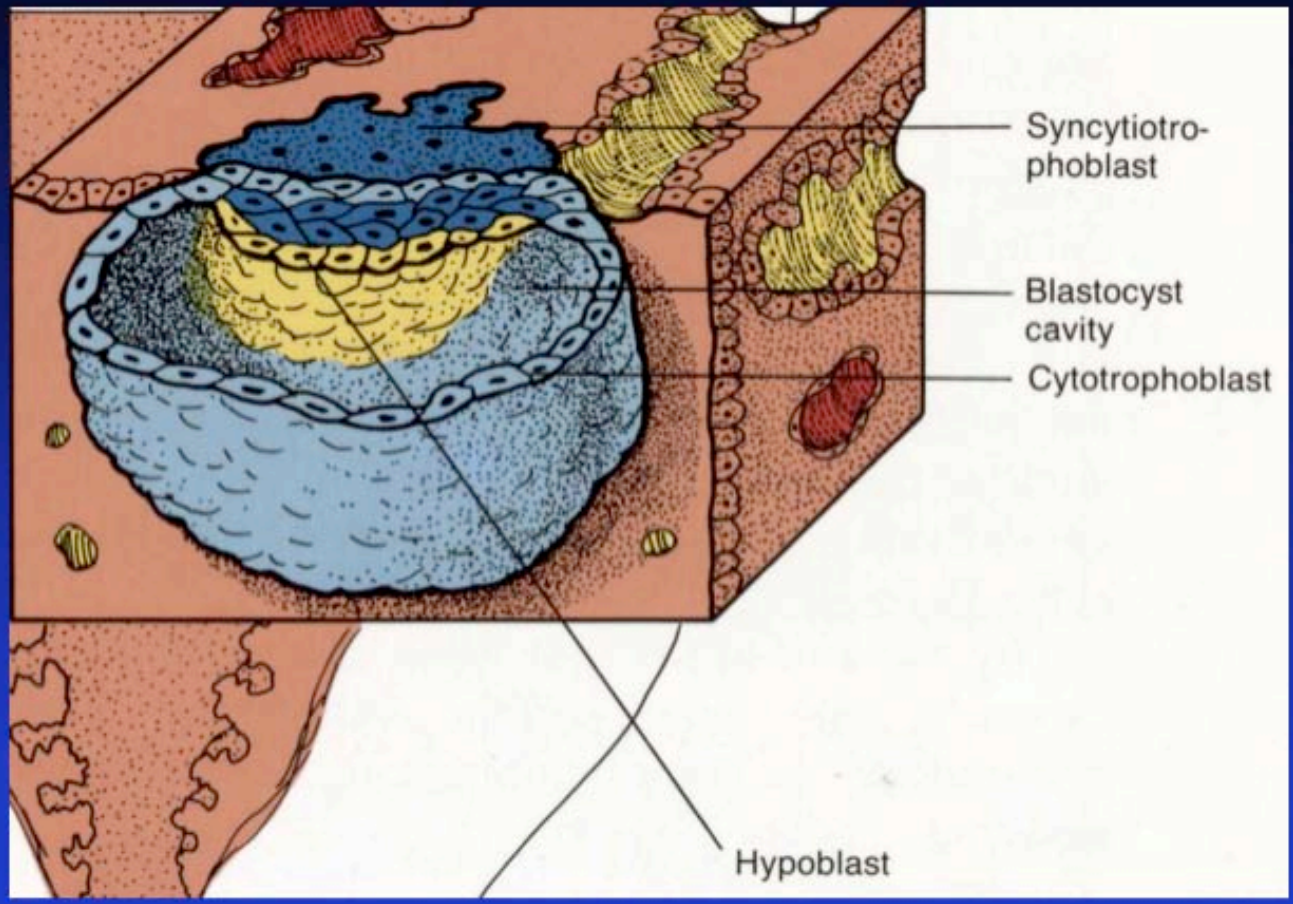
Day 6

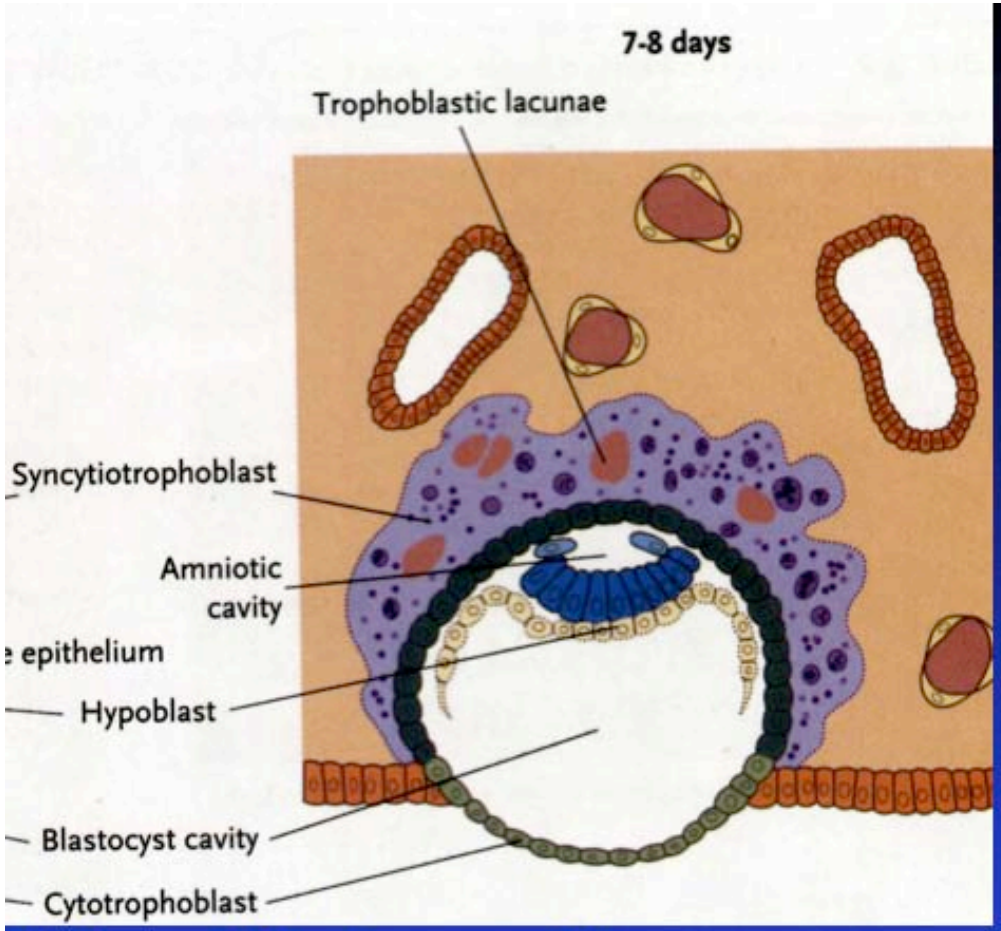
Blastocyst adheres to endometrium at embryo pole

Trophoblast proliferation production of hCG (maintains corpus luteum)

Trophoblasts → Syncytiotrophoblast → hydrolytic enzymes → Embryo invasion

Trophoblasts → Cytotrophoblast


Syncytiotro-
phoblast
Blastocyst
cavity
Cytotrophoblast
Hypoblast



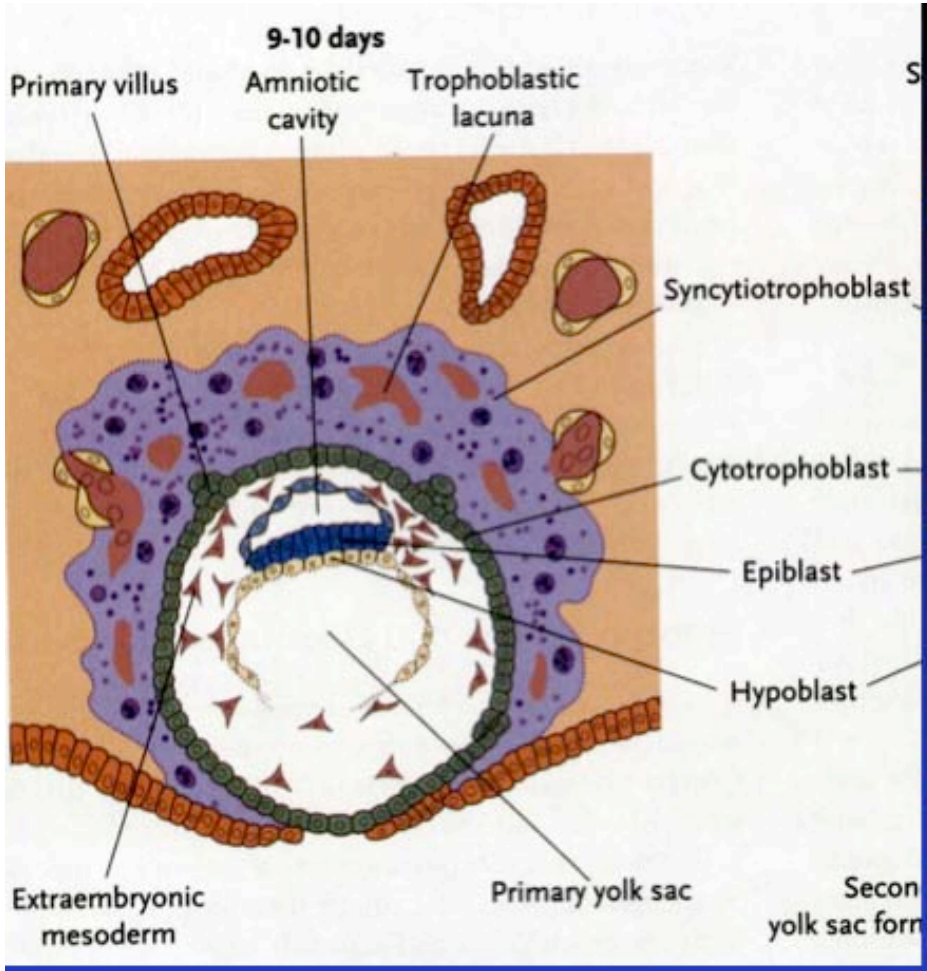
Day 7-8

- Syncytiotrophoblast expansion
- Lacunae form – filled with fluid (embryotroph)
- Embryotroph provides nutrients to the embryo. Derived from maternal blood.

Embryo - Bilaminar germ disc:

Epiblast layer – cavitates to form the amnionic cavity.

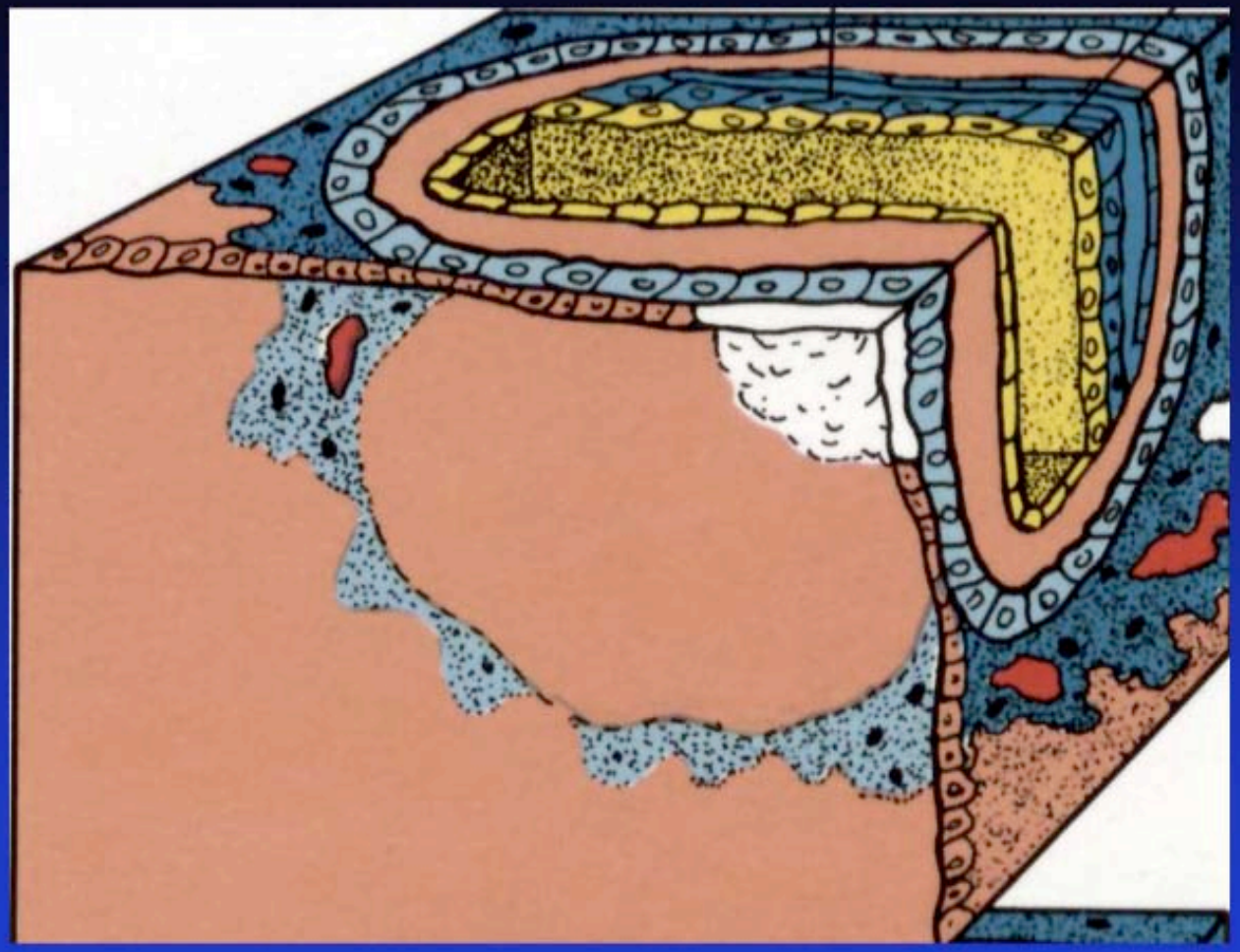
Hypoblast layer form the exocoelomic cavity / primary yolk sac

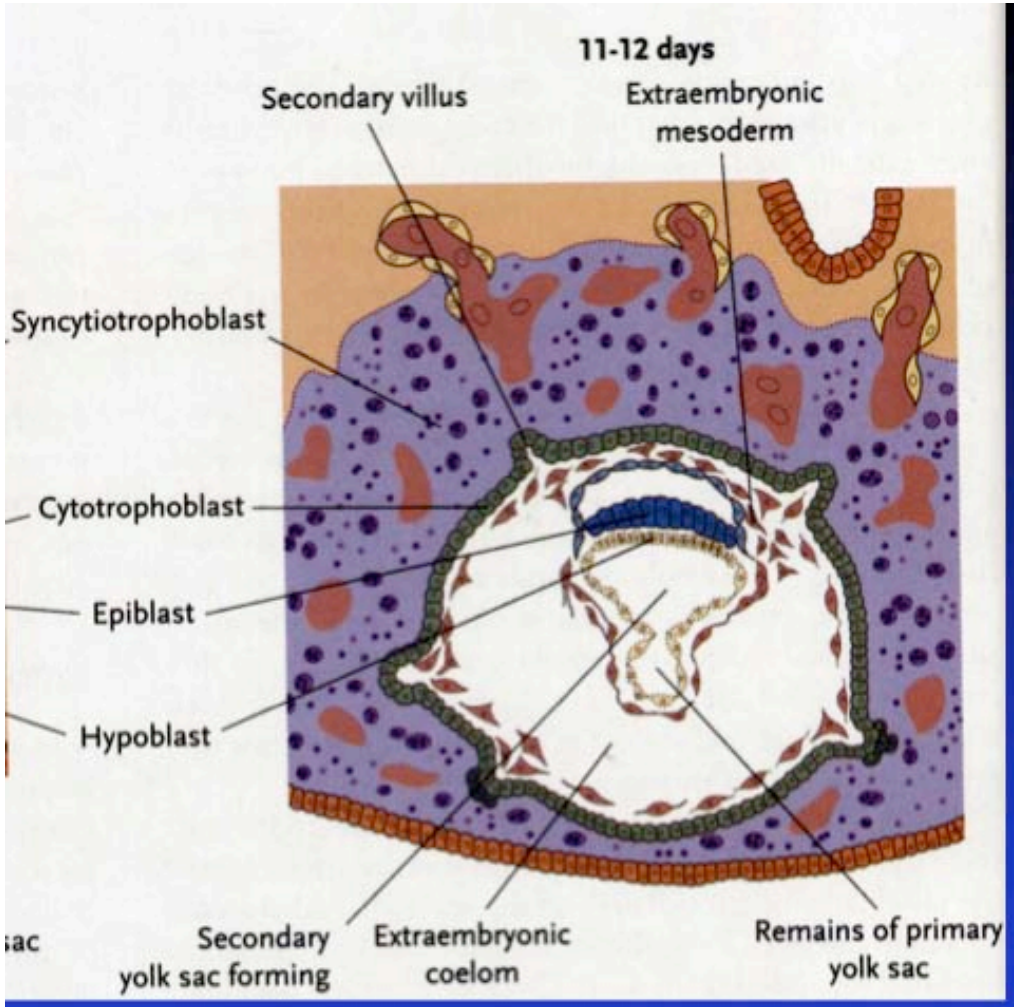


Day 9-10

- Lacunae enlarge
- Syncytiotrophoblast expands around entire blastocyst
- Cytotrophoblasts form primary villus – initiation of placenta formation
- Implantation Complete
- Coagulation Plug forms

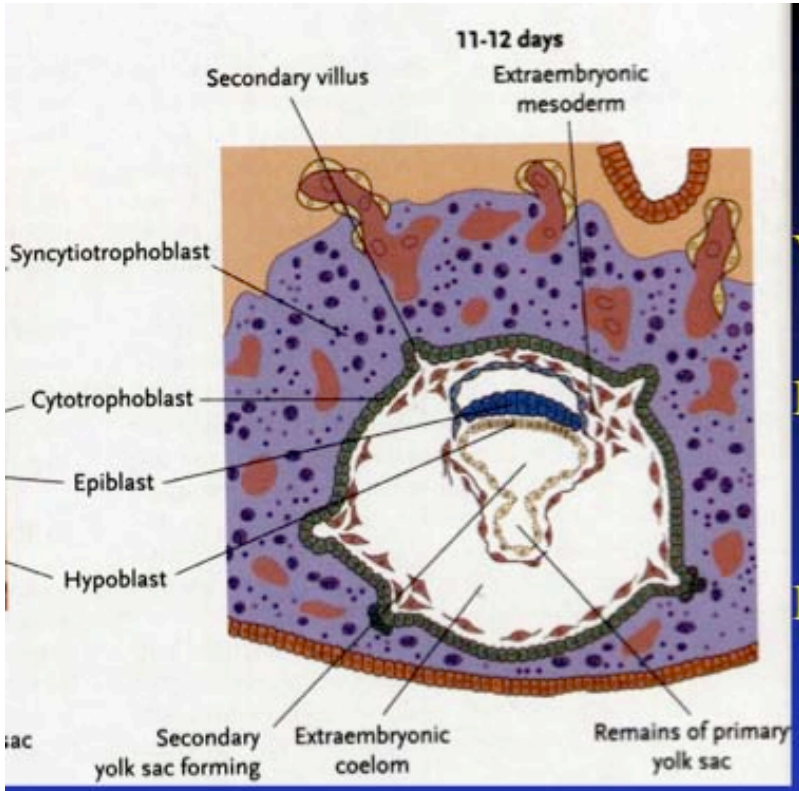
Embryo: hypoblast → exocoelomic membrane = Hauser's membrane
Extraembryonic mesoderm from yolk sac





Day 11-12

- Syncytiotrophoblast erode maternal capillaries – form sinusoids
- Syncytial lacunae become continuous with sinusoids
- Maternal blood to enter lacunae establishing the uteroplacental circulation



Day 11-12 – Embryo

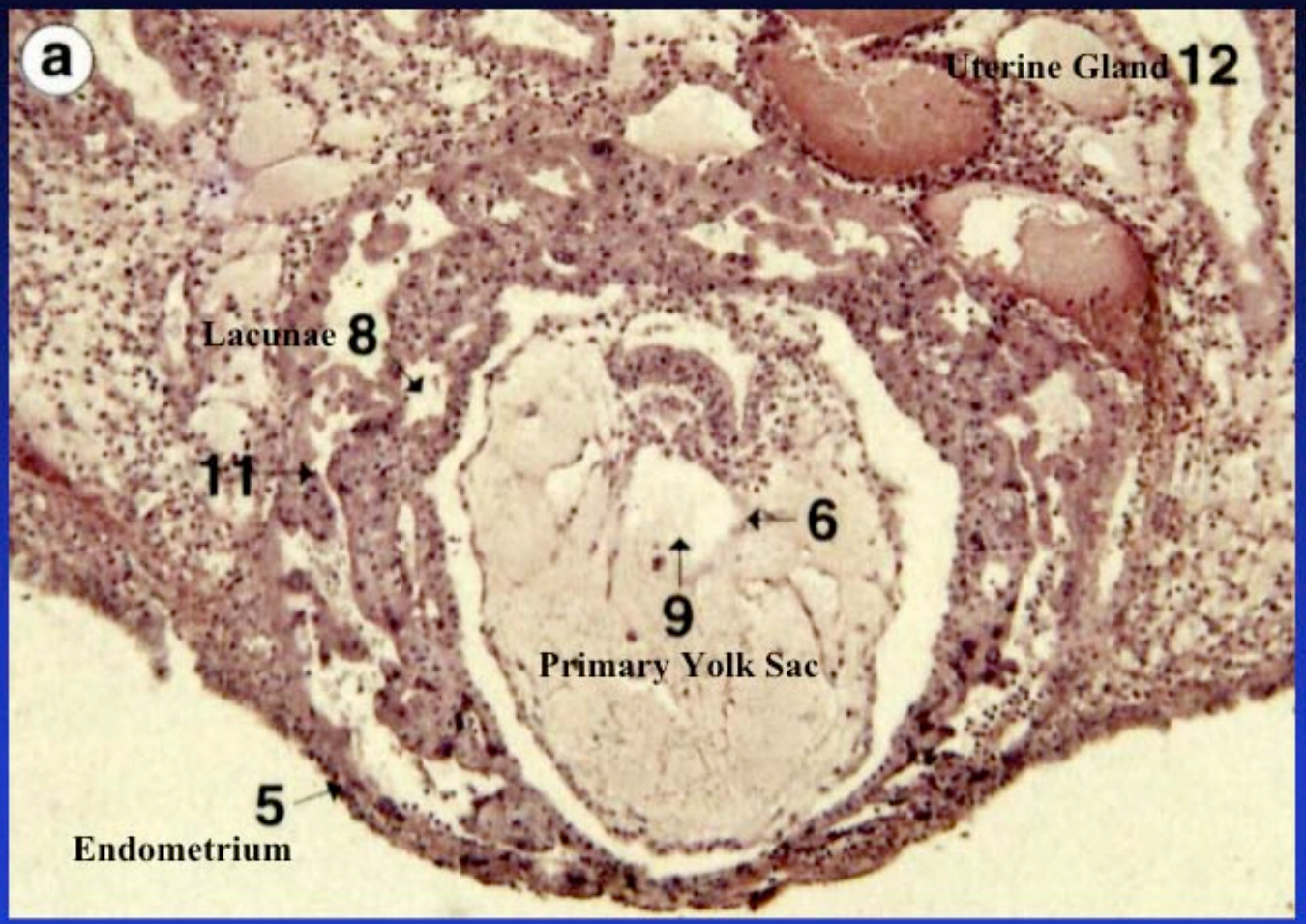
Yolk sac → extraembryonic mesoderm

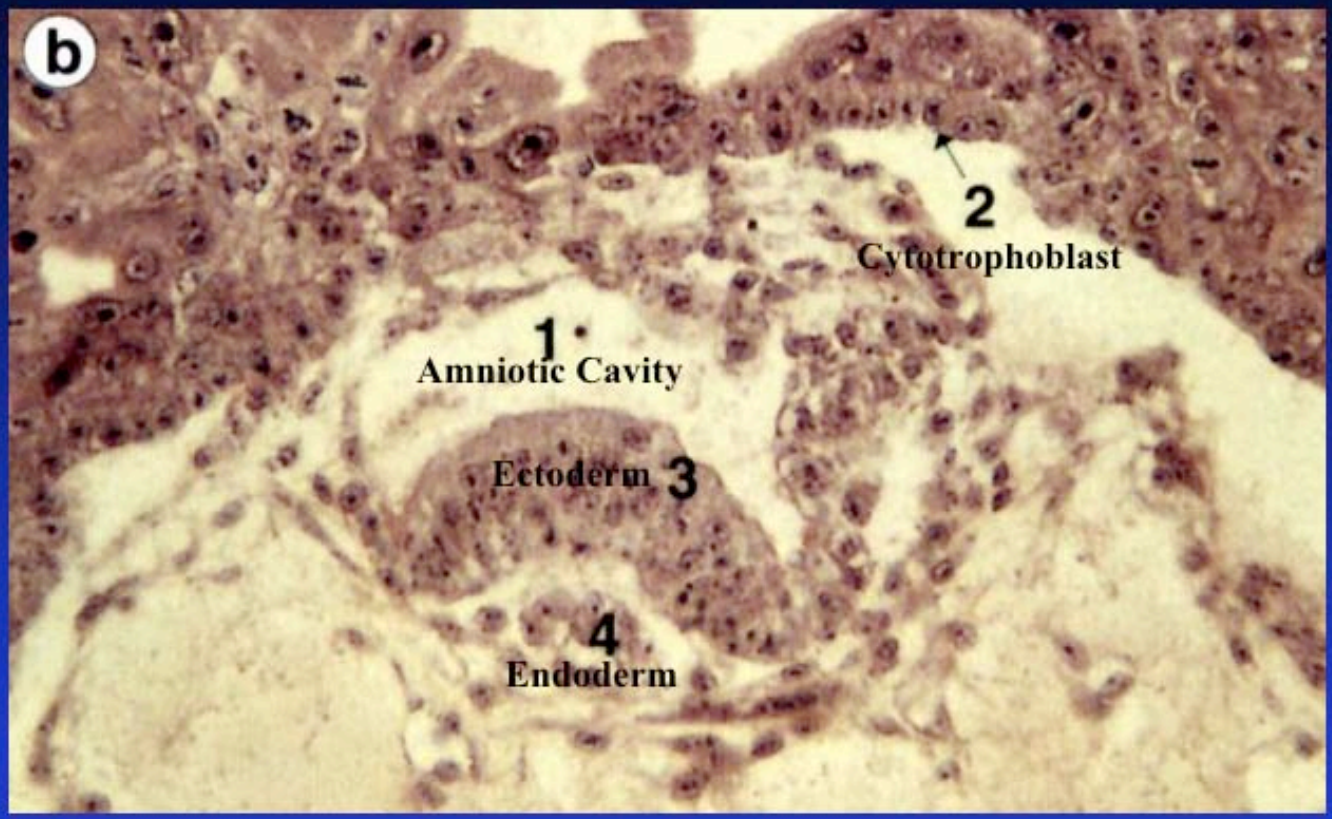
Extraembryonic Somatopleuric mesoderm - layer between amnion and cytotrophoblst

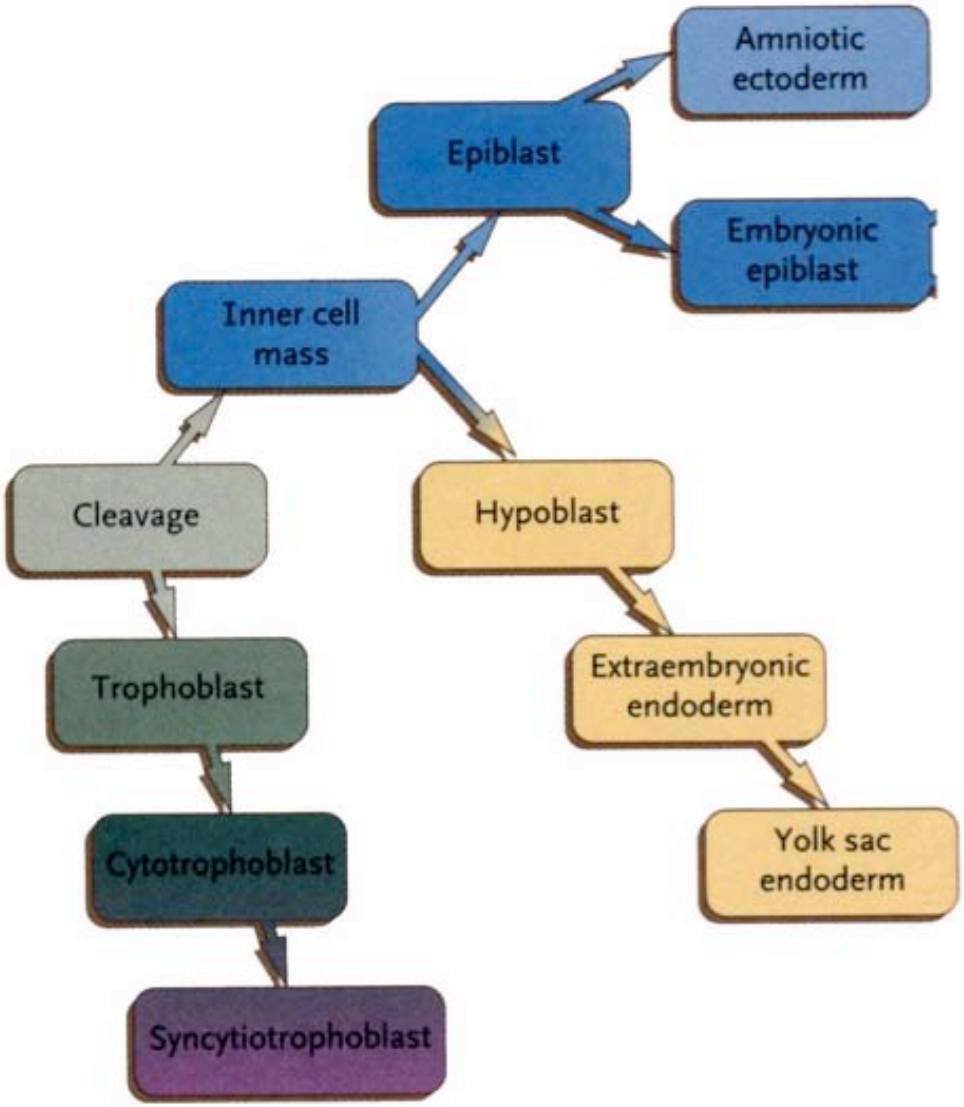
Extraembryonic Splanchnopleuric mesoderm - layer between Primary yolk sac and cytotrophoblast

Extraembryonic mesoderm becomes confluent and forms another cavity – extraembryonic coelom or chorionic cavity

Implantation




b
2
Cytotrophoblast
1
Amniotic Cavity
Ectoderm 3
4
Endoderm



Amnion

Amnionic Cavity

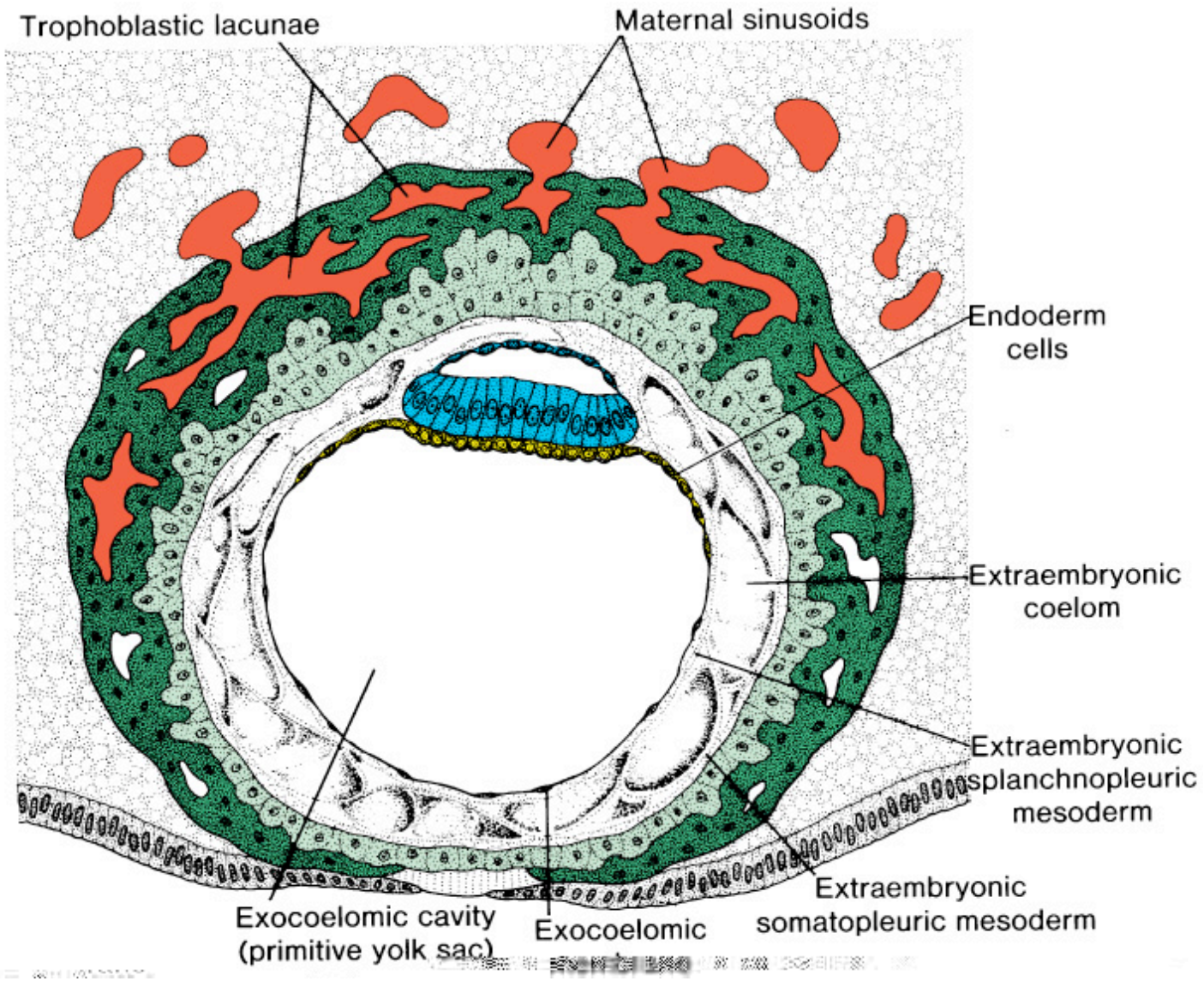
Cavitation

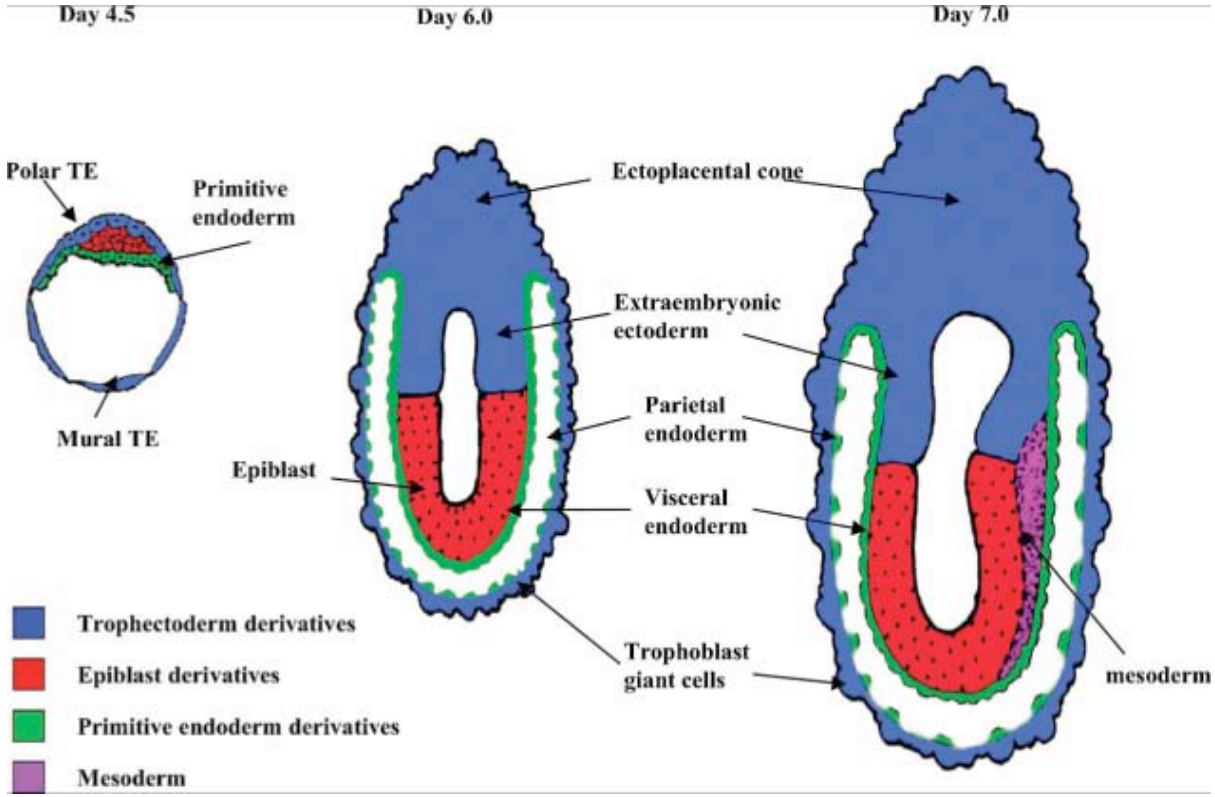
From BM Carlson, 1999

From BM Carlson

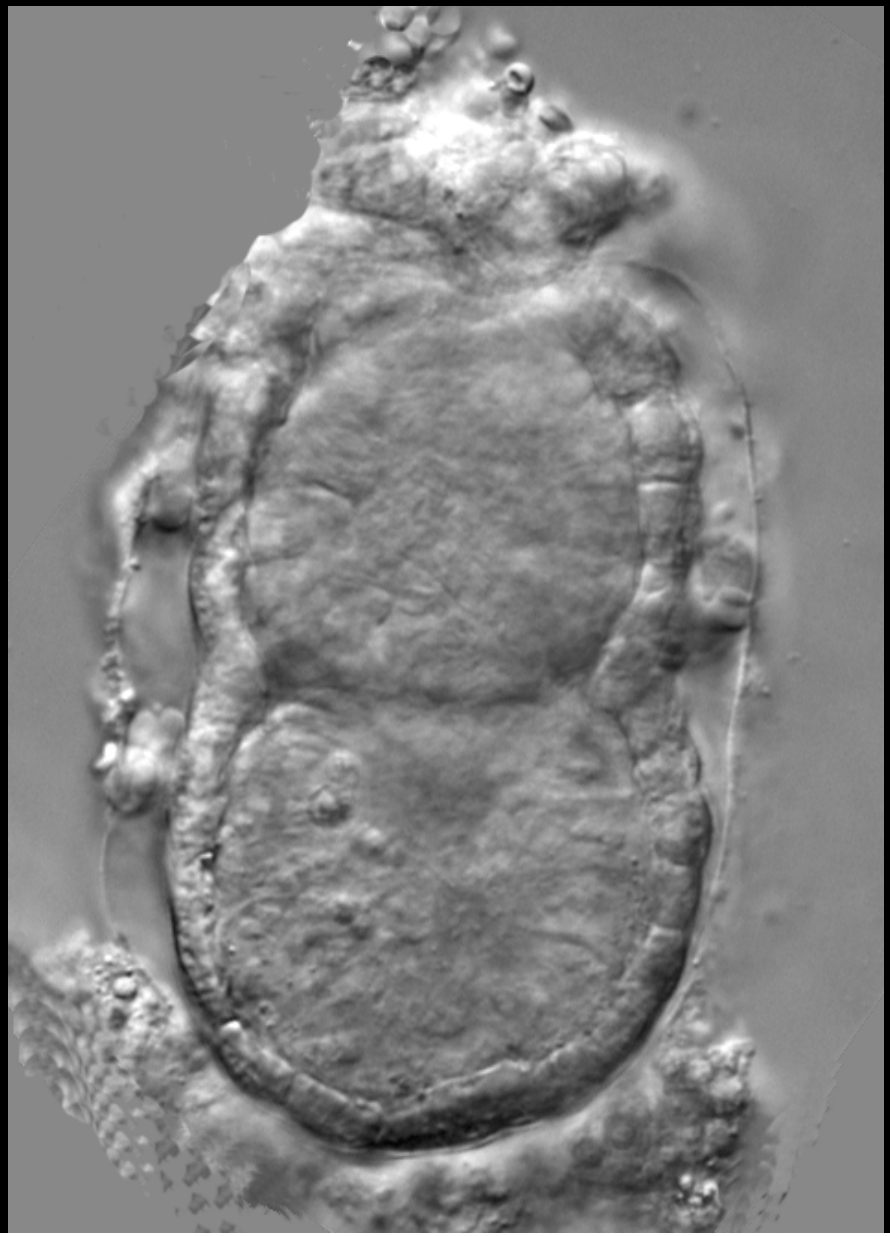
Extraembryonic Somatopleuric Mesoderm

Extraembryonic Splanchnopluric Mesoderm


Trophoblastic lacunae
Maternal sinusoids
Endoderm cells
Extraembryonic coelom
Extraembryonic splanchnopleuric mesoderm
Extraembryonic somatopleuric mesoderm
Exocoelomic cavity (primitive yolk sac)
Exocoelomic


Day 4.5
Day 6.0
Day 7.0
Polar TE
Primitive endoderm
Mural TE
Ectoplacental cone
Extraembryonic ectoderm
Parietal endoderm
Epiblast
Visceral endoderm
Trophoblast giant cells
mesoderm
Trophectoderm derivatives
Epiblast derivatives
Primitive endoderm derivatives
Mesoderm

Early postimplantation embryo



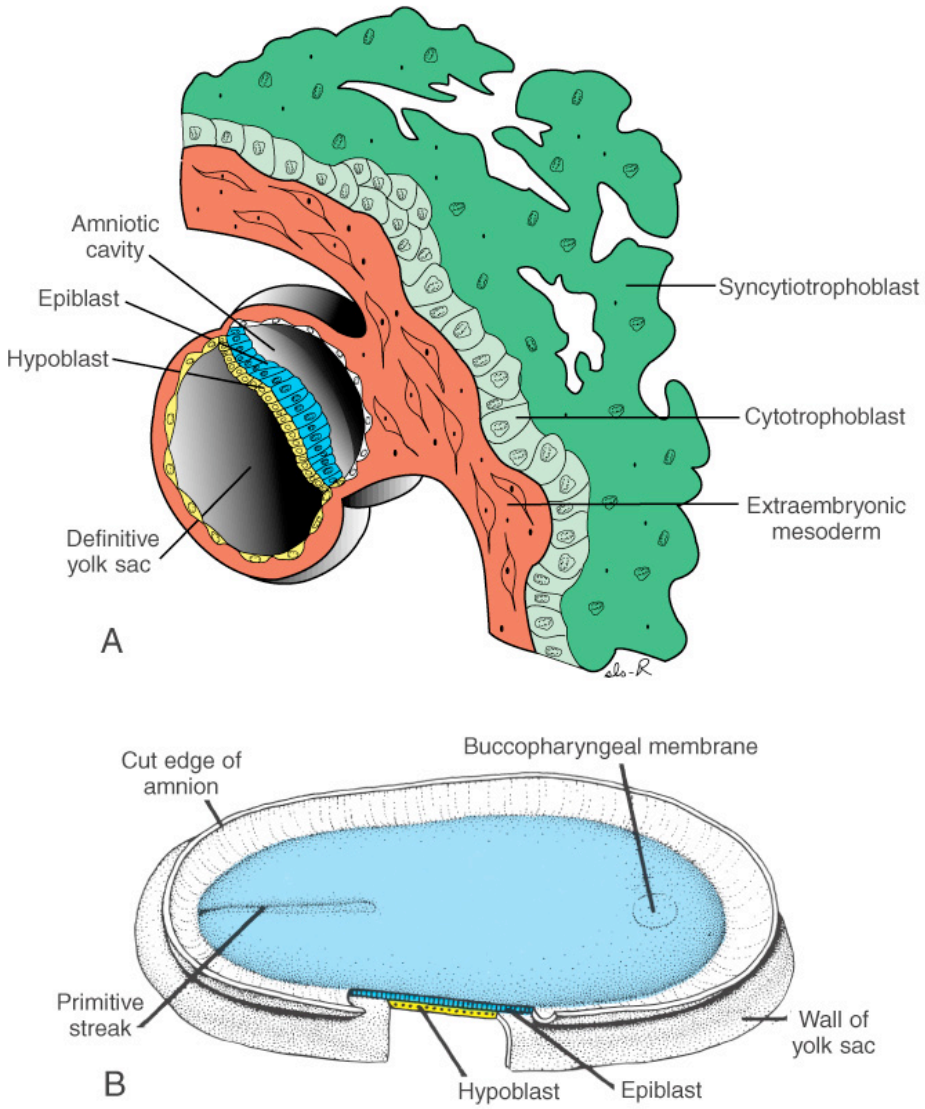
Ectoplacental cone

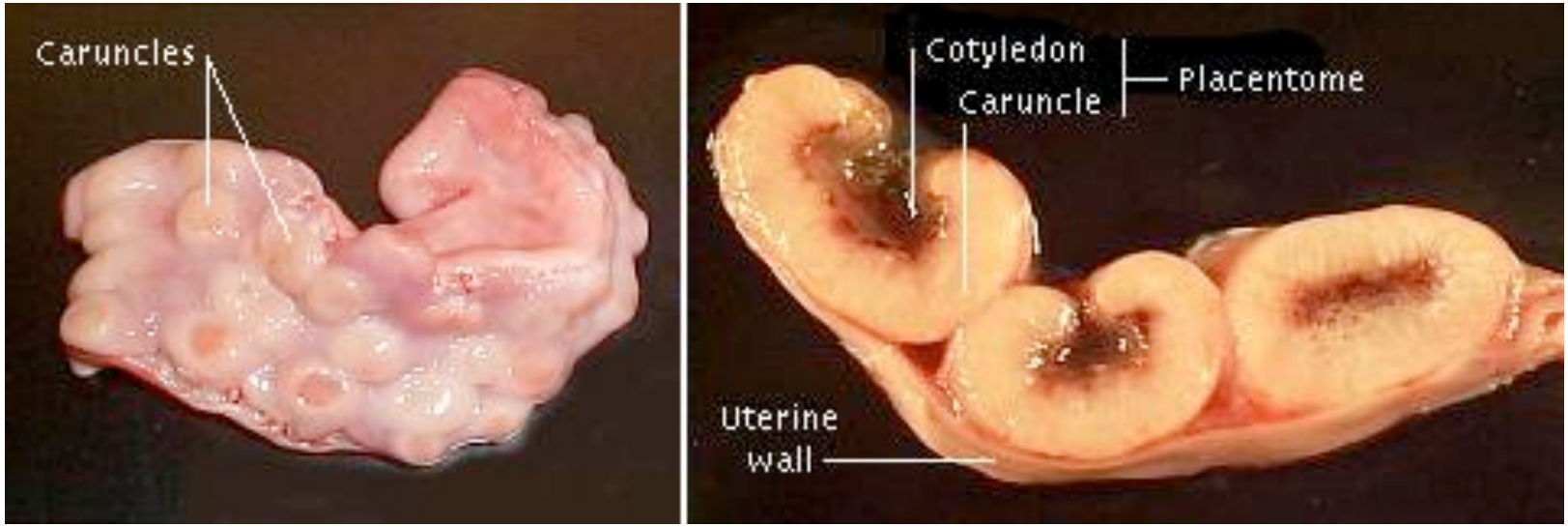
Extra-embryonic ectoderm

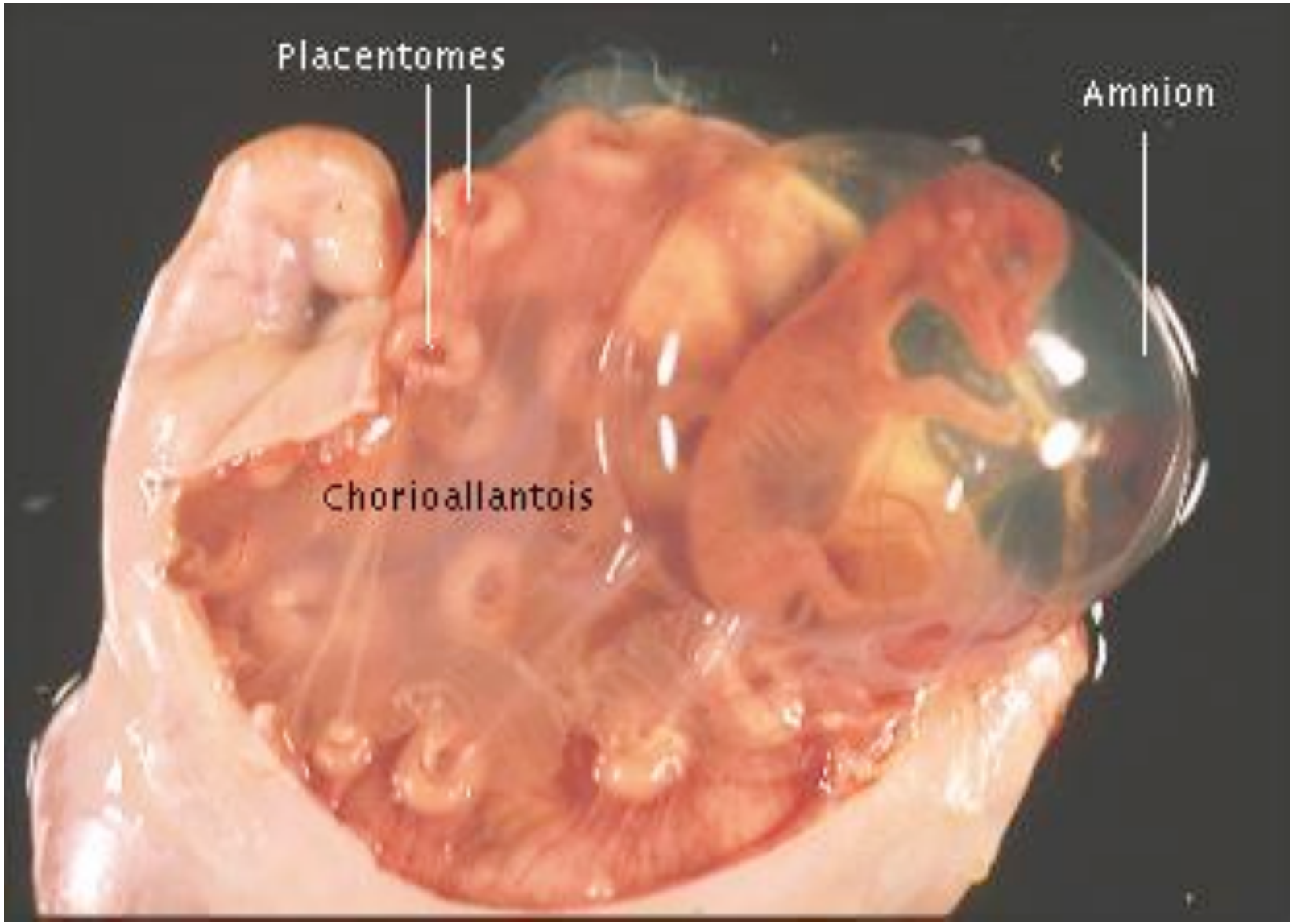
Embryonic ectoderm or epiblast

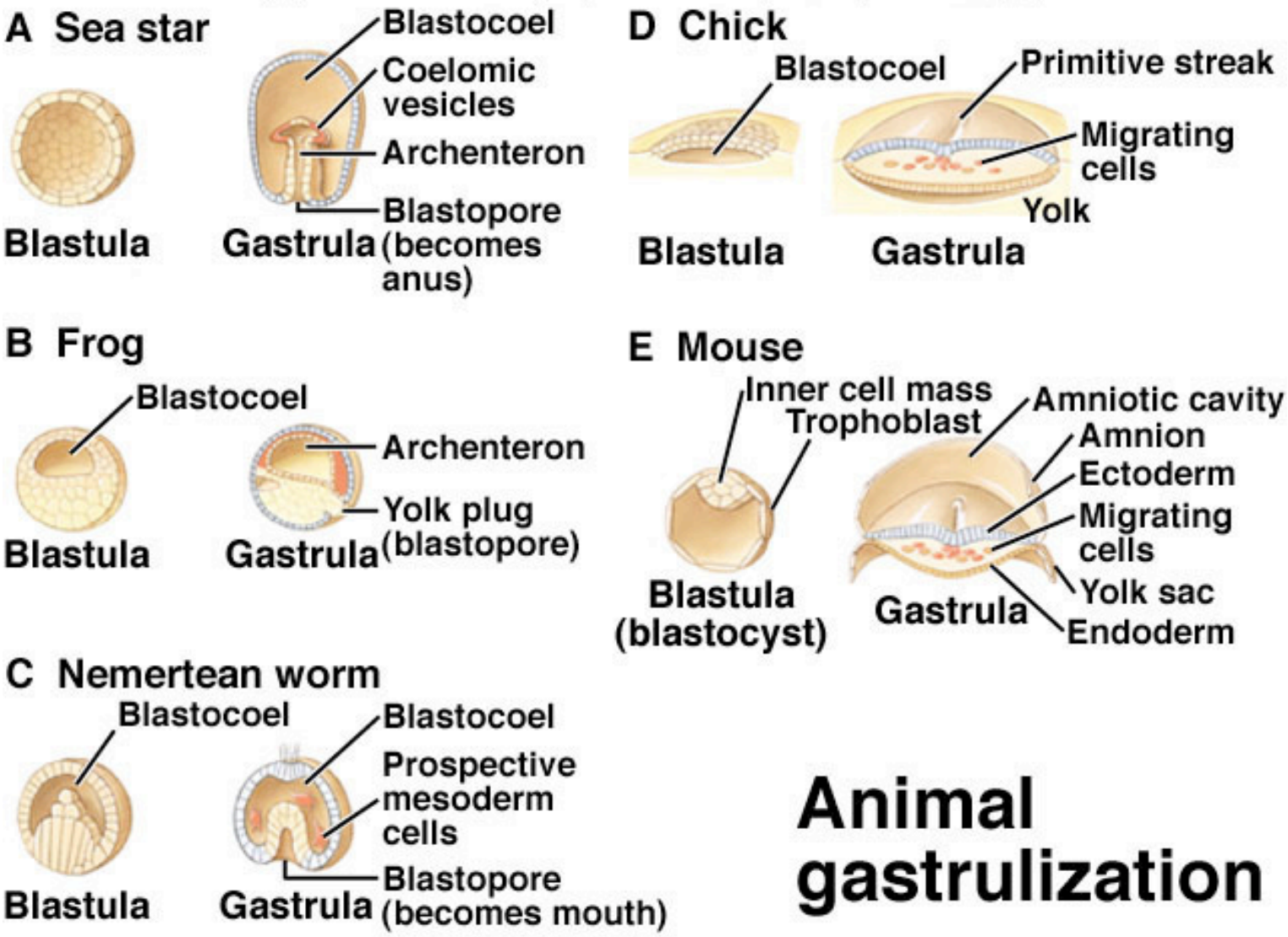
Visceral endoderm

Reichert's membrane


Amniotic cavity
Epiblast
Hypoblast
Definitive yolk sac
Syncytiotrophoblast
Cytotrophoblast
Extraembryonic mesoderm
A
Cut edge of amnion
Buccopharyngeal membrane
Primitive streak
Wall of yolk sac
Hypoblast
Epiblast
B

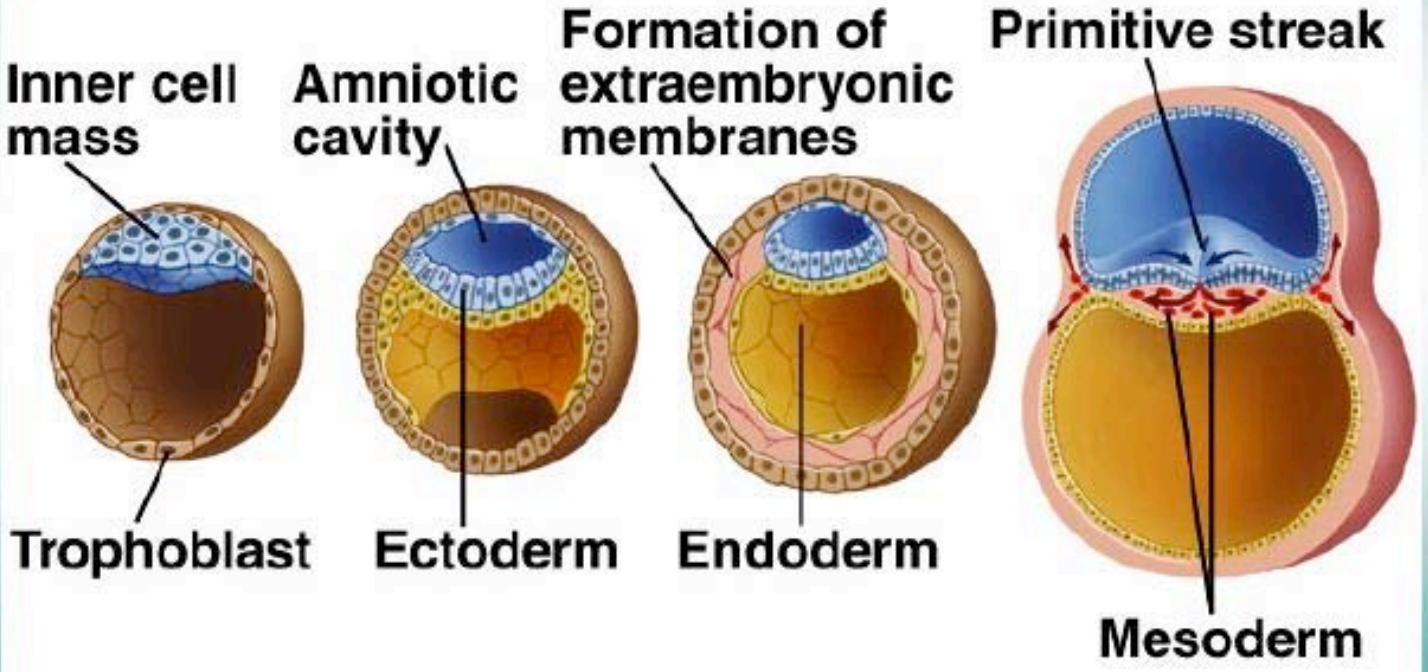

Caruncles
Cotyledon
Placentome
Caruncle
Uterine
wall

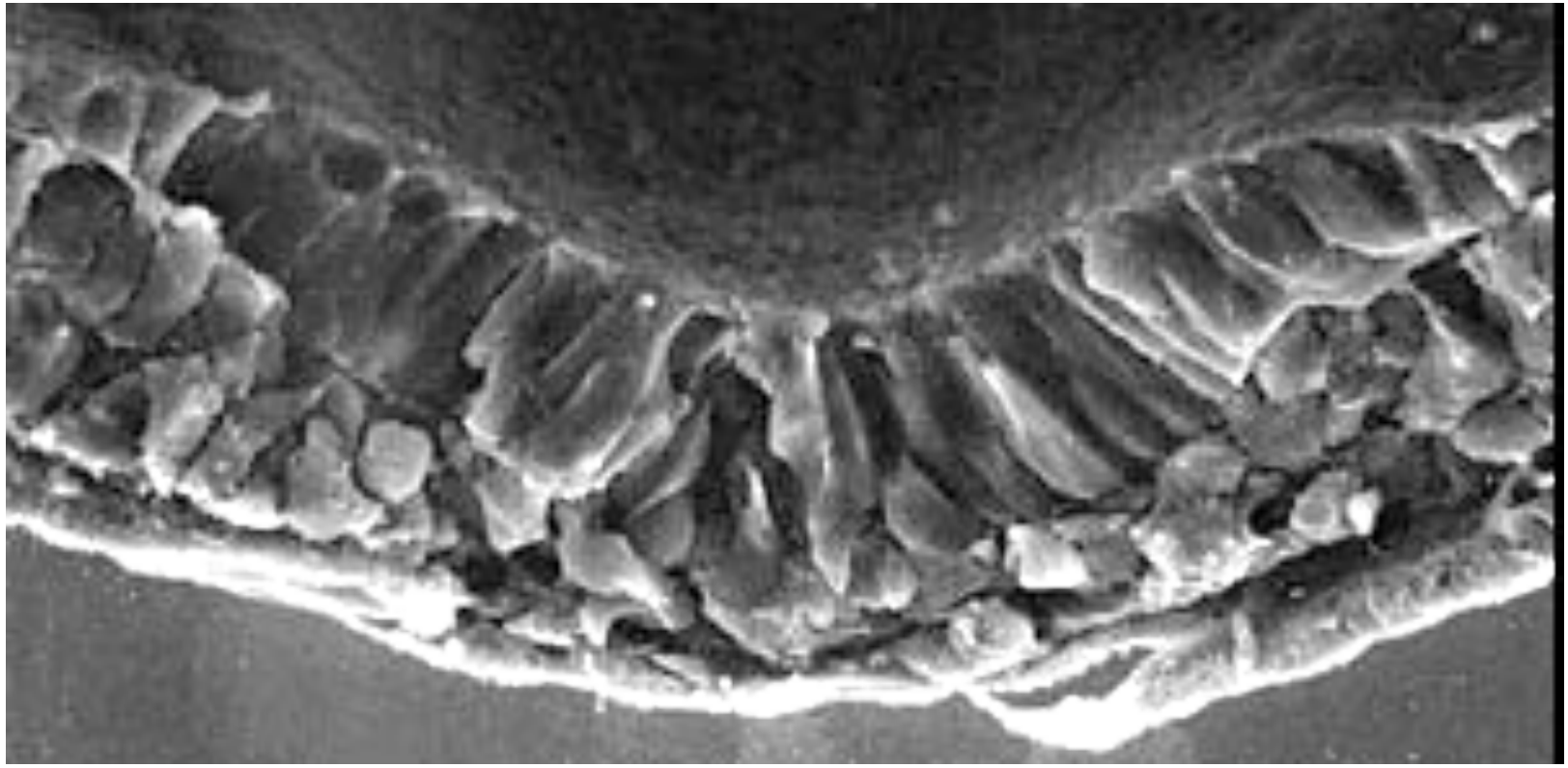

Placentomes
Amnion
Chorioallantois

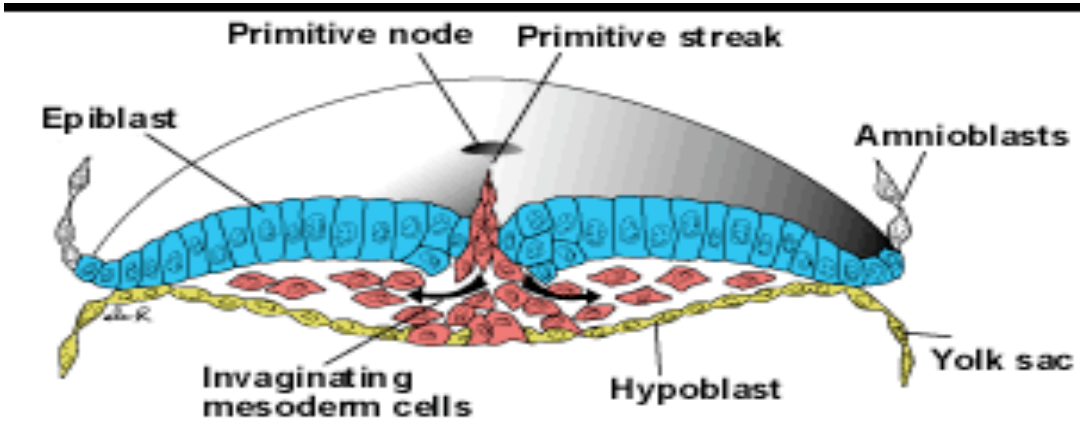


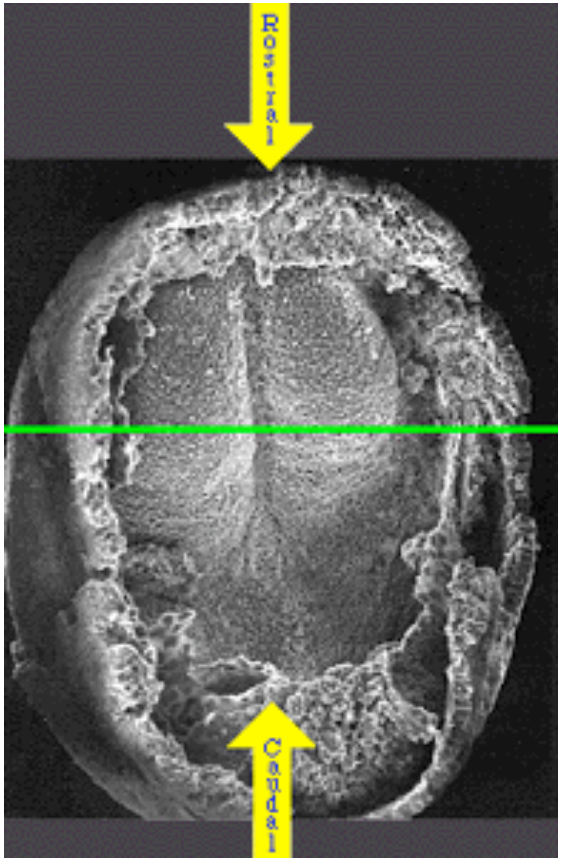
Animal gastrulization

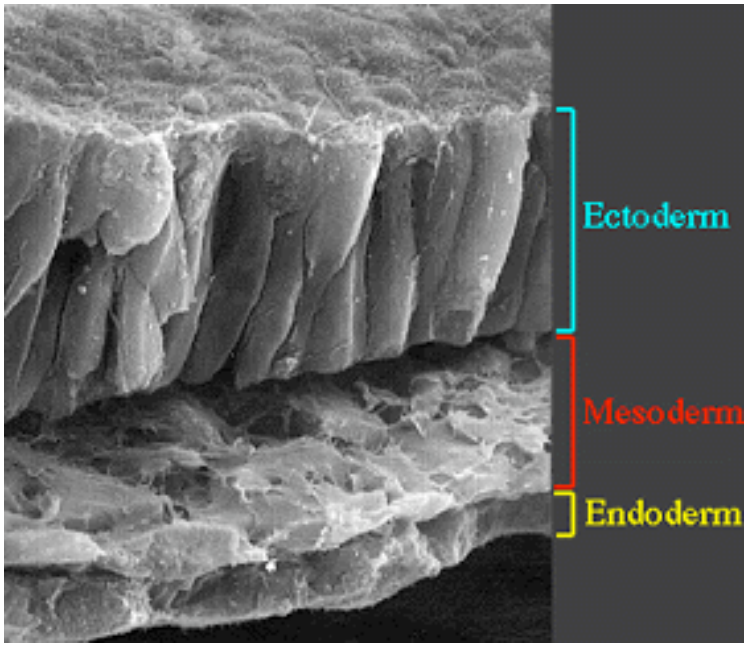
Gastrulation — Mammal

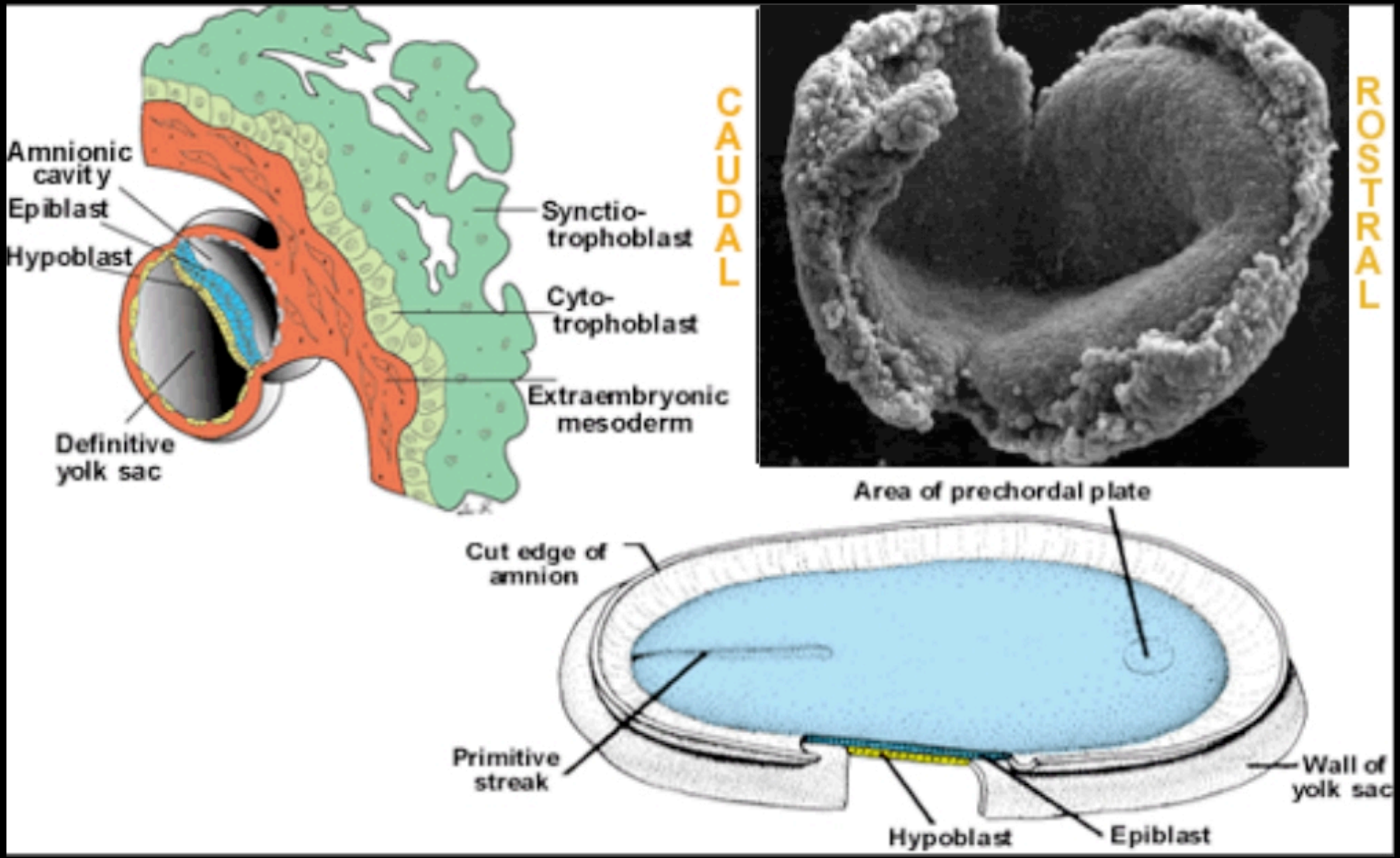




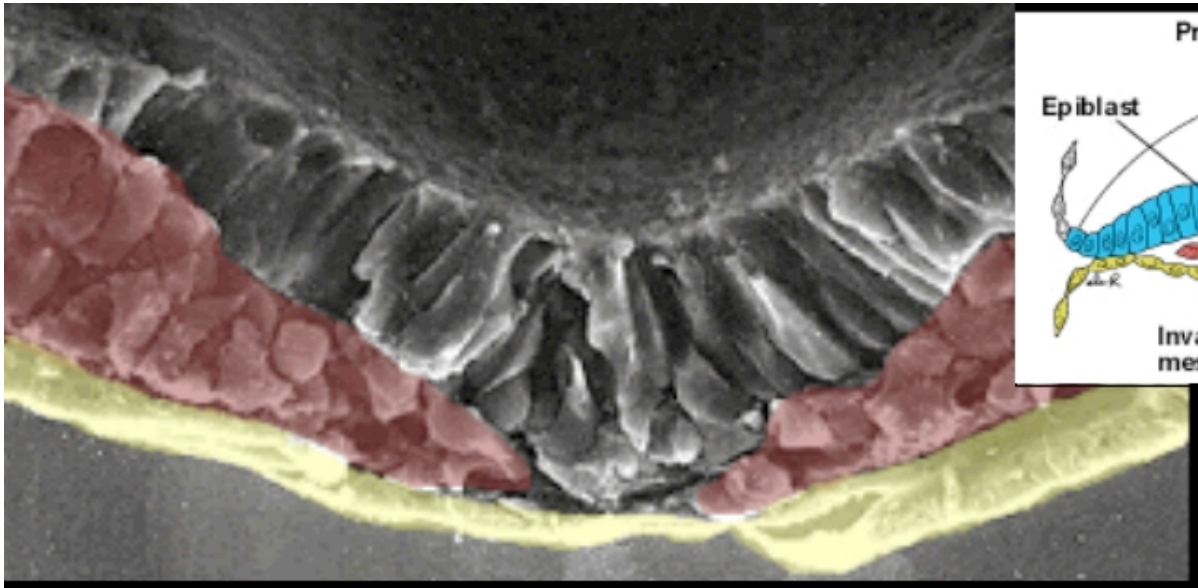

Primitive node
Primitive streak
Epiblast
Amnioblasts
Yolk sac
Invaginating
mesoderm cells
Hypoblast

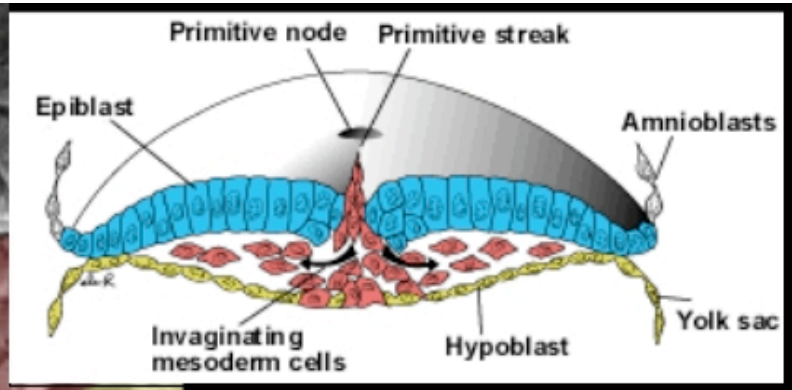

Rostral
Caudal

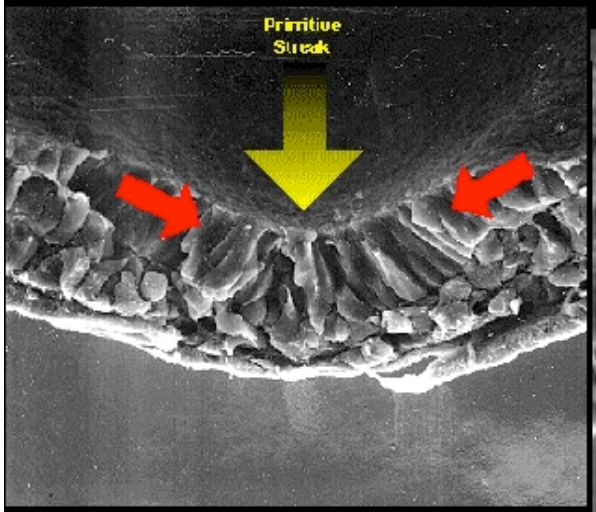

Ectoderm
Mesoderm
Endoderm

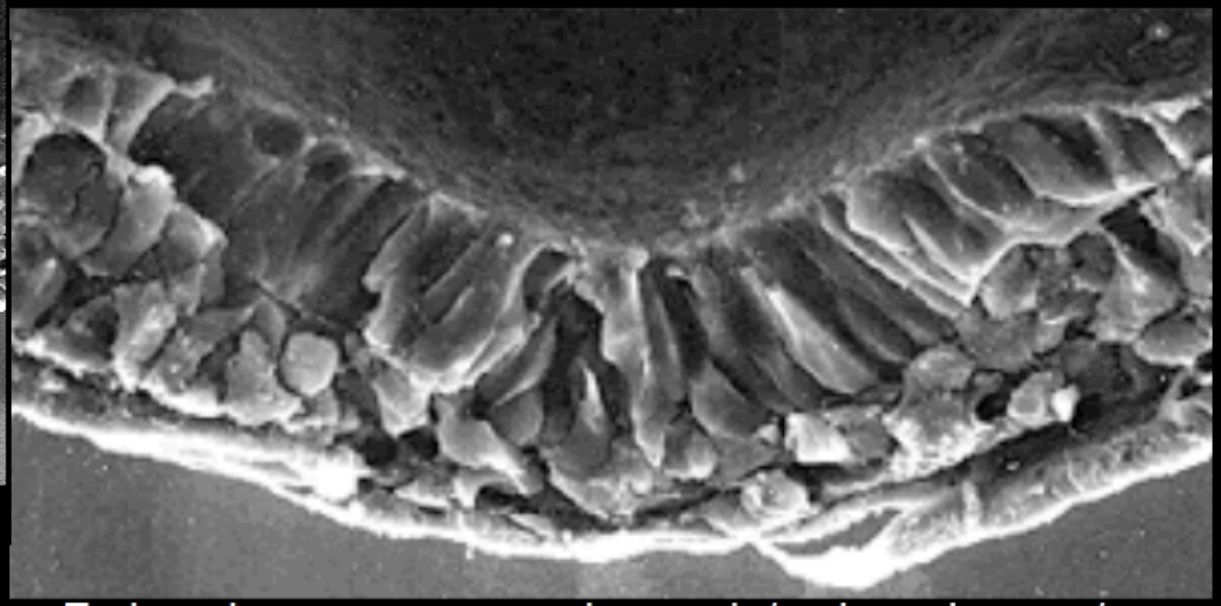


Pictures courtesy Embryo Images: www.med.unc.edu/embryo_images/

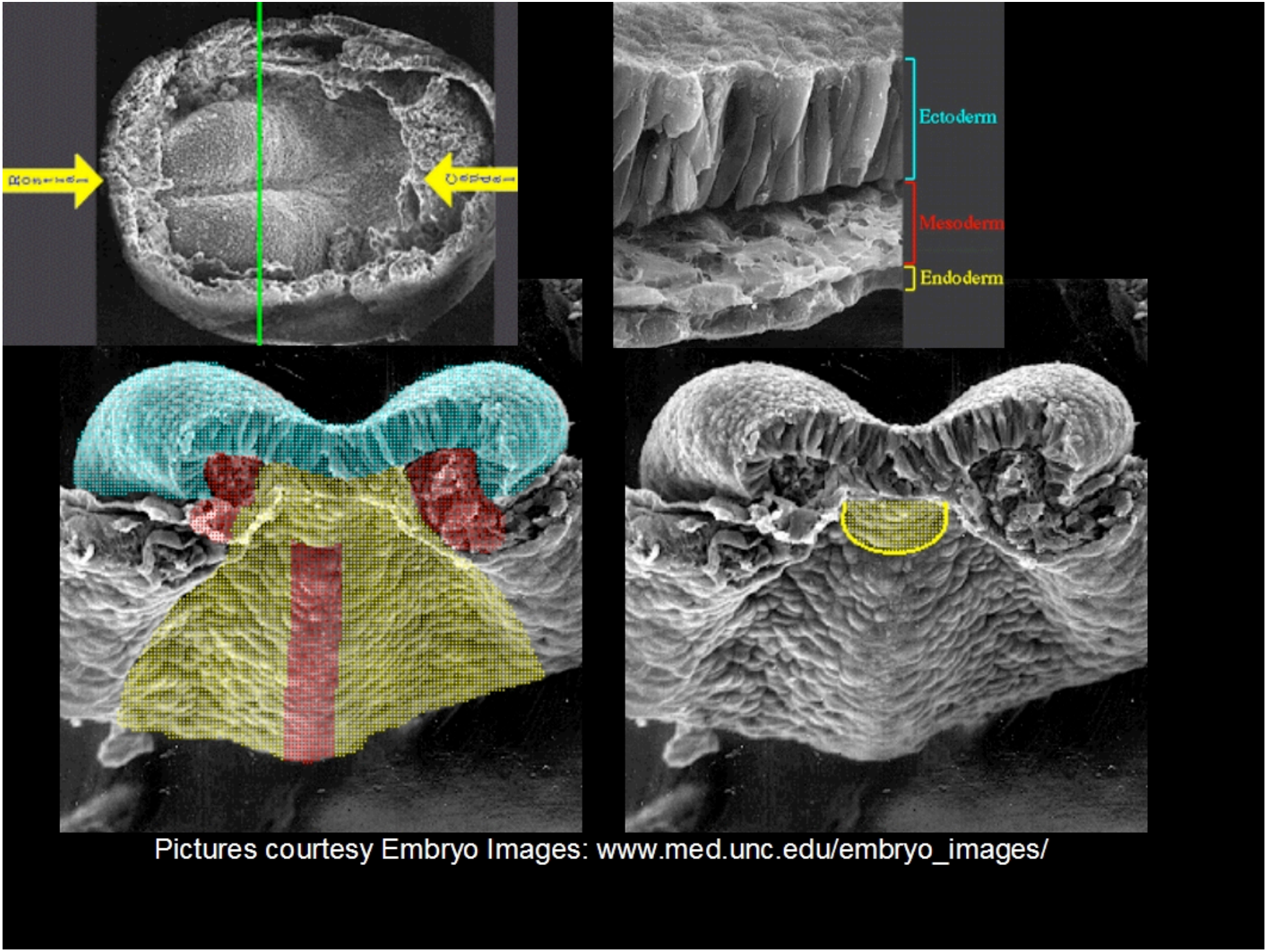




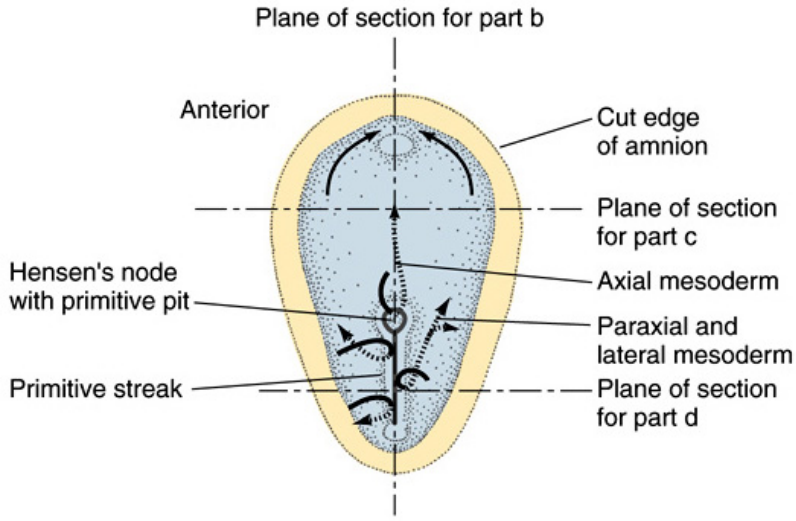




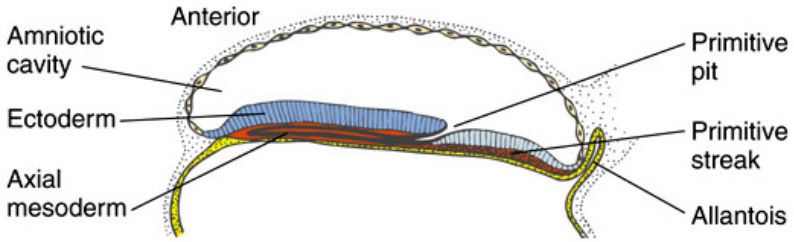
Pictures courtesy Embryo Images: www.med.unc.edu/embryo_images/



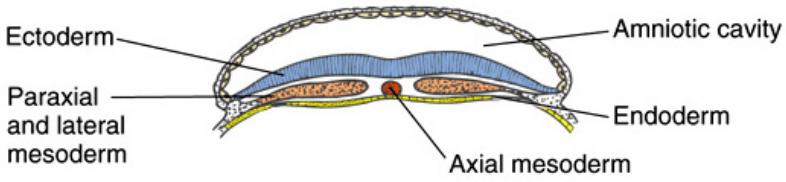
Pictures courtesy Embryo Images: www.med.unc.edu/embryo_images/


Plane of section for part b
Anterior
Cut edge of amnion
Plane of section for part c
Hensen's node with primitive pit
Axial mesoderm
Paraxial and lateral mesoderm
Primitive streak
Plane of section for part d

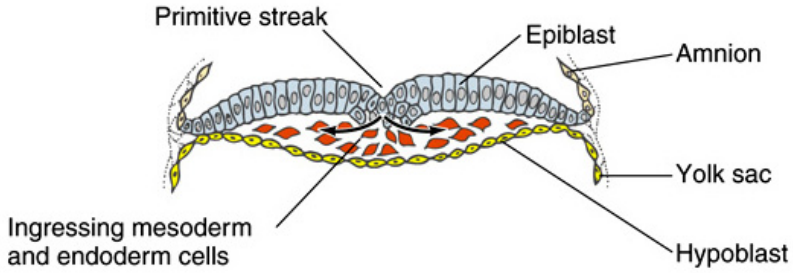
(a)


Anterior
Amniotic cavity
Primitive pit
Ectoderm
Primitive streak
Axial mesoderm
Allantois

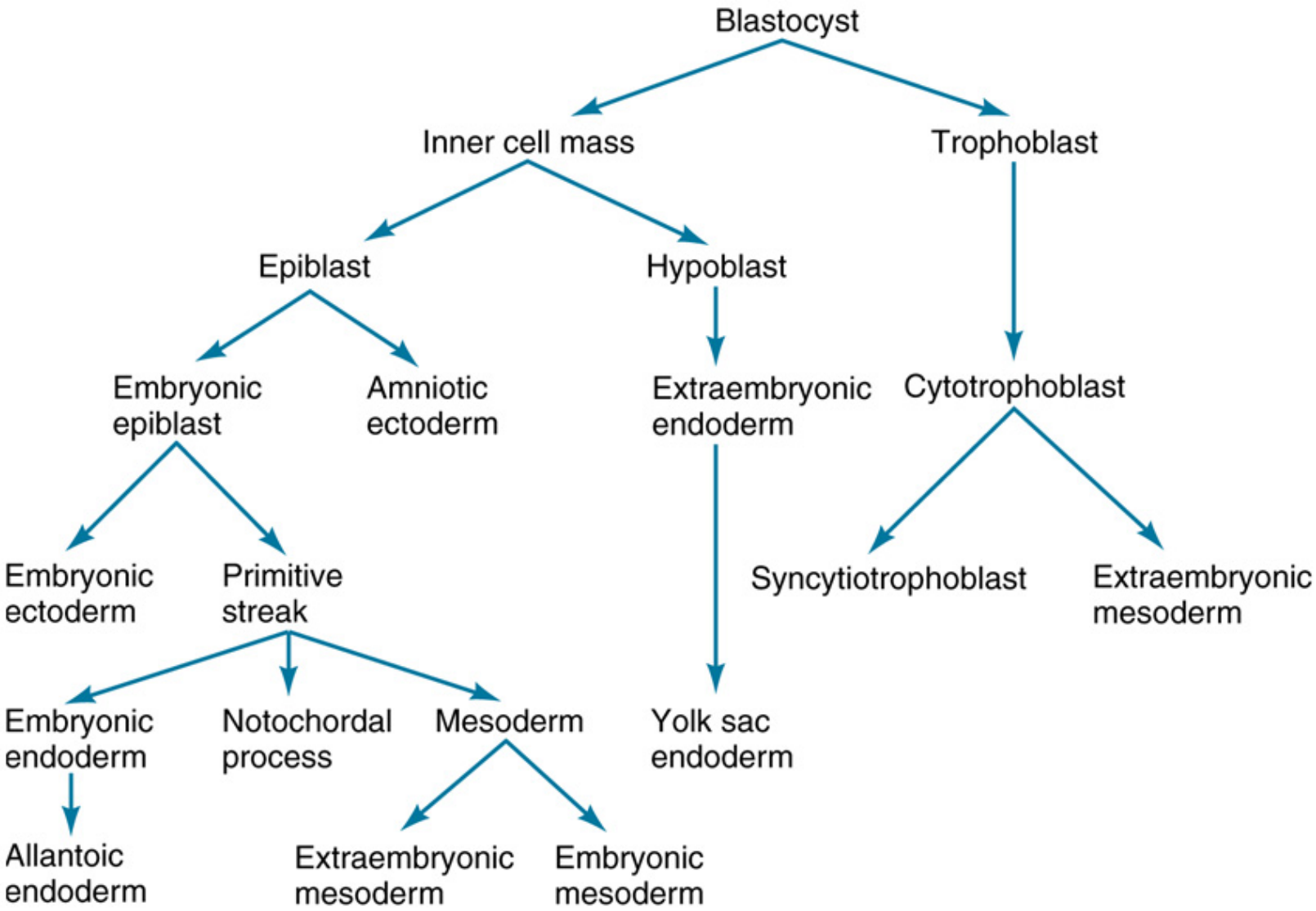
(b)


Ectoderm
Amniotic cavity
Paraxial and lateral mesoderm
Endoderm
Axial mesoderm

(c)


Primitive streak
Epiblast
Amnion
Yolk sac
Ingressing mesoderm and endoderm cells
Hypoblast

(d)


Blastocyst
Inner cell mass
Trophoblast
Epiblast
Hypoblast
Embryonic epiblast
Amniotic ectoderm
Extraembryonic endoderm
Cytotrophoblast
Embryonic ectoderm
Primitive streak
Syncytiotrophoblast
Extraembryonic mesoderm
Embryonic endoderm
Notochordal process
Mesoderm
Yolk sac endoderm
Allantoic endoderm
Extraembryonic mesoderm
Embryonic mesoderm

Common features of gastrulation

1. Involves cell movement and reorganization

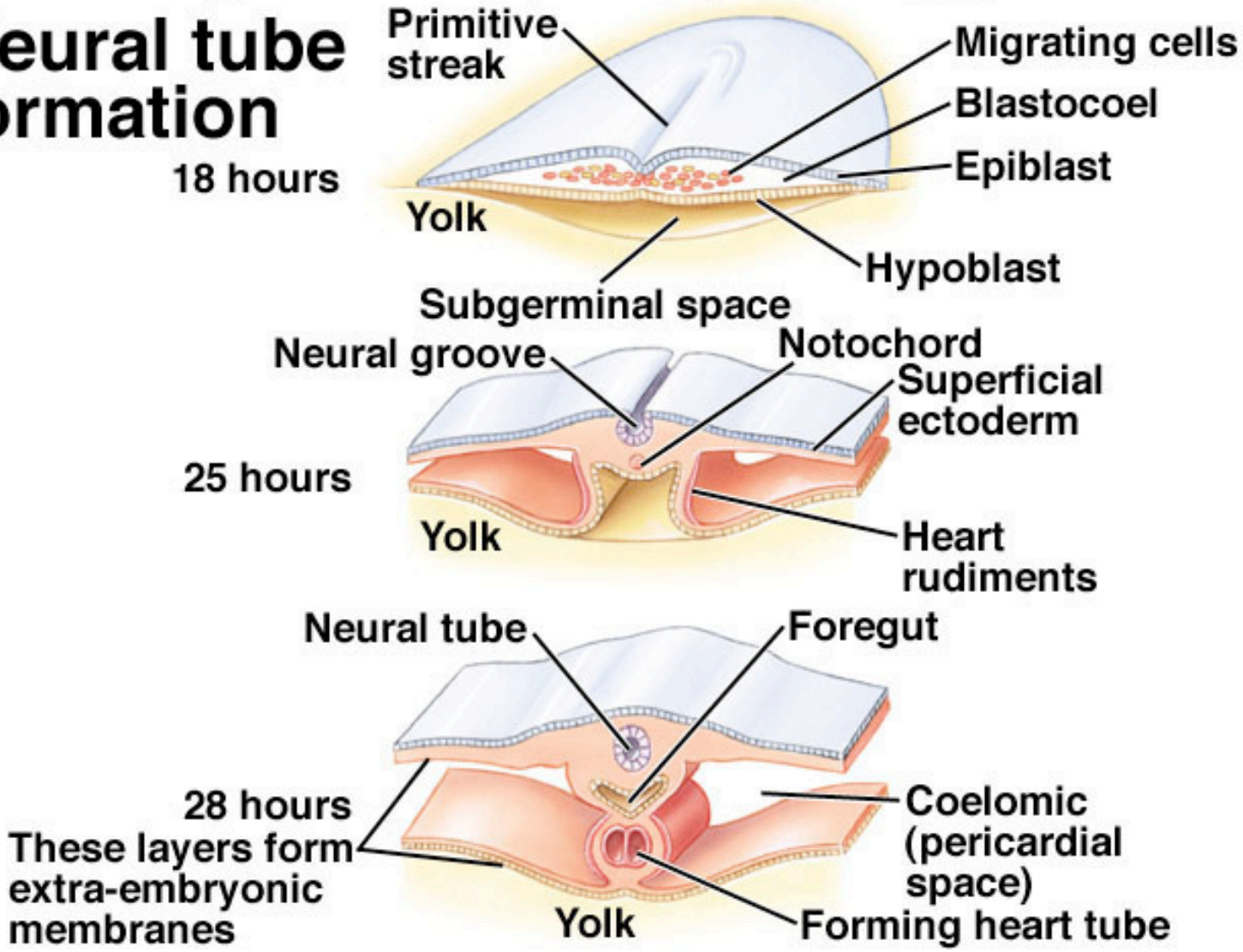
2. Gut (inner tube) forms from the archenteron, replacing the blastocoel
    - deuterostomes (vertebrates, sea urchins)
    - protostomes (all other inverts)

3. The three primary germ layers are formed (endoderm, ectoderm and mesoderm)

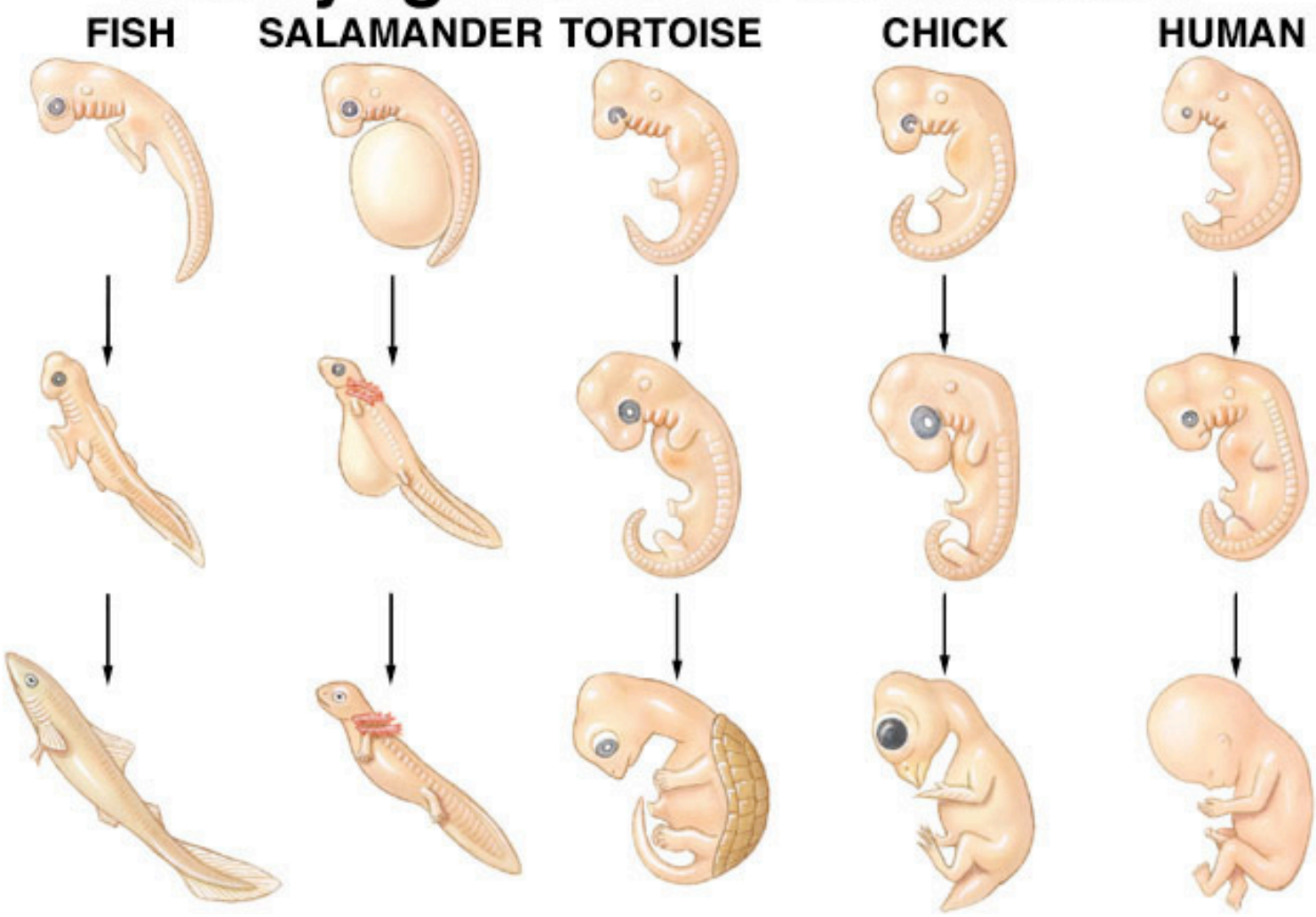
4. Form the two basic cell types
    epithelia - endoderm and ectoderm
    mesenchyme – mesoderm

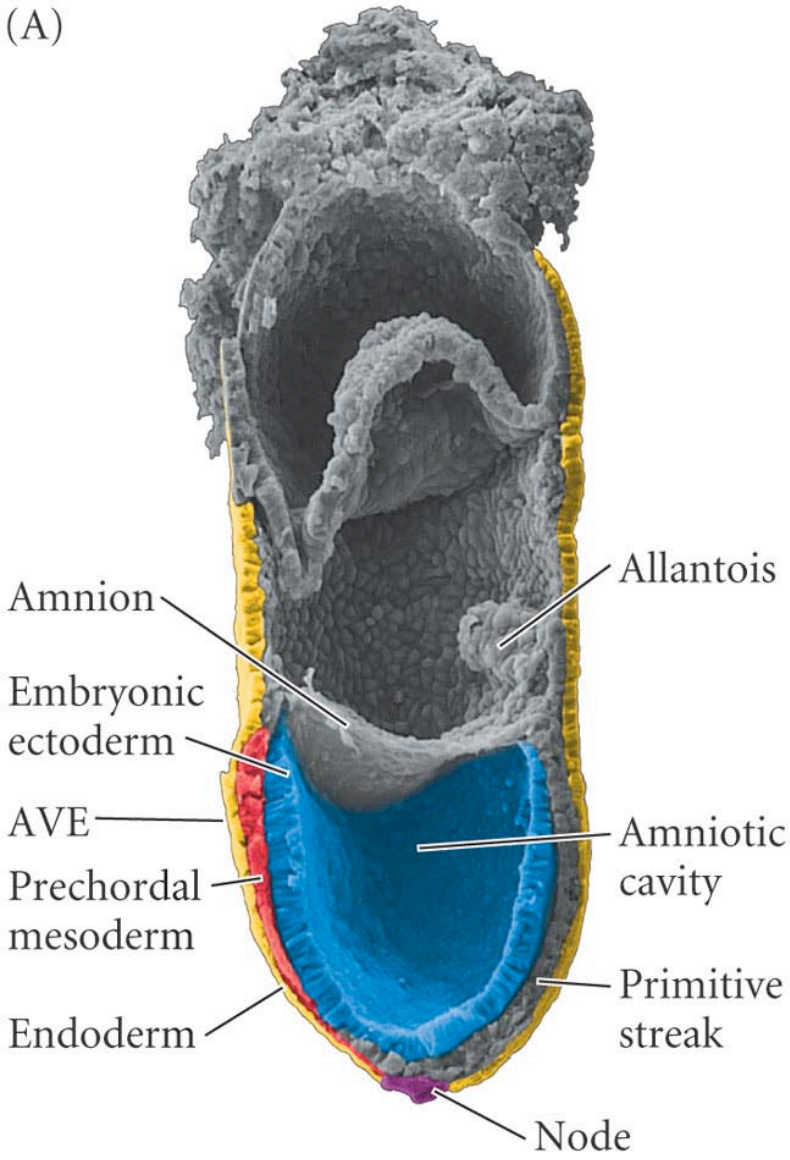
Gastrulation involves a major epithelial/ mesenchymal transition
    - mesoderm forms from an epithelial blastula

Neural tube formation

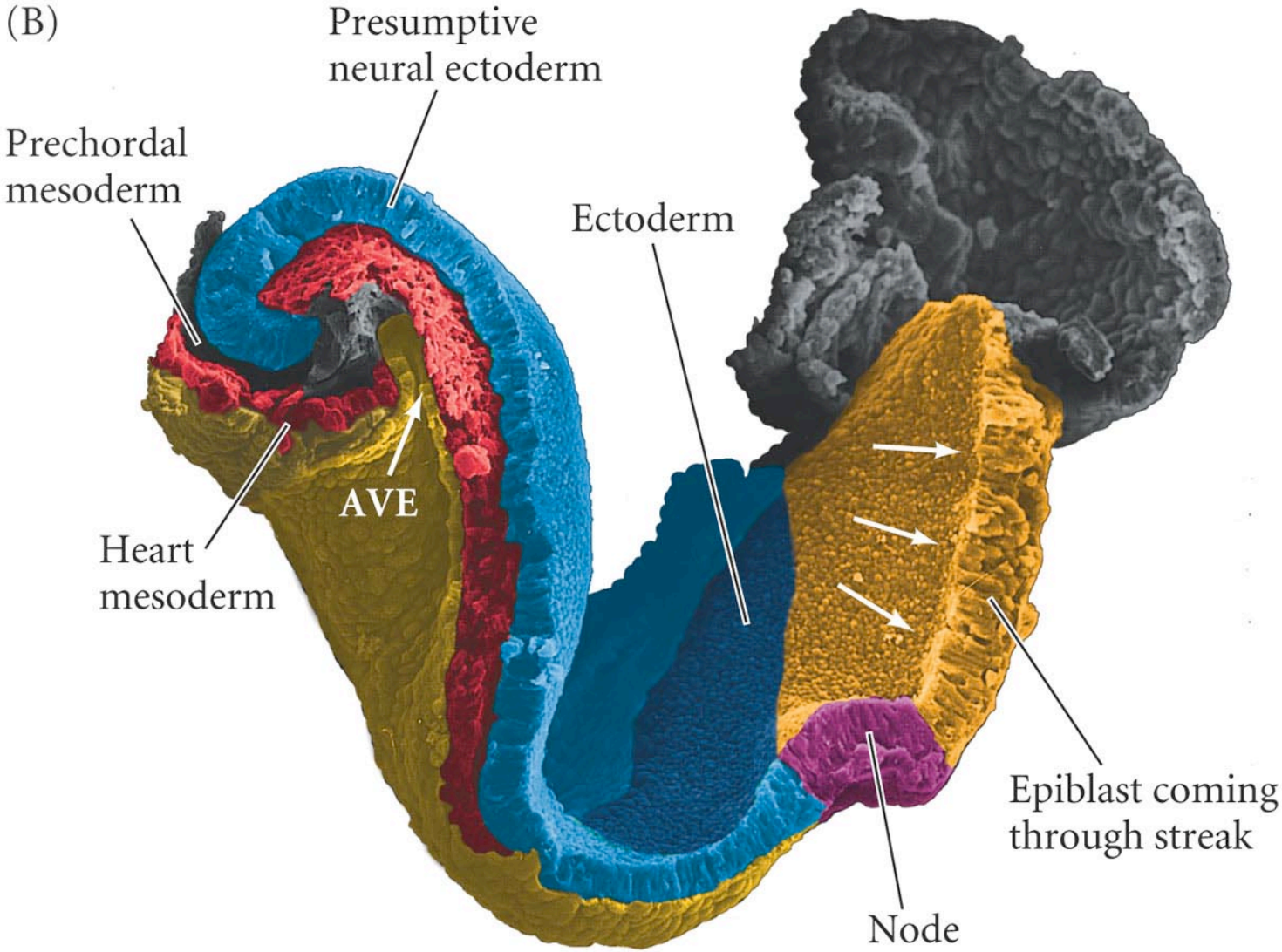


Embryogenesis in vertebrates



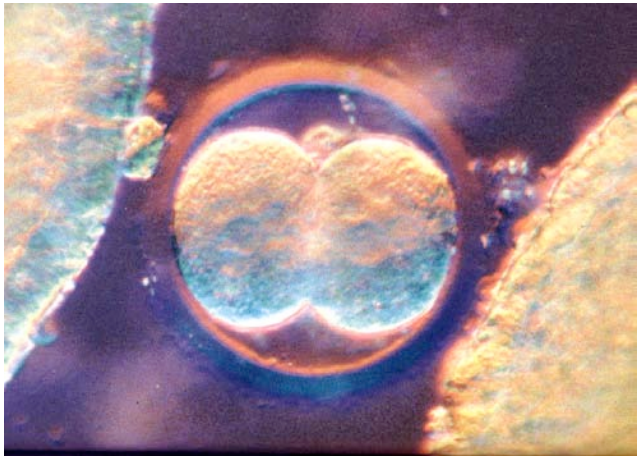


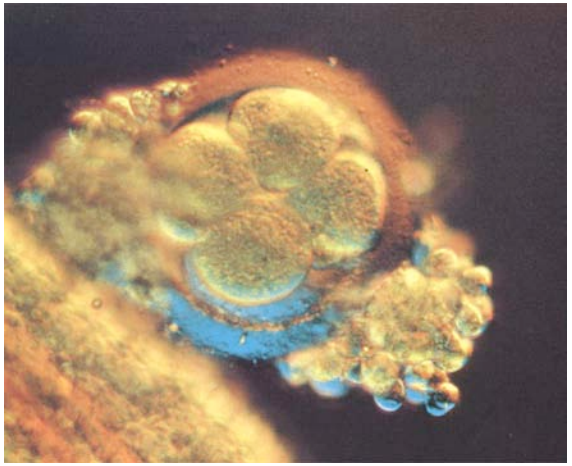
DEVELOPMENTAL BIOLOGY, Seventh Edition, **Figure 11.39 (Part 1)** Sinauer Associates, Inc.



Early Human Cleavage
t=30 hrs to 2 days

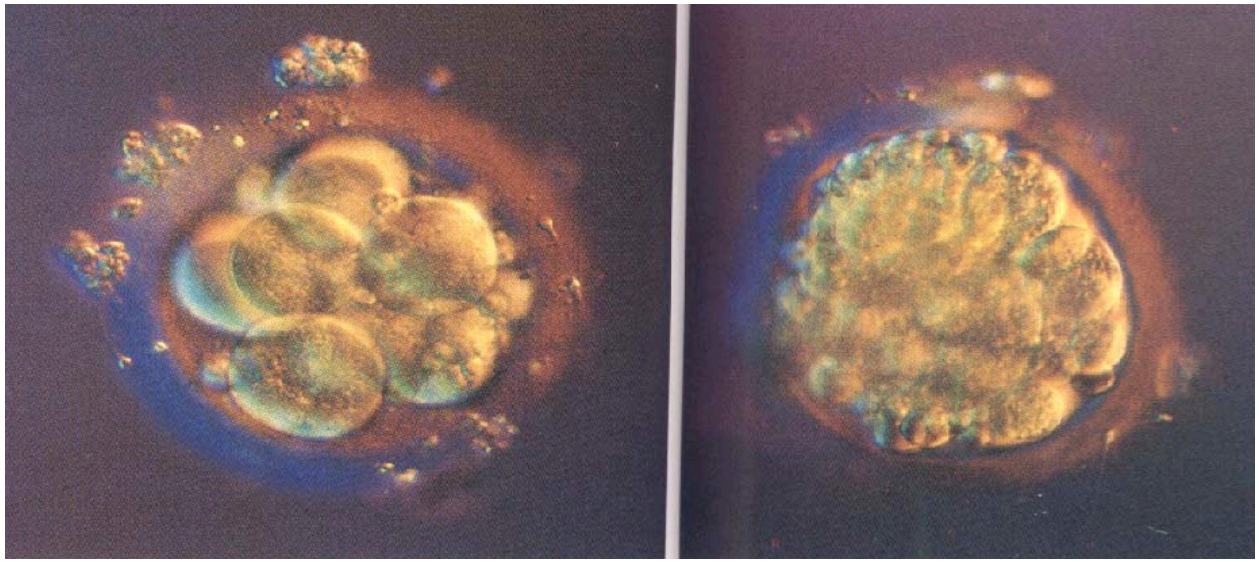
2 Cell





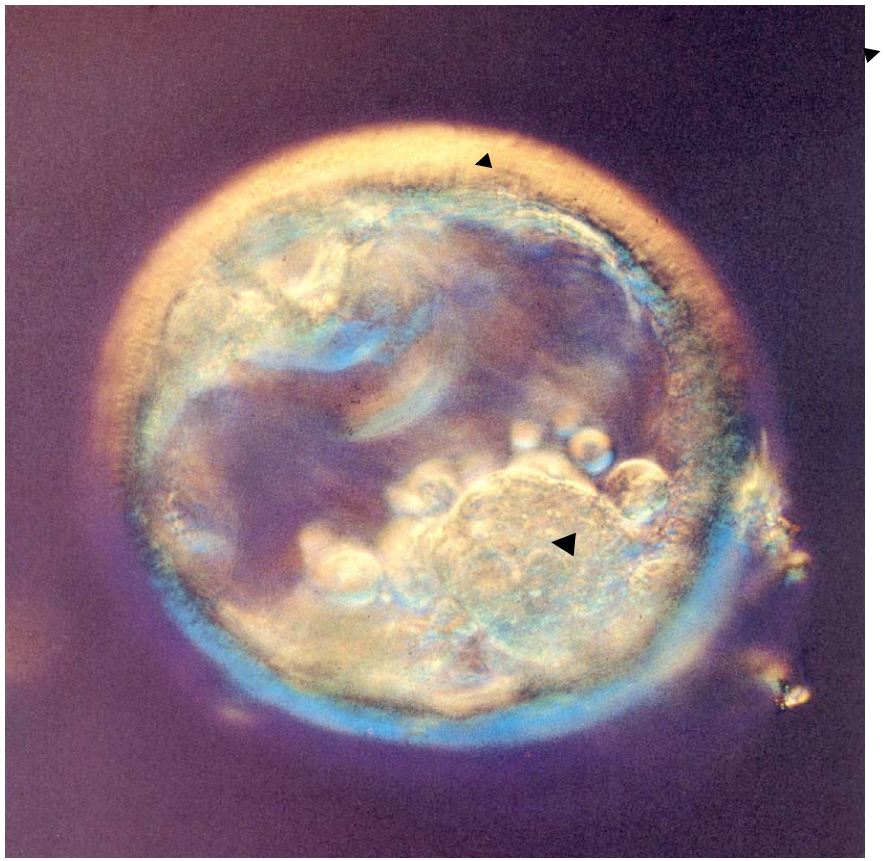
8 Cell

16 cell



32 Cell

Blastocyst t=4 Days



Trophoblast will
Help form the
placenta
And other membranes,
but not the embryo

Inner
Cell Mass:
Pluripotent
cells that will
form the embryo
proper.