

C8545 Developmental Biology

Lesson 3

Early Development of Amphibians and Amniotes

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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Tato prezentace je spolufinancována
Evropským sociálním fondem
a státním rozpočtem České republiky



Outline of Lesson 3

Early Development of Amphibians and Amniotes

- Oogenesis in amphibians
- Blastula formation and dorsoventral axis formation in amphibians
 - cleavage of *Xenopus* zygote (video)
- Gastrulation
 - gastrulation of amphibians (video)
- Neurulation
 - neurulation in *Xenopus* (video)
- Oogenesis in amniotes - chicken
- Gastrulation in amniotes – chicken
 - early and late gastrulation in chicken (video)



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Early Development of Amphibians and Amniotes

- Gastrulation in amniotes – chicken
 - early and late gastrulation in chicken (video)
- Formation of extraembryonic tissues in amniotes – chicken



Outline of Lesson 3

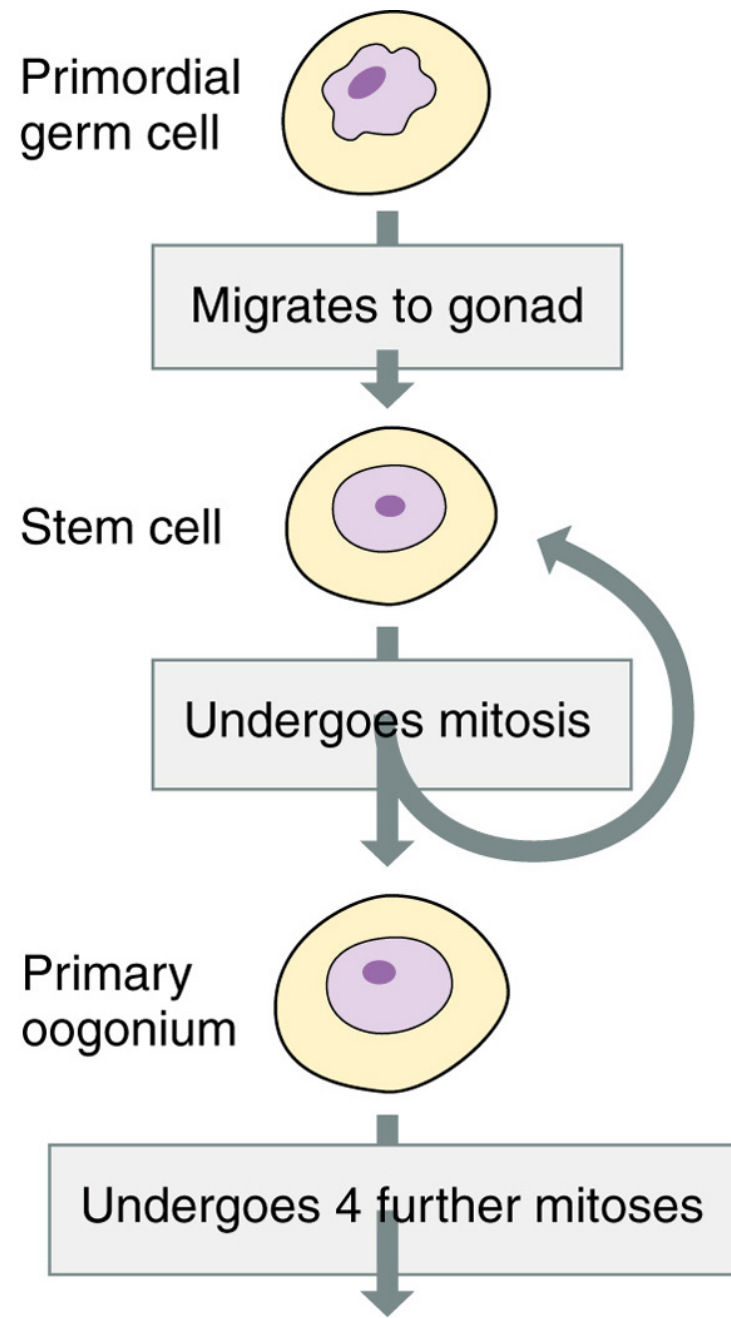
Early Development of Amphibians and Amniotes

- Oogenesis in amphibians

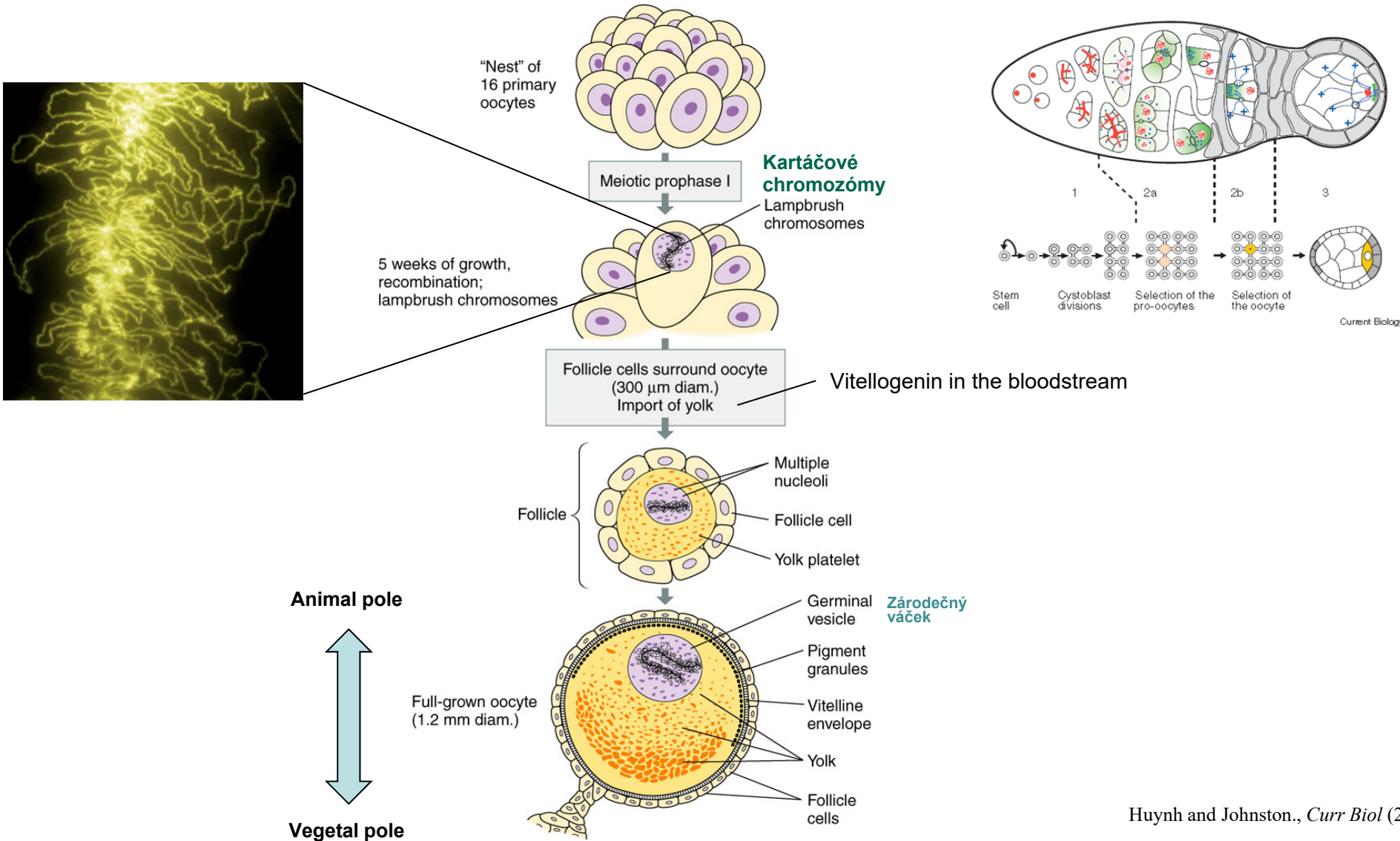


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Oogenesis in *Xenopus* vs. oogenesis in *Drosophila*

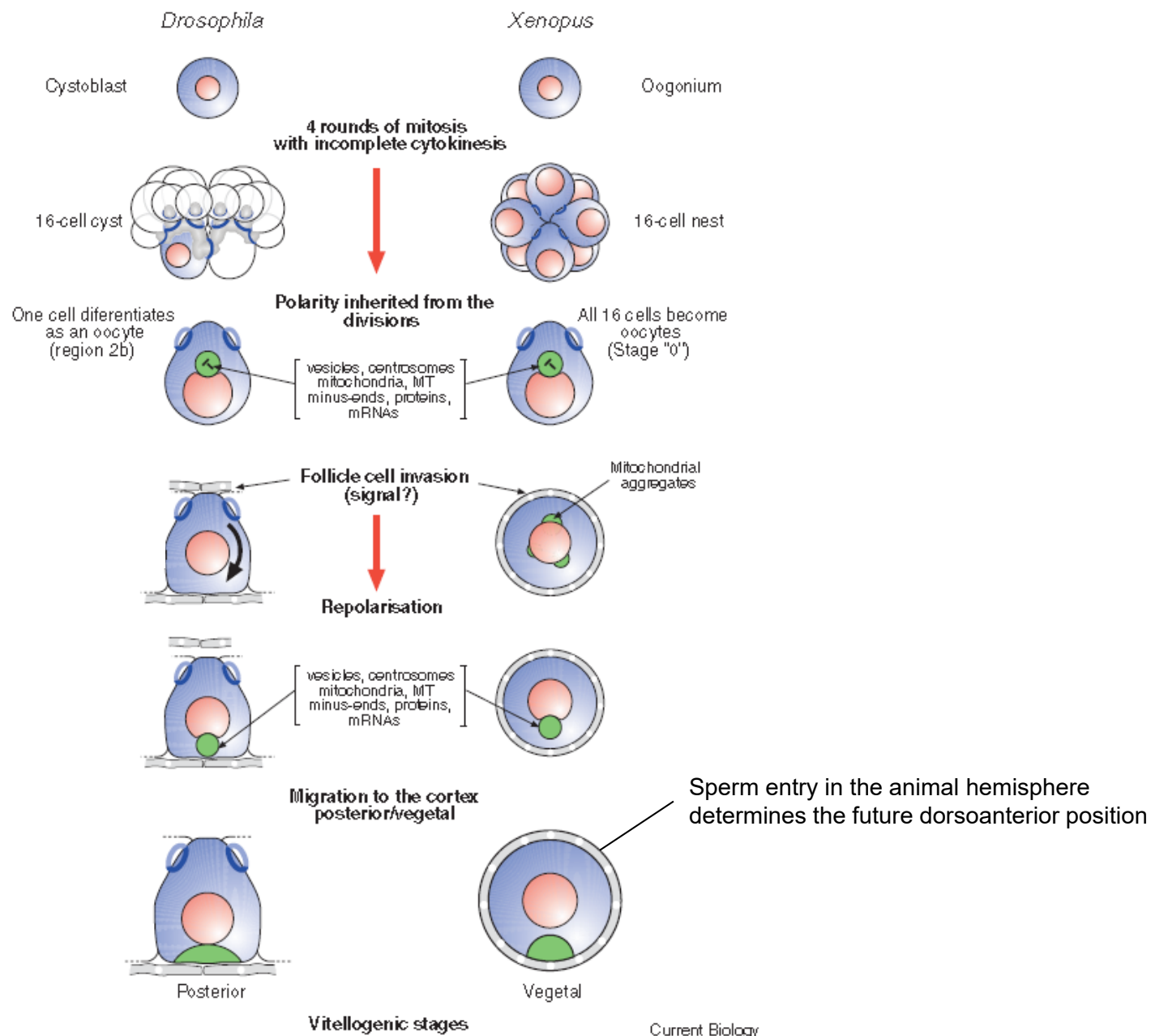


Huynh and Johnston., *Curr Biol* (2004)



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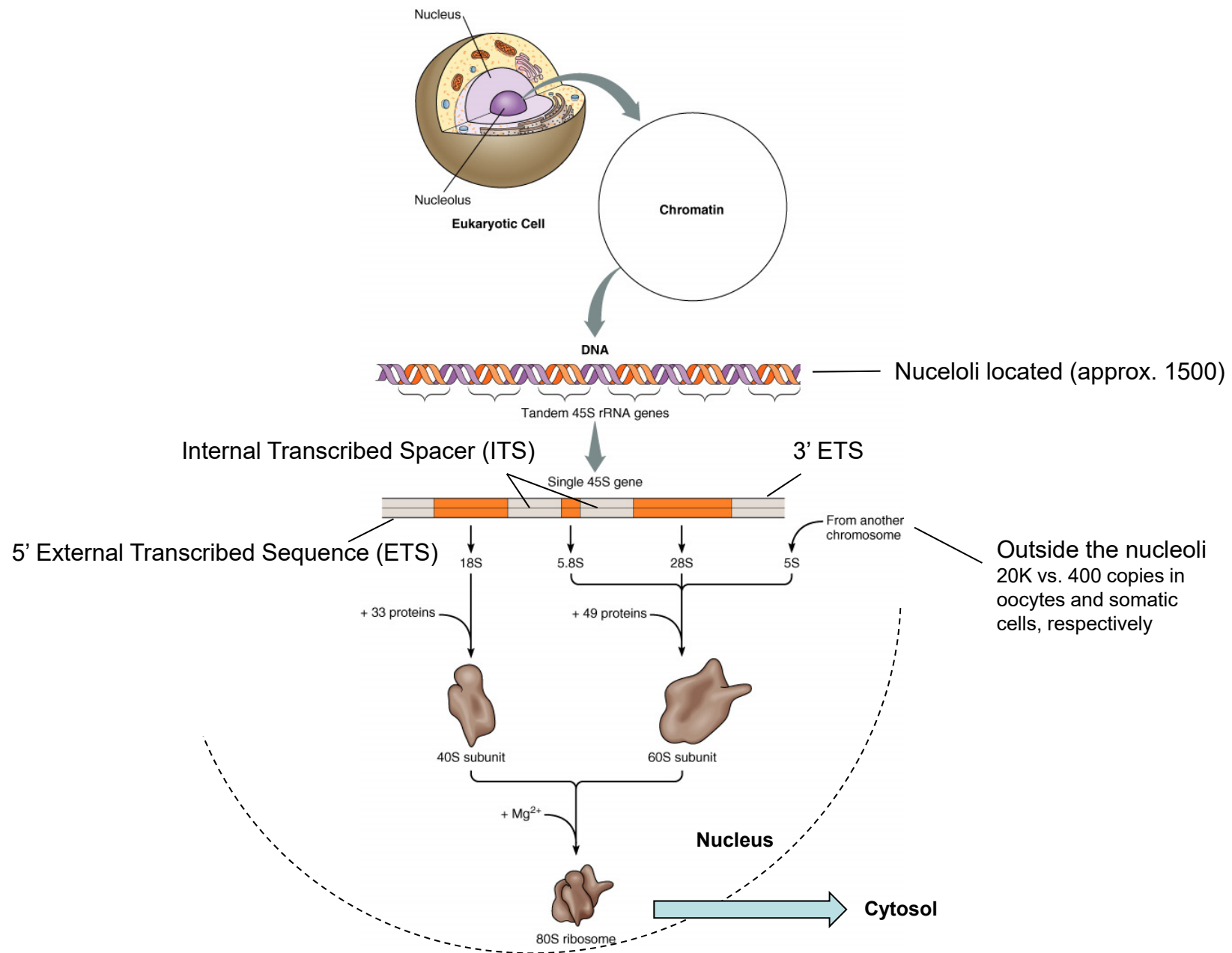
Huynh and Johnston., *Curr Biol* (2004)

Current Biology



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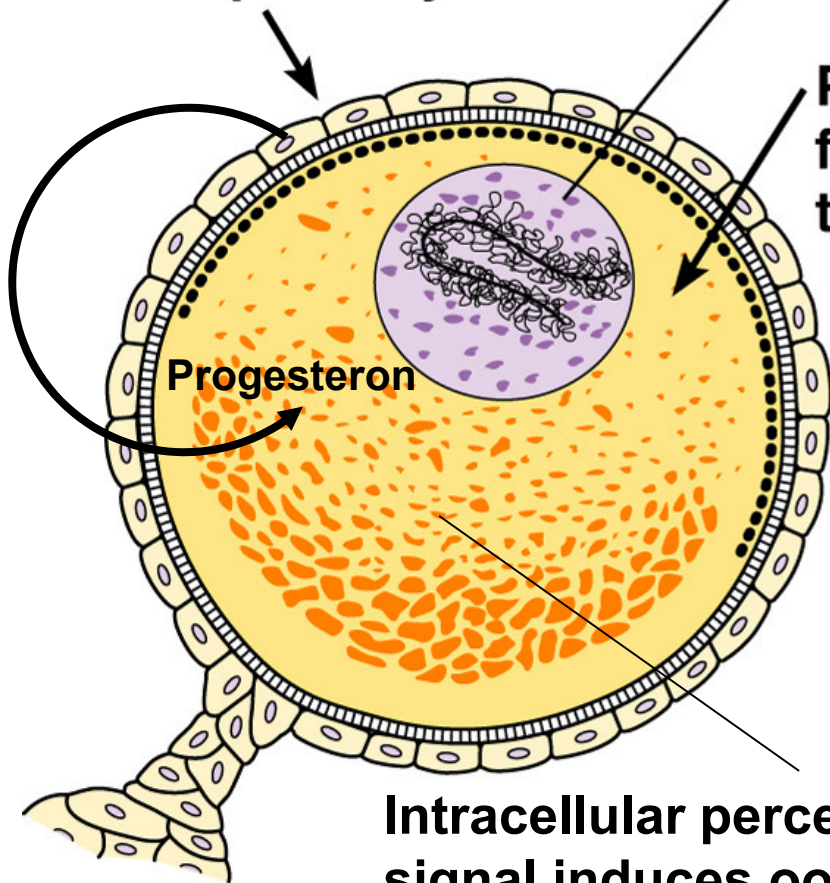
**Hormonální stimulace
hormony hypofýzy
(gonádotropin)**

**Hormonal stimulation
from pituitary**

Zárodečný váček

Germinal vesicle

**Progesterone
from follicle
to oocyte**



Progesteron

**Intracellular perceived progesterone
signal induces oocyte maturation.**

Primary oocyte

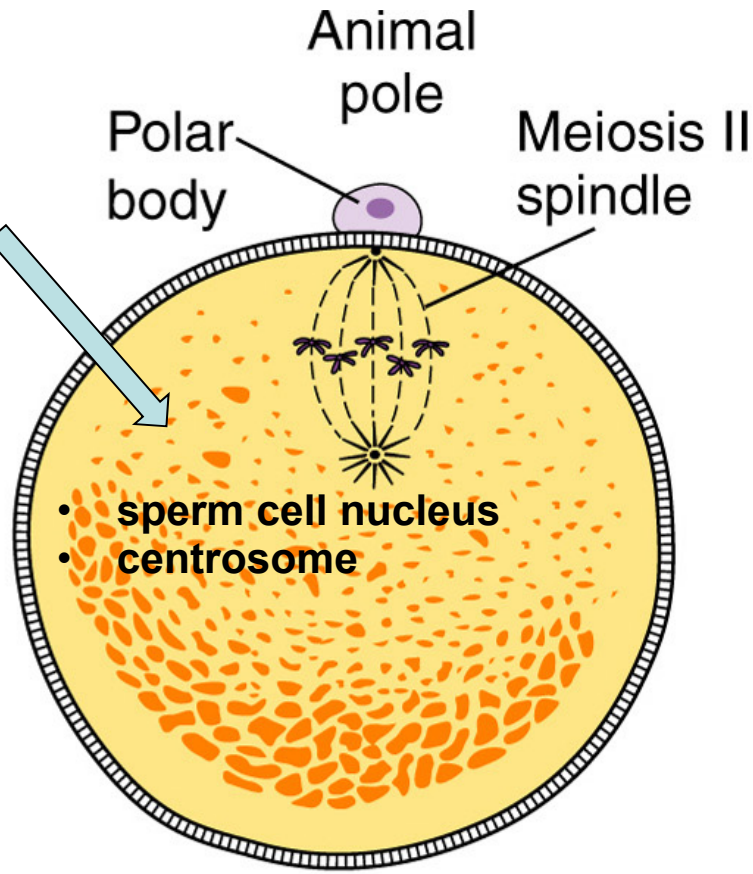
Meiosis I



Germinal vesicle
breaks down

**Folicle
disassembles,
release to oviduct**

Sperm
cell
entry



Animal
pole

Polar
body

Meiosis II
spindle

- sperm cell nucleus
- centrosome

Vegetal pole

**“Fertilizable”
secondary oocyte**



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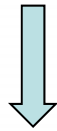
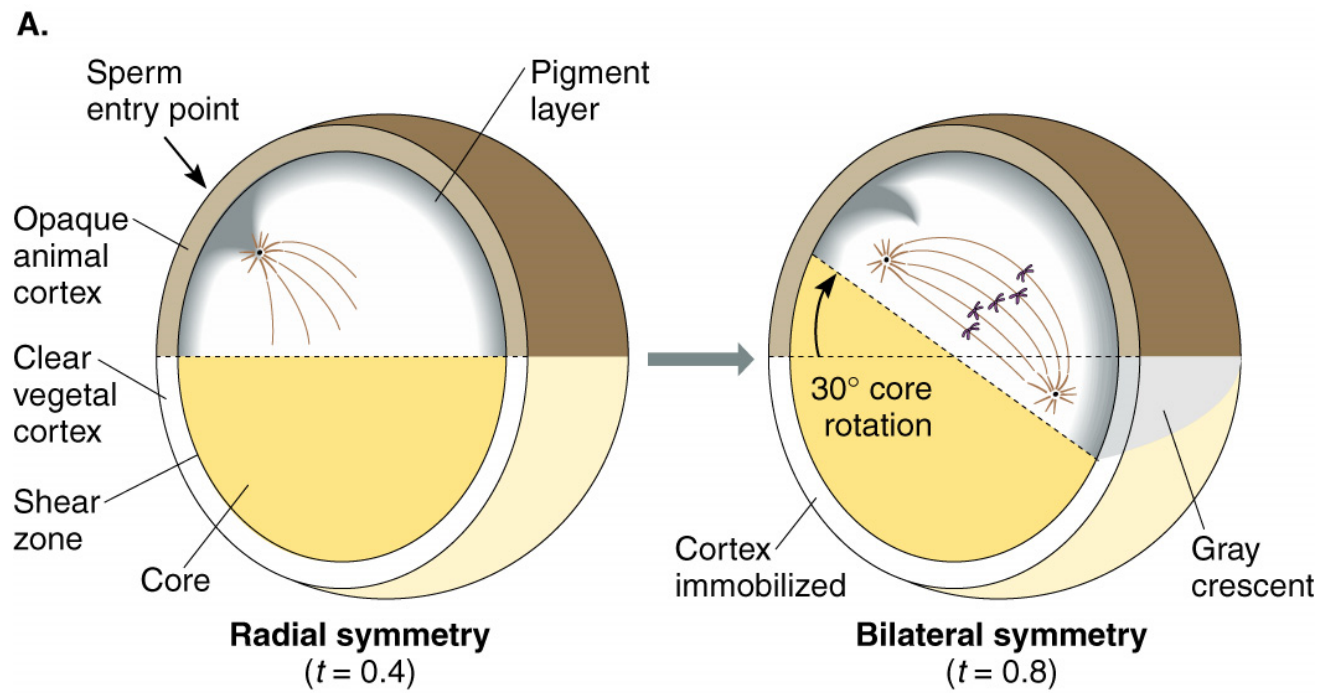
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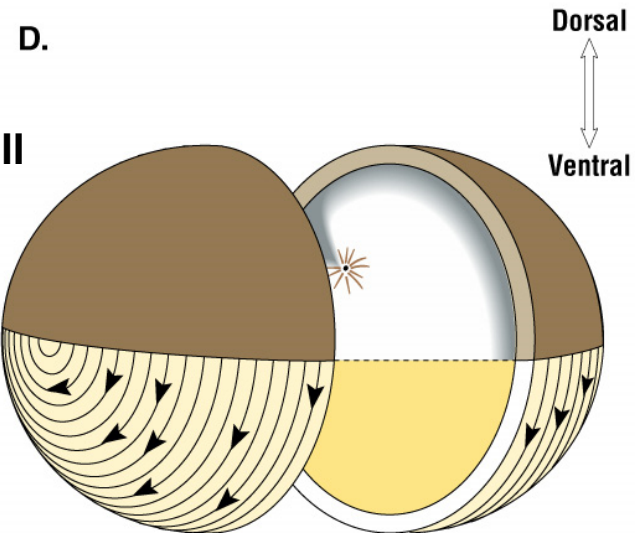


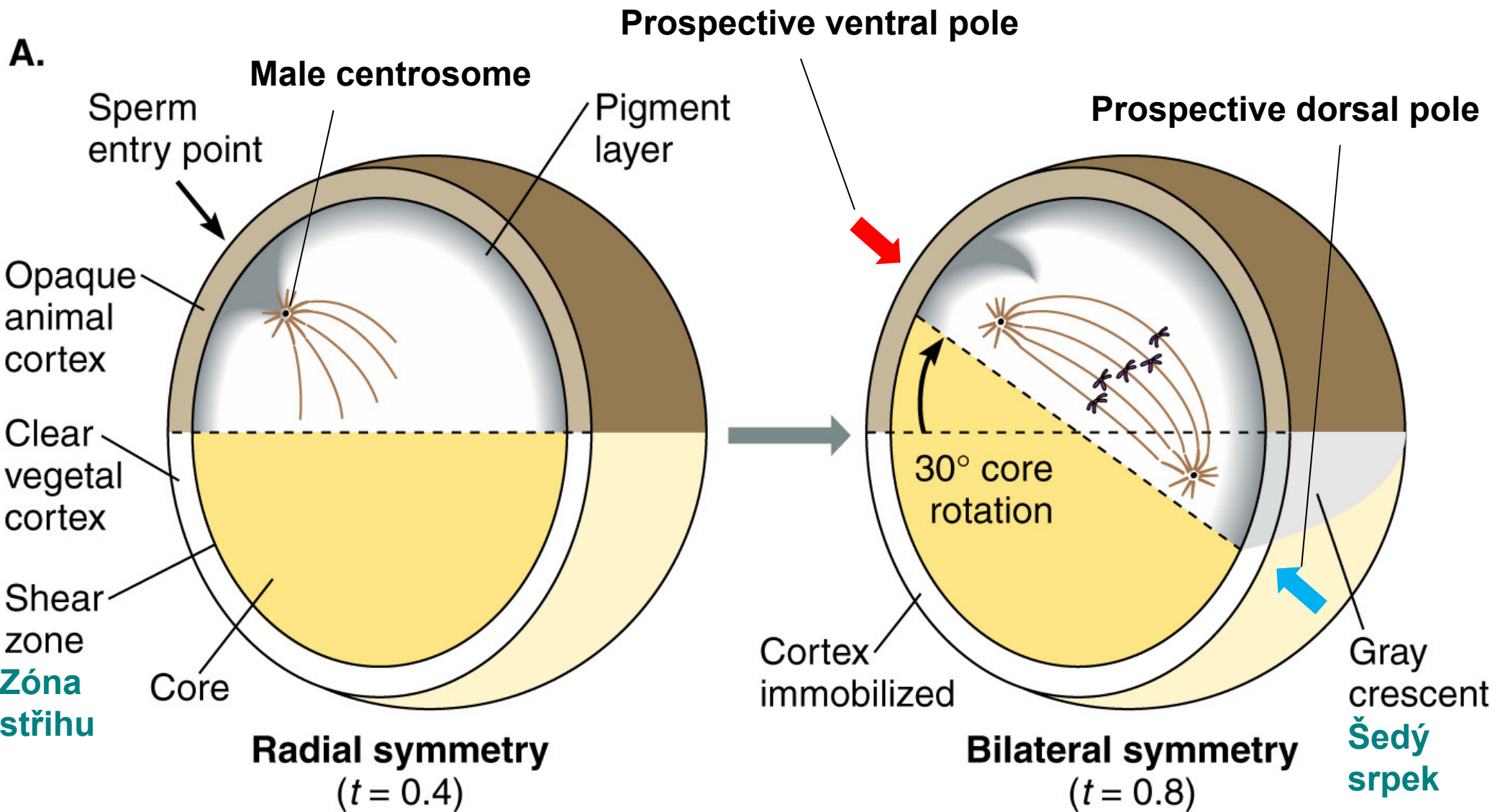
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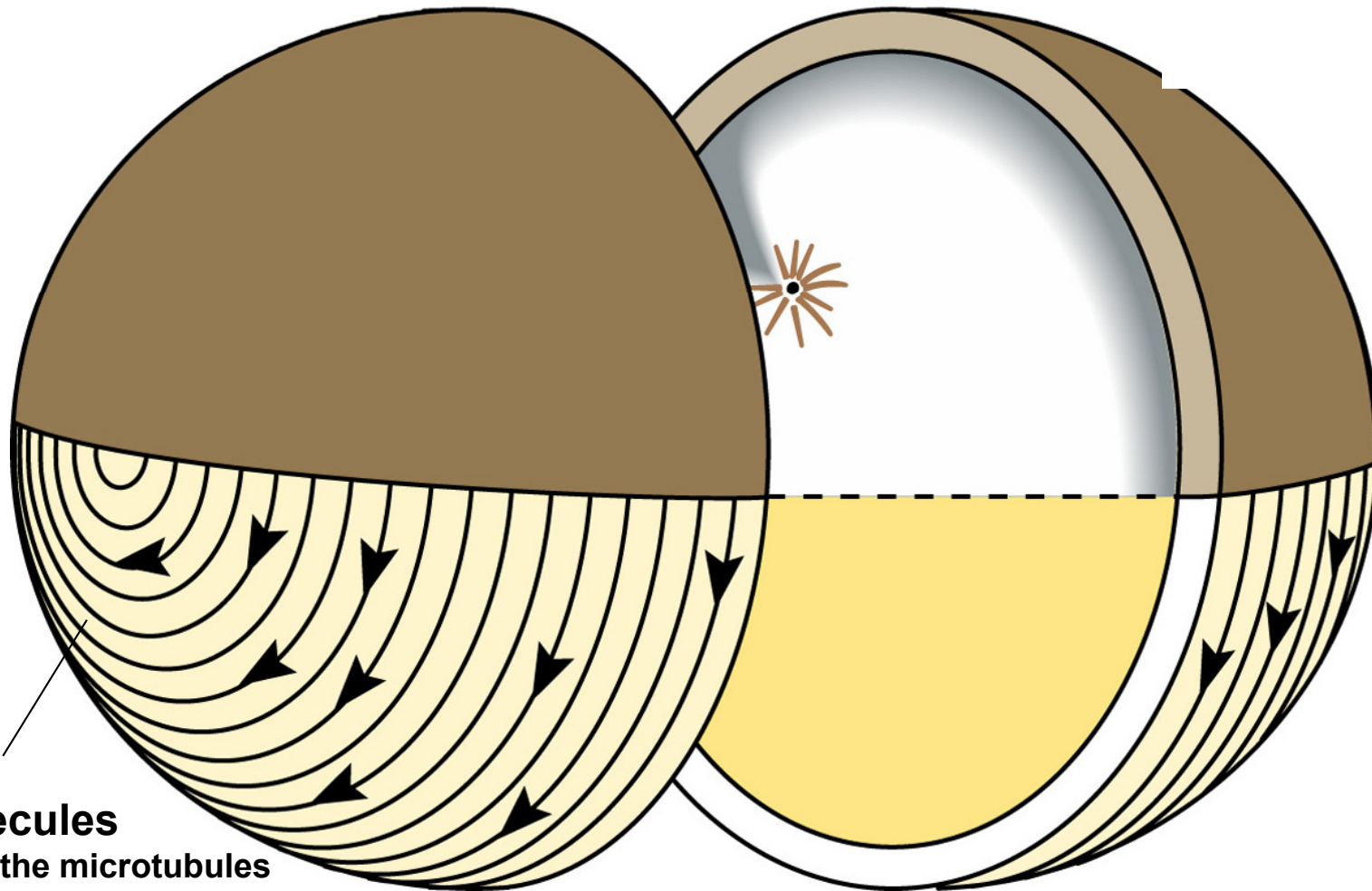


- **Completion of meiosis II**
- **Syngamy**

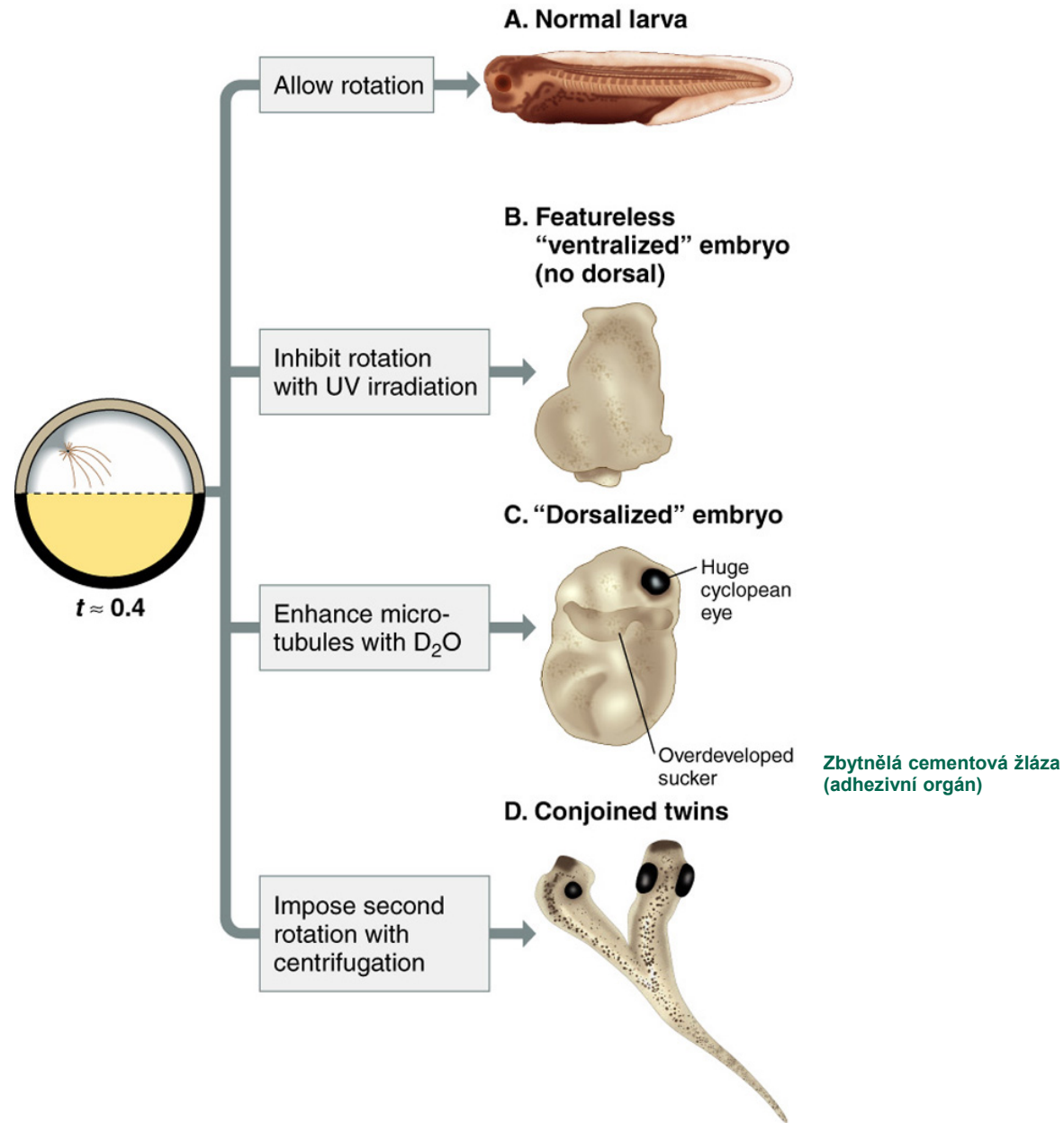




D.



Motor molecules
located along the microtubules

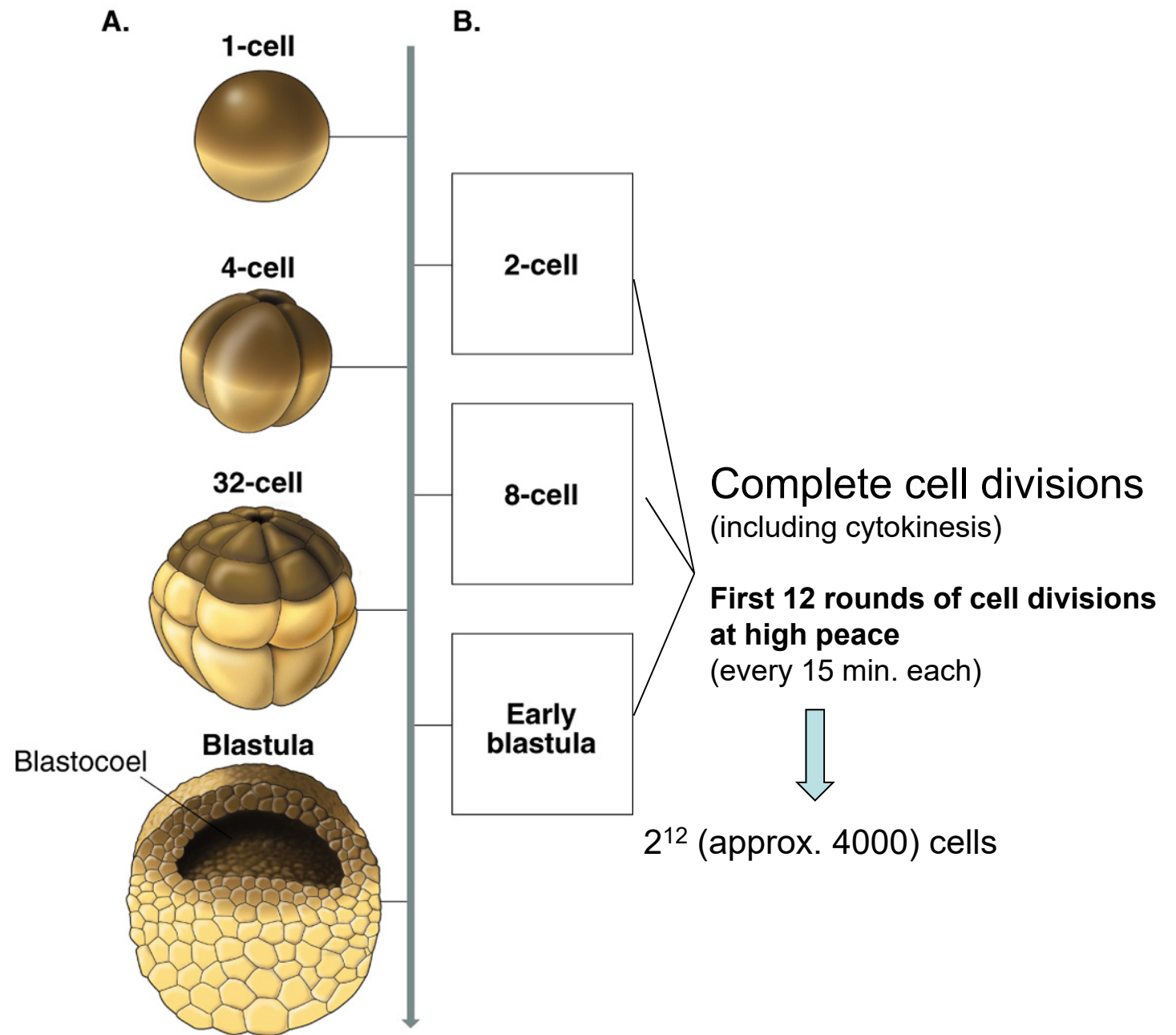




Morus nigra (mulberry)

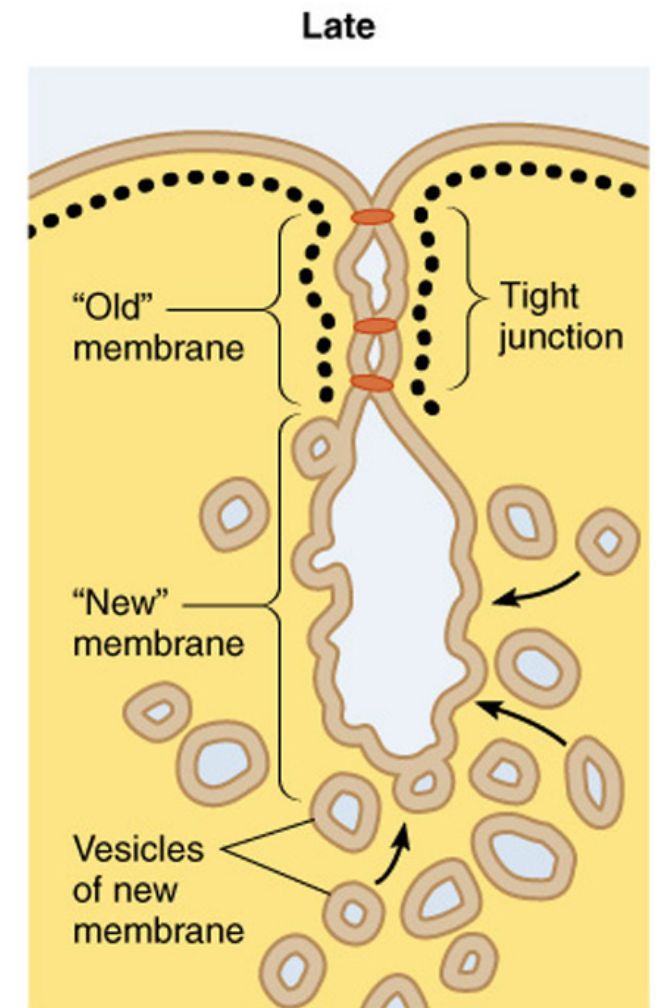
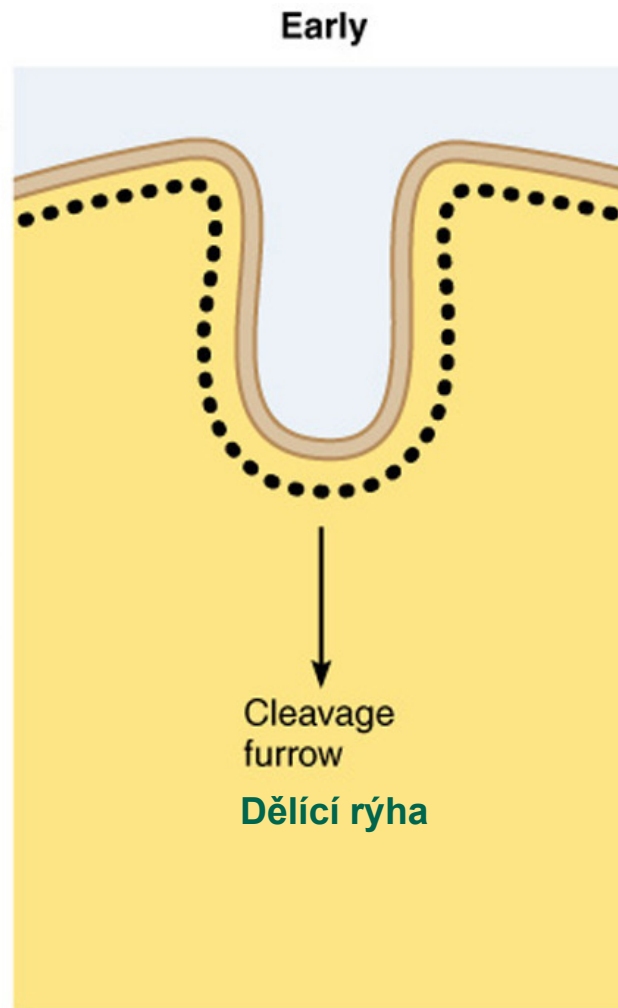
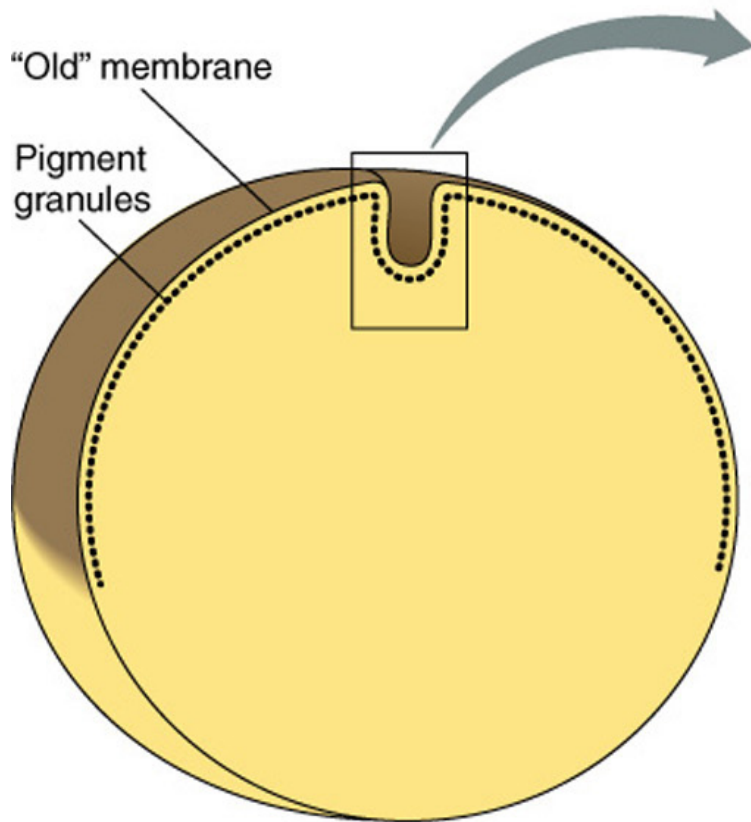
16-64 cells: morula

128 cells: blastula



Important molecular events precede further development at the midblastula transition (MBT)

- Induction of transcription
- Acquiring potential of cell motility
- Slowing down the cell division cycle

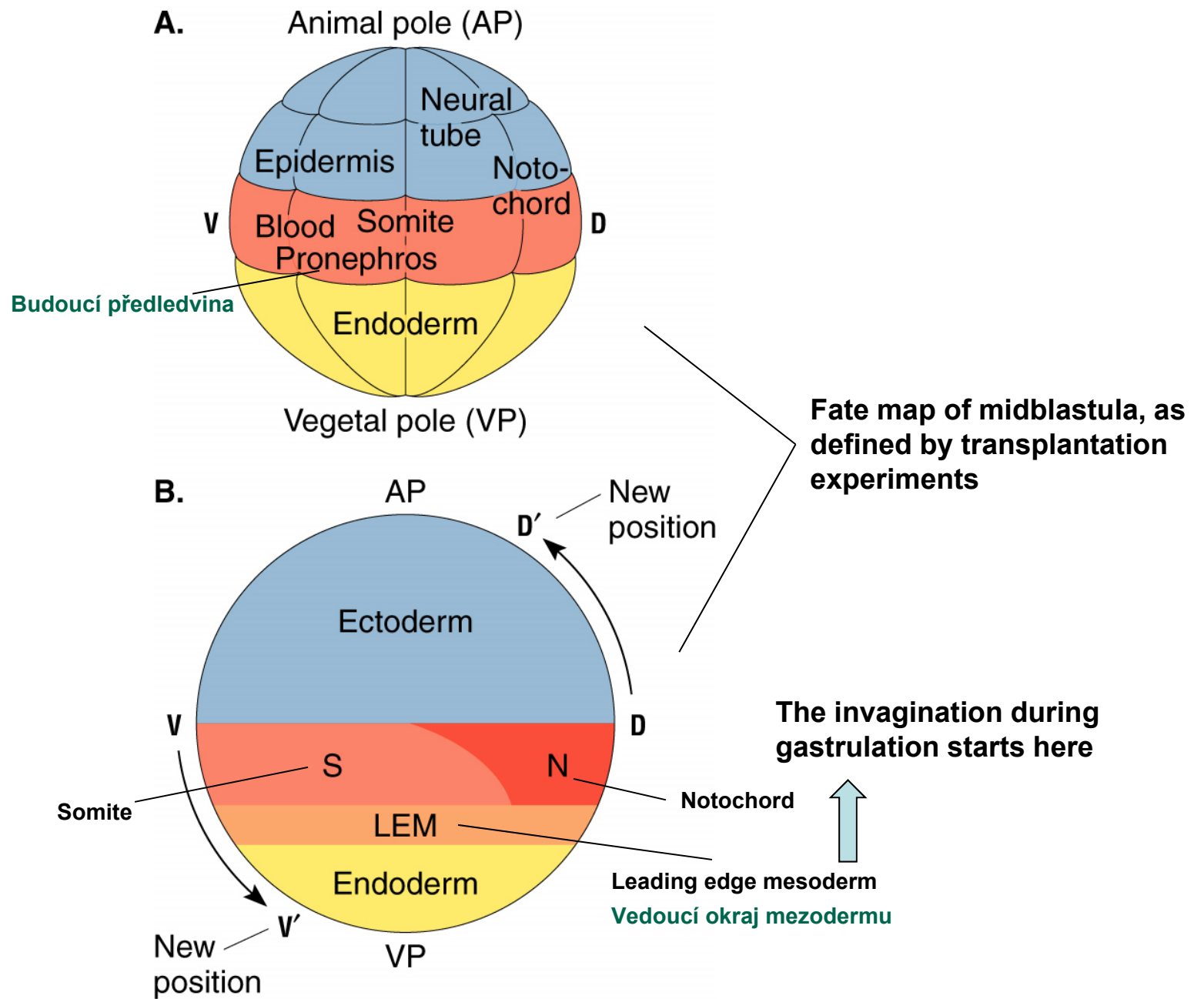


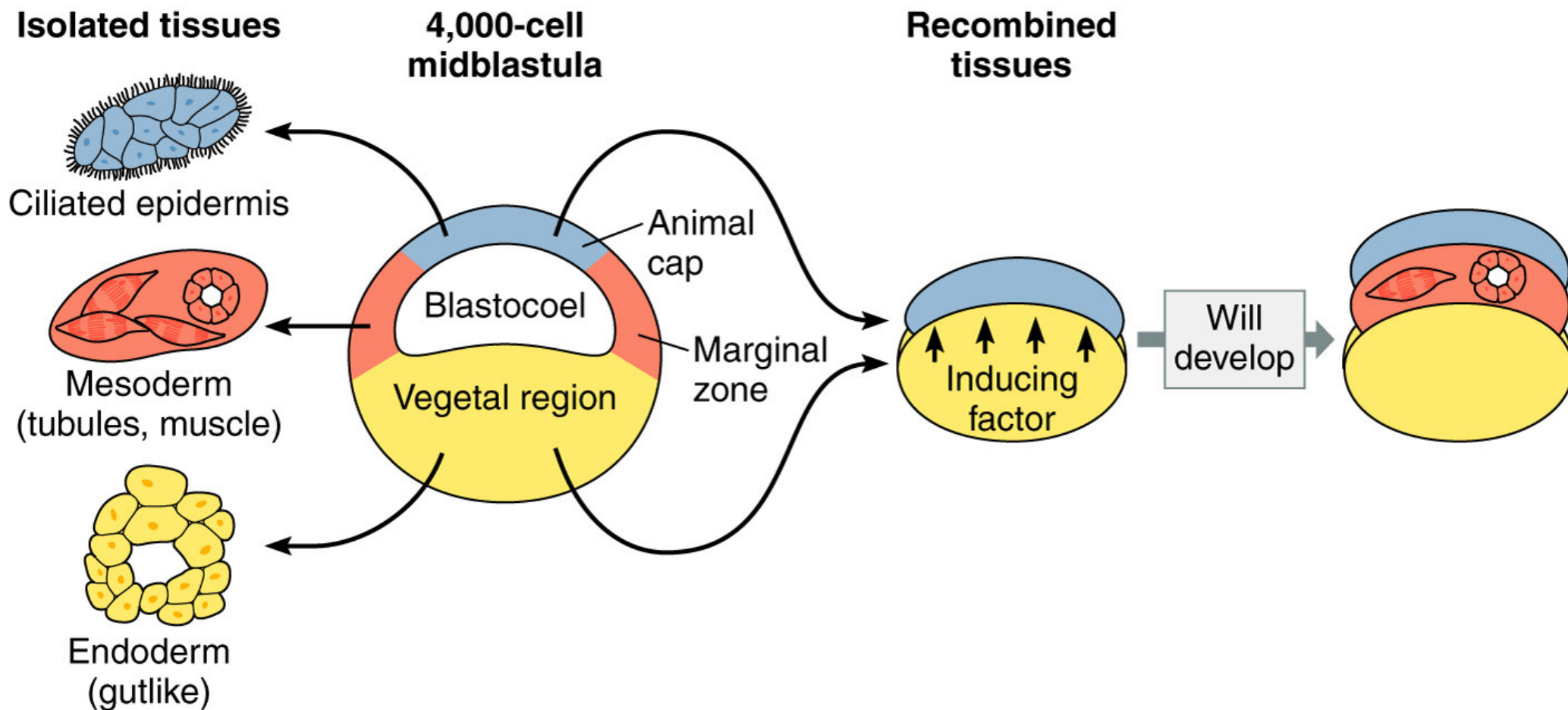


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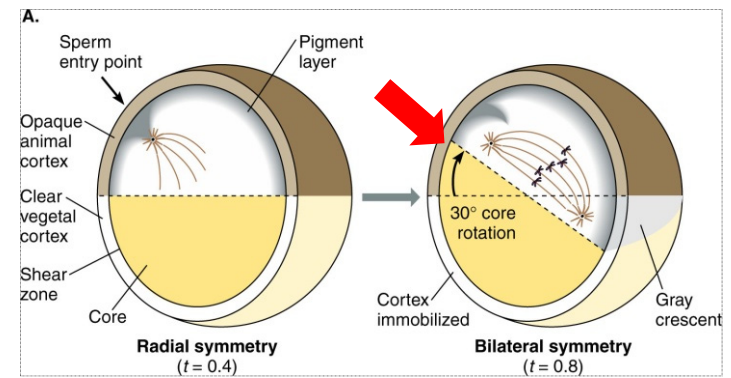
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- Gastrulation in amphibians



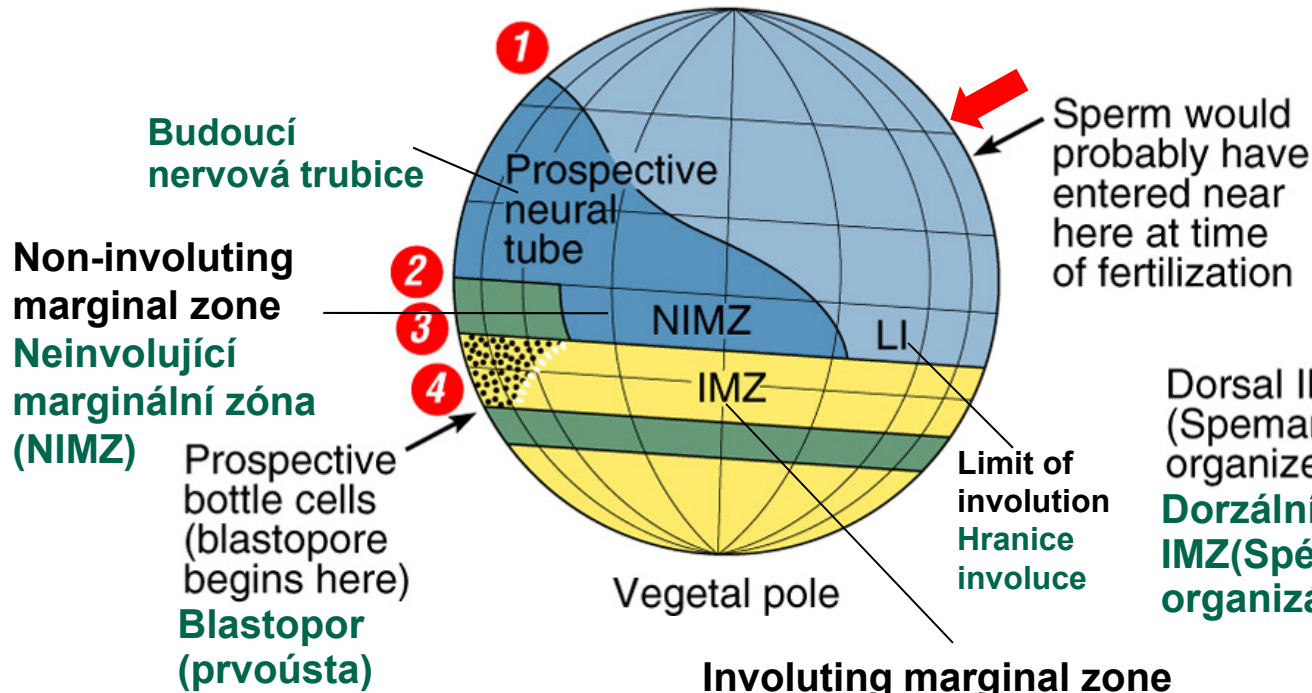
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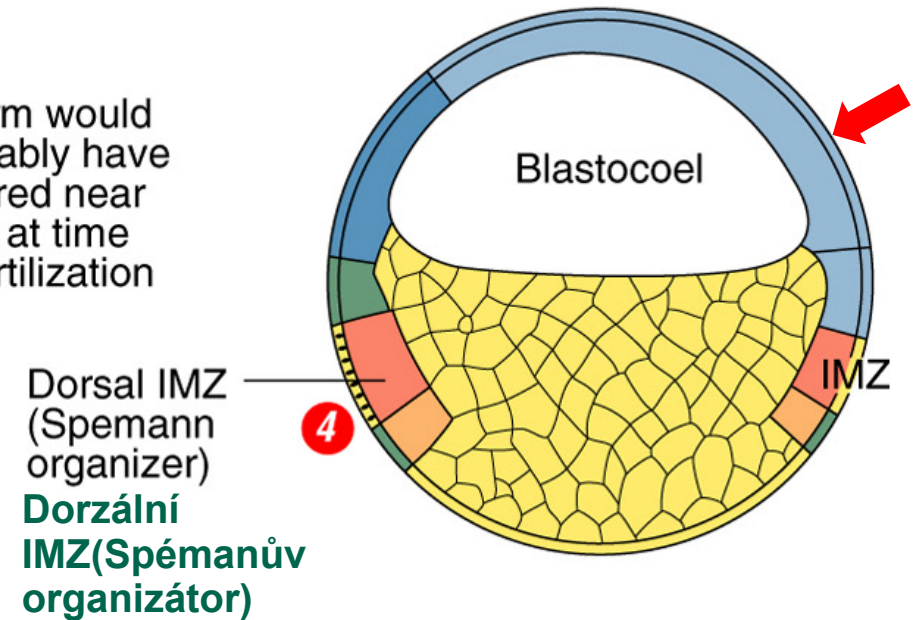


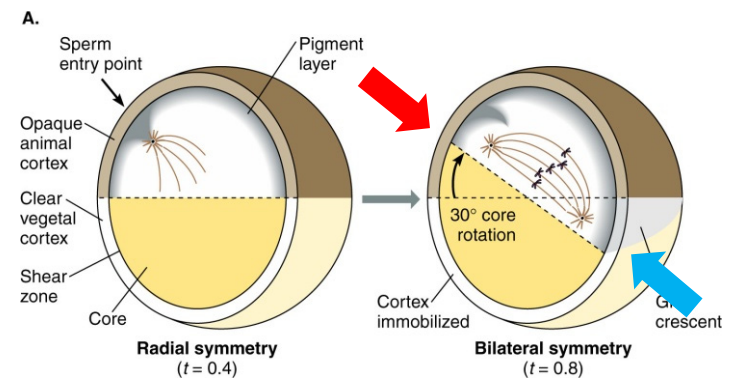
**Stage
A. Late Blastula**

**Surface Views
Animal pole**

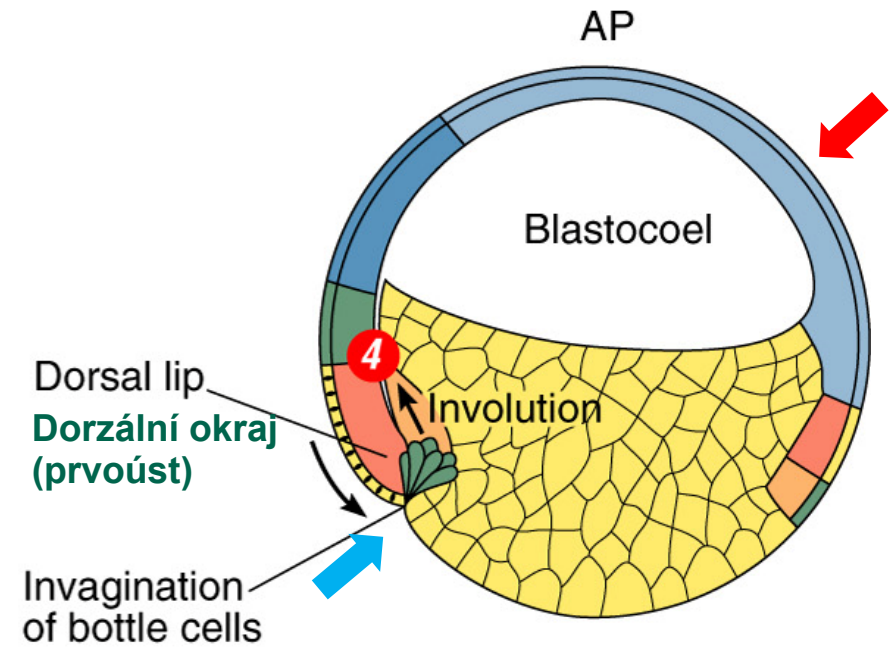
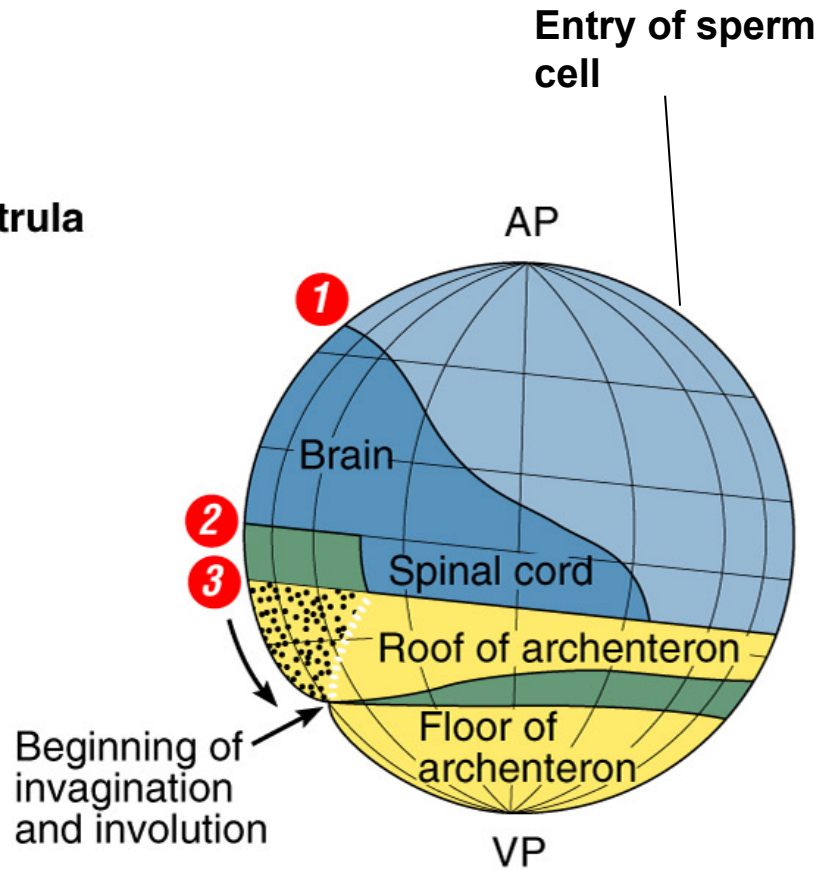


**Cutaway Views
AP**

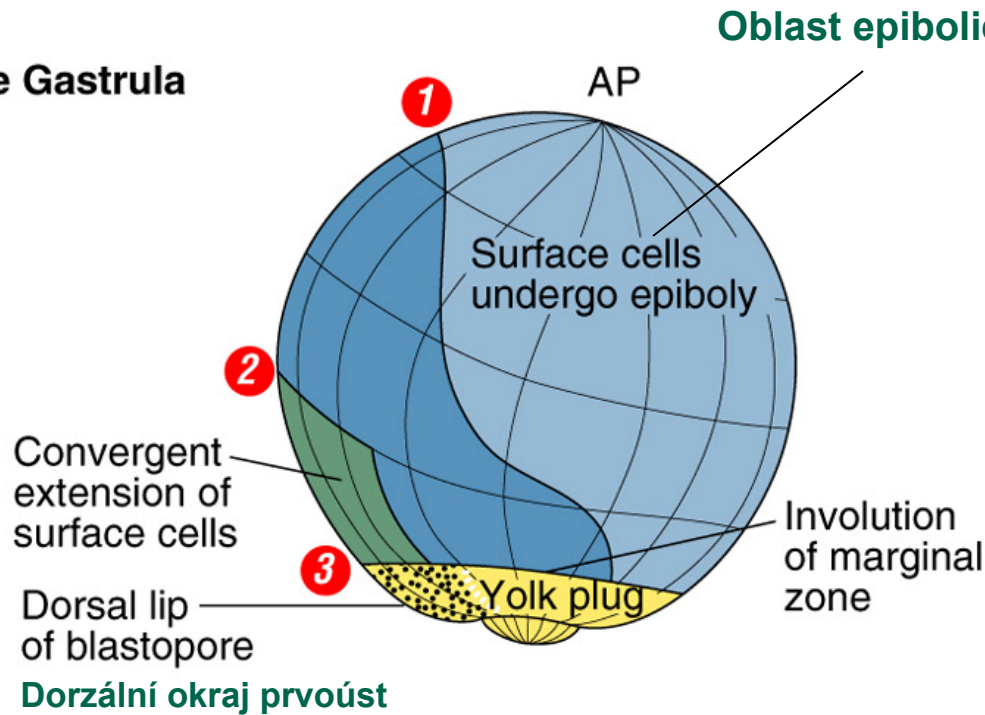




B. Early Gastrula

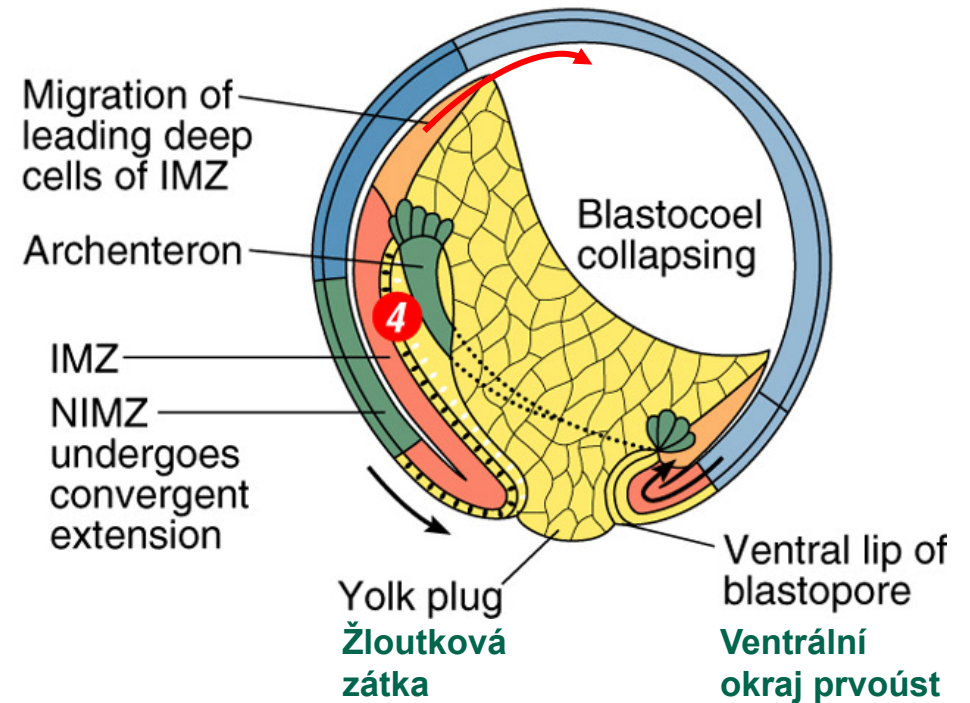


C. Late Gastrula

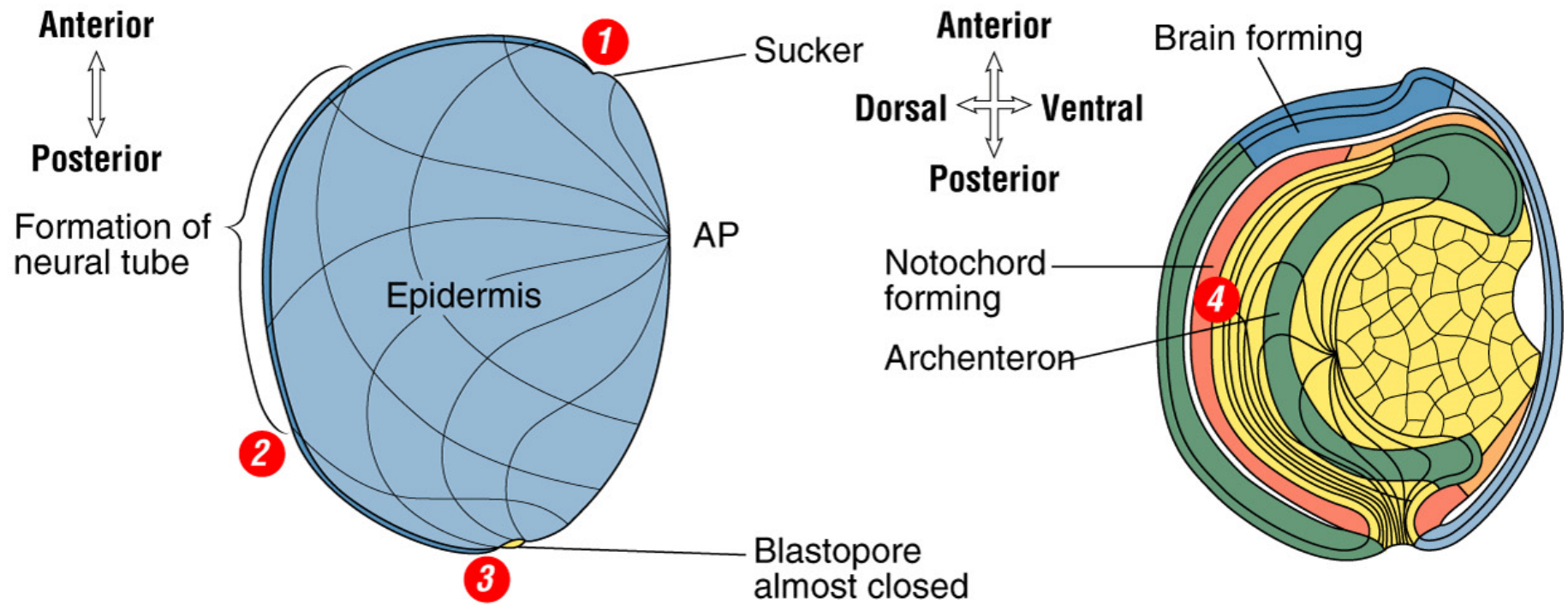


Oblast epibolie (radiální interkalace)

deep marginal cells move anteriorly



D. Neurulation Finished





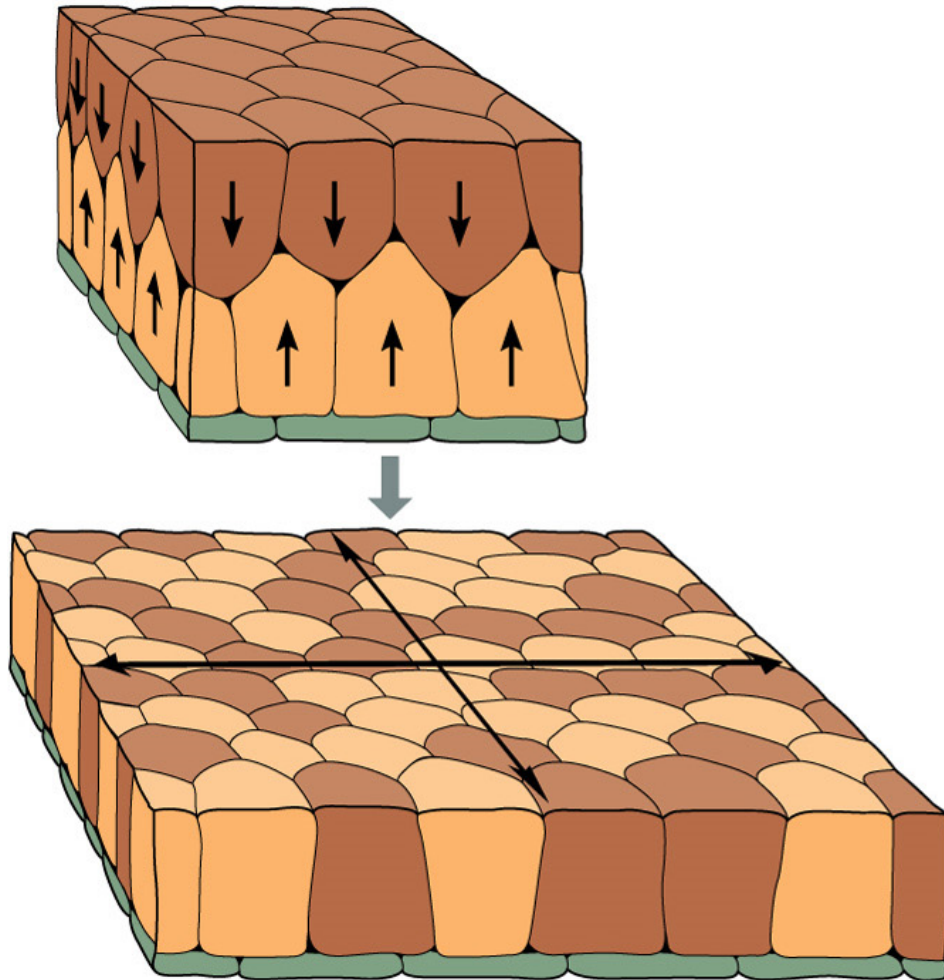
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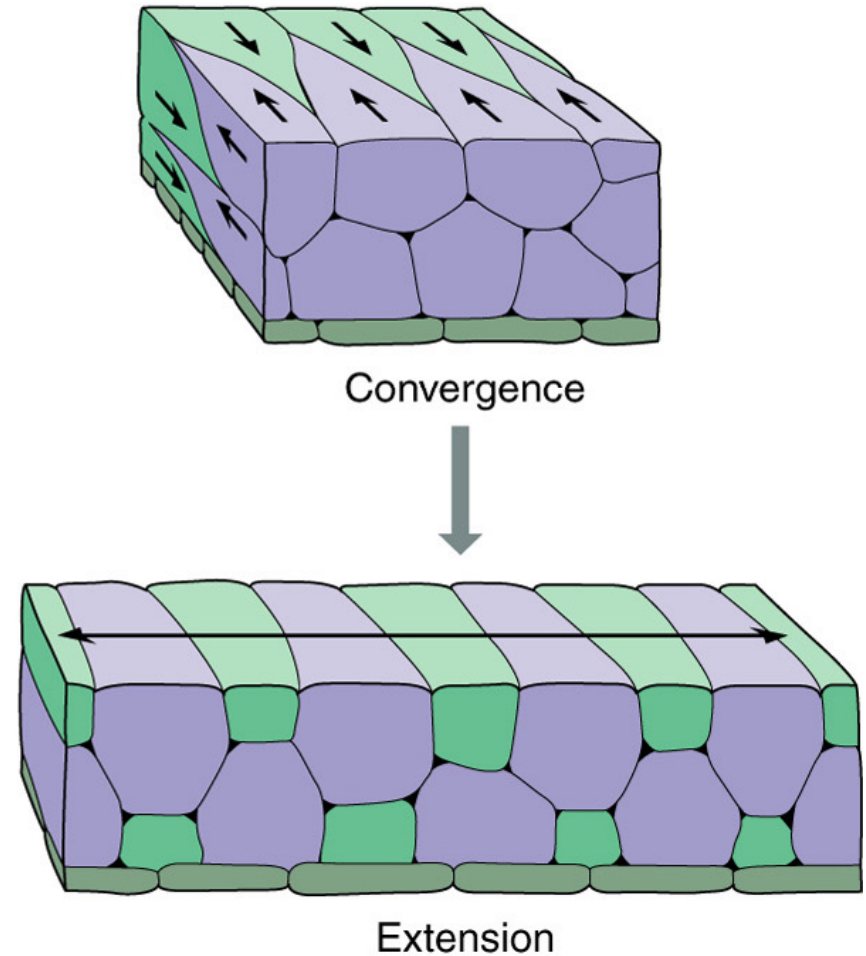
Radiální interkalace

A. Radial intercalation

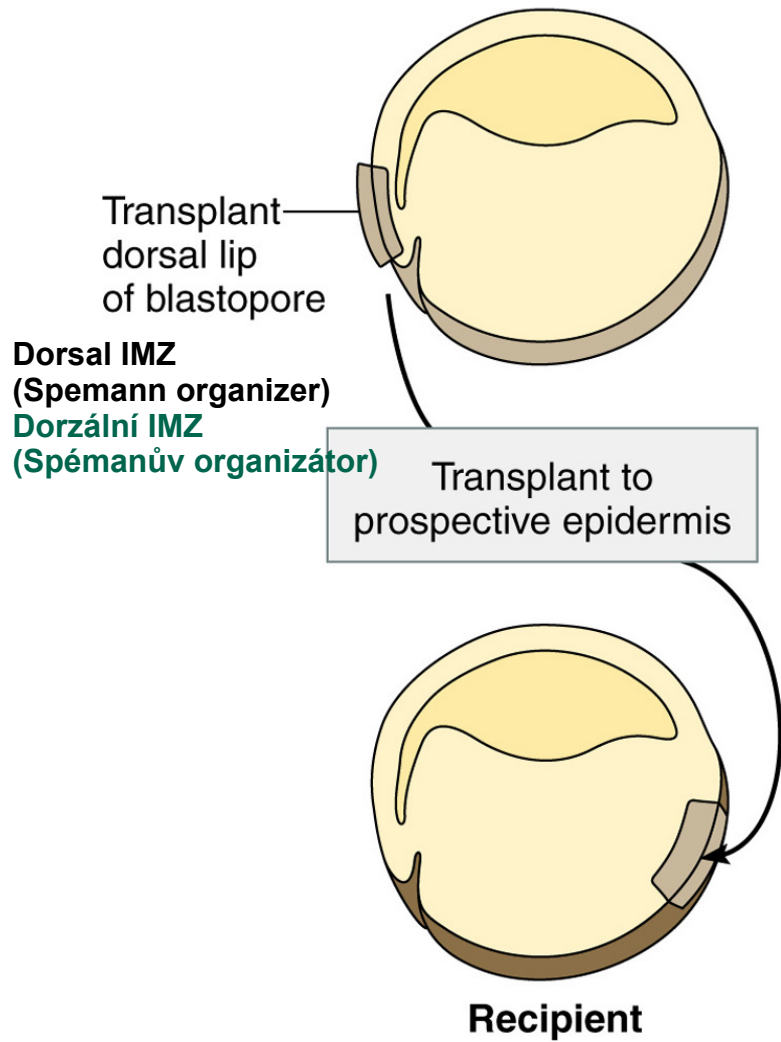


Mediolaterální interkalace

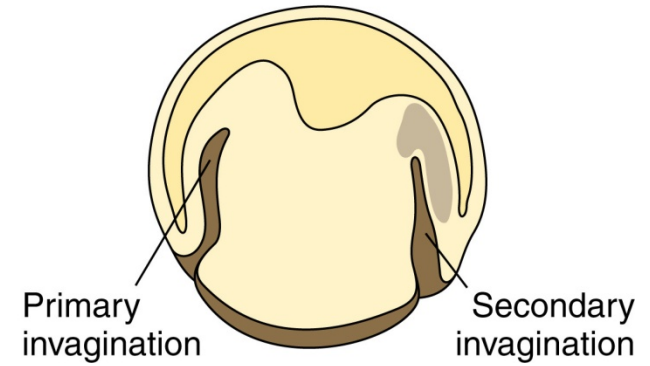
B. Mediolateral intercalation



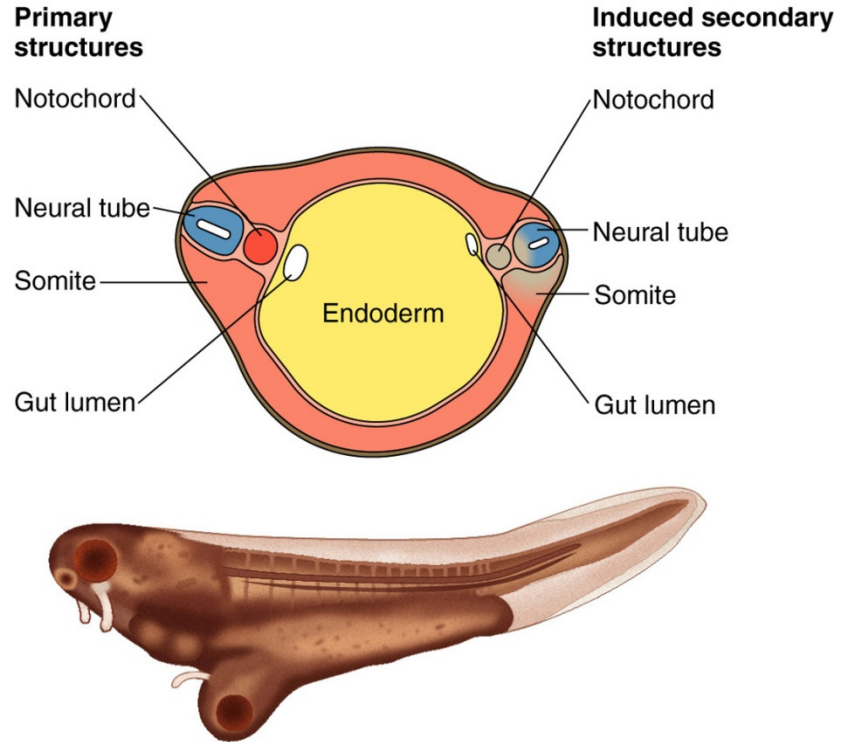
A.



B.



C.



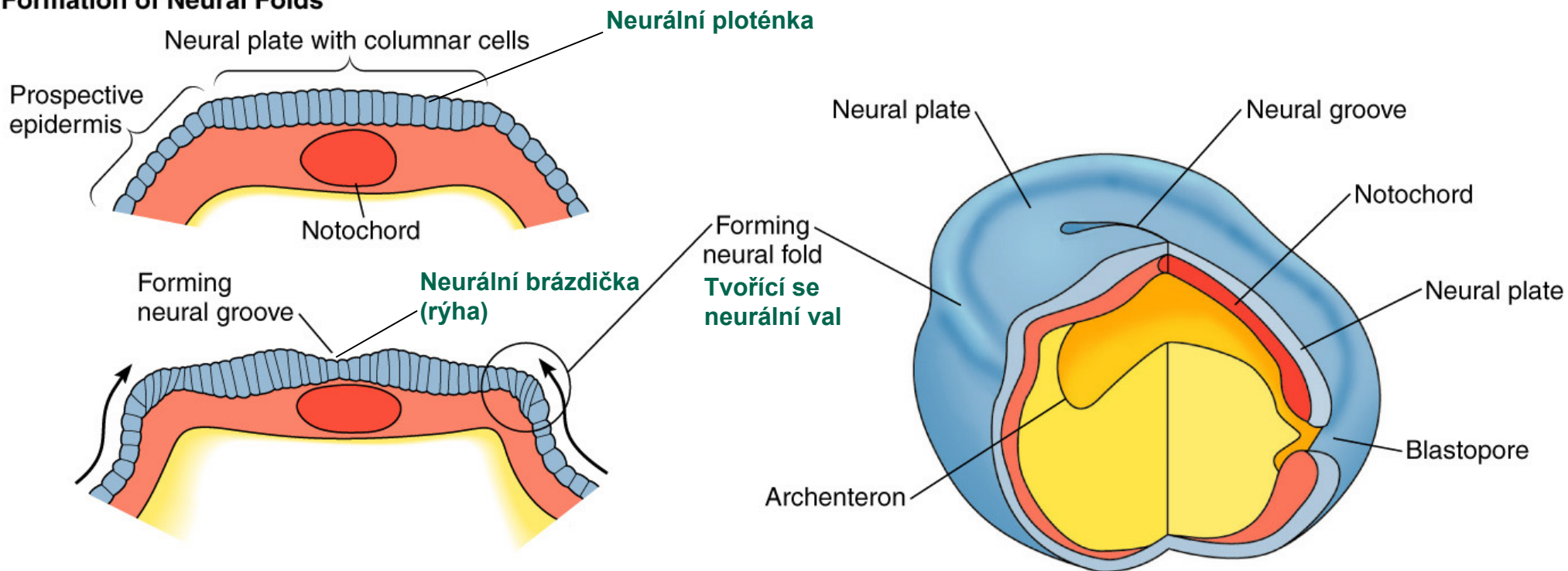


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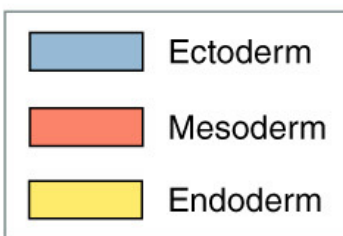
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- Neurulation

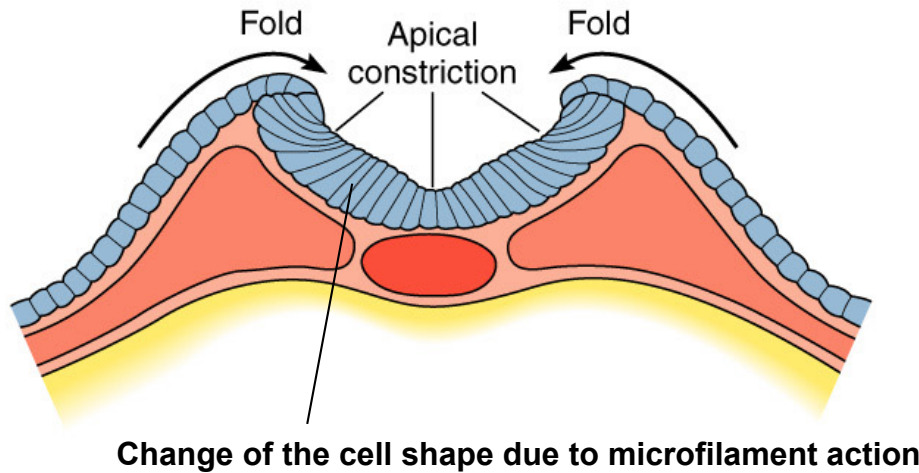
A. Formation of Neural Folds



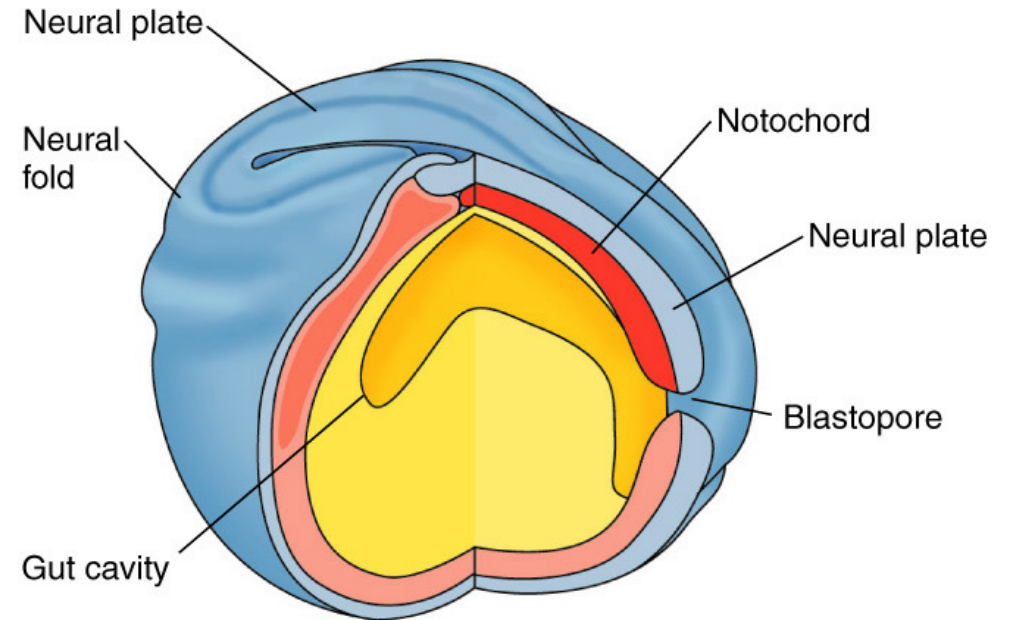
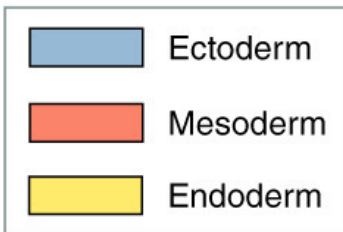
KEY



B. Elevation of Neural Folds



KEY

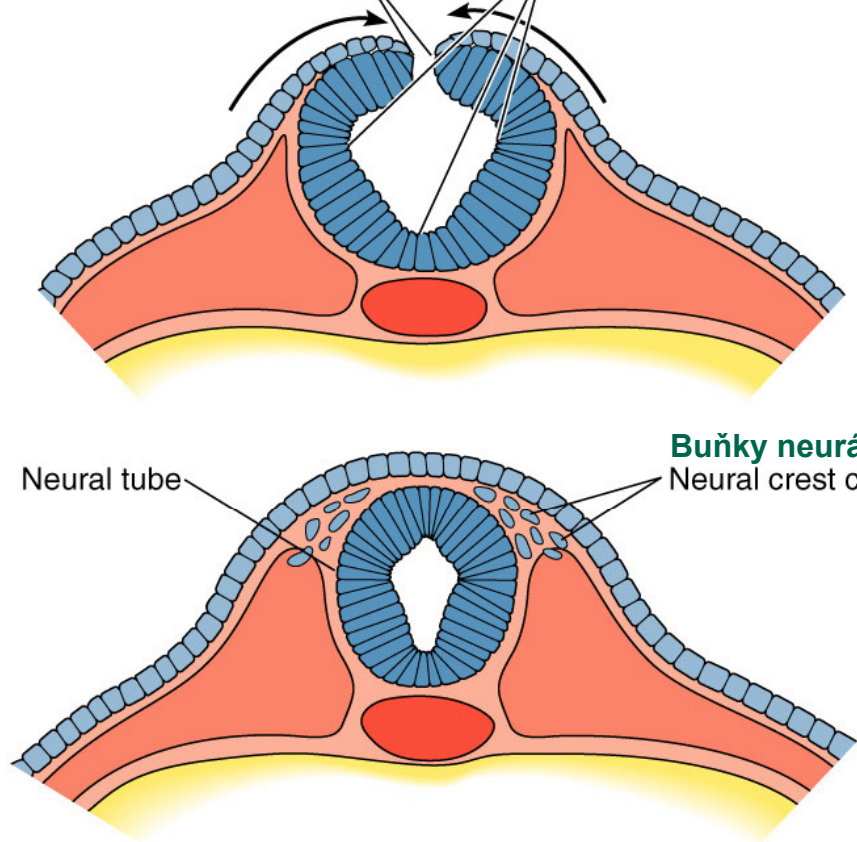


C. Formation of Neural Tube

Prospective neural crest

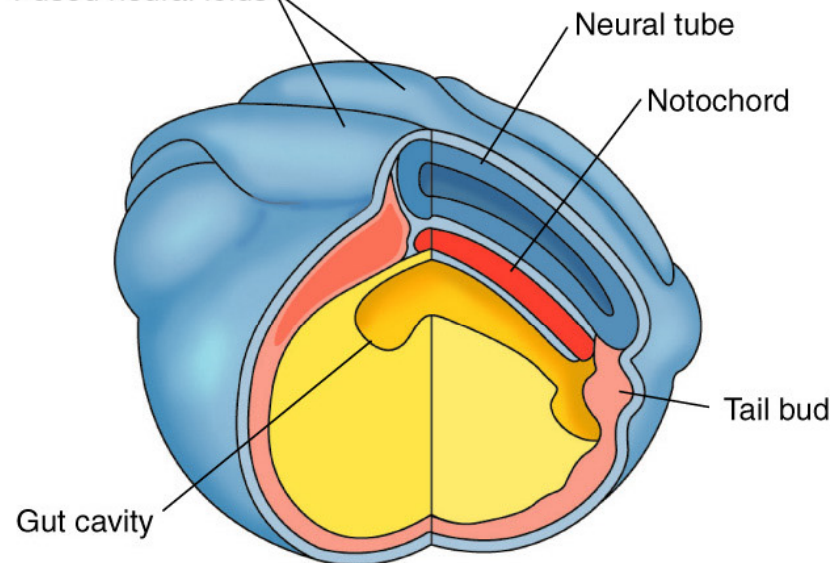
Místa ohybu

Hinge points



Fúzované neurální valy

Fused neural folds






Neural tube

Buňky neurální lišty

Neural crest cells

KEY

	Ectoderm
	Mesoderm
	Endoderm

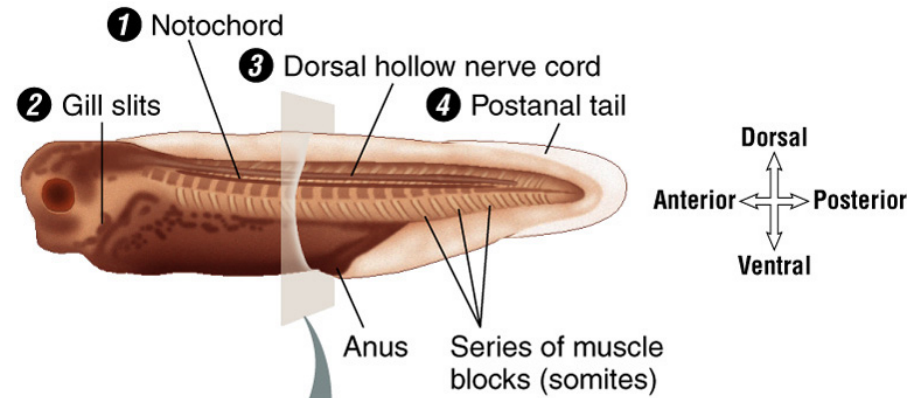


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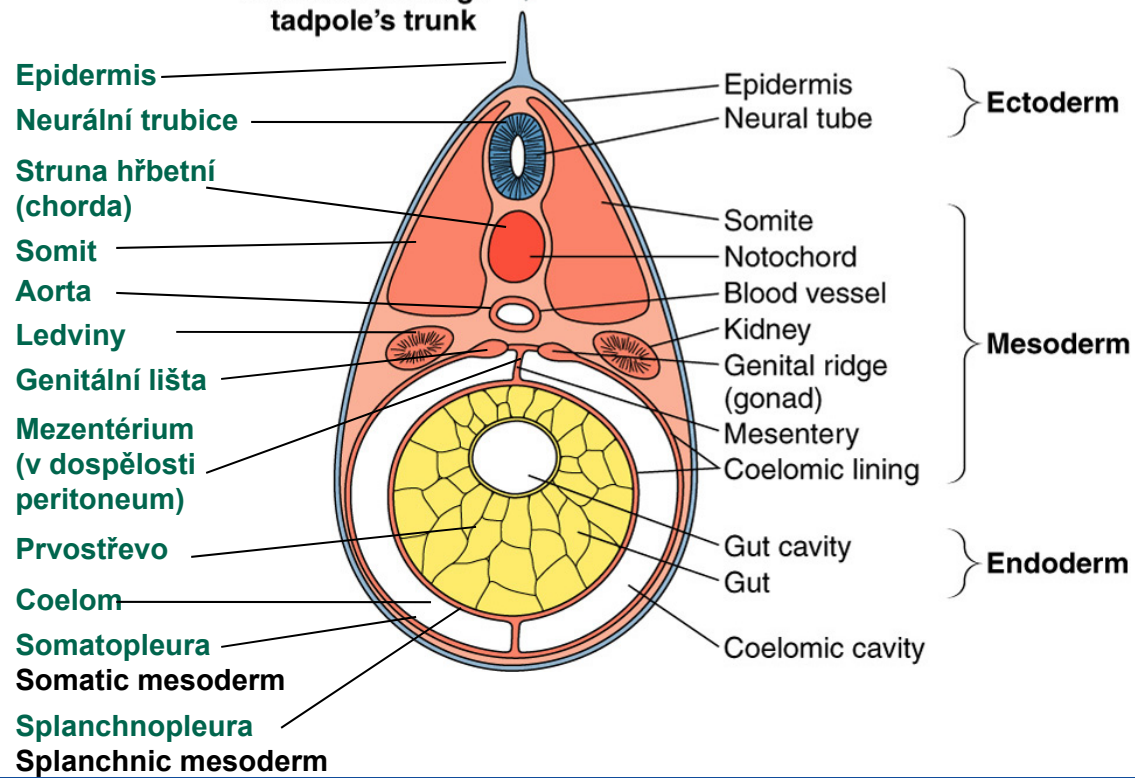
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- Neurulation
 - neurulation in *Xenopus* (video)

A. The vertebrate “body axis” (head–trunk–tail) and the four characteristics of chordates



B. Section through tadpole's trunk

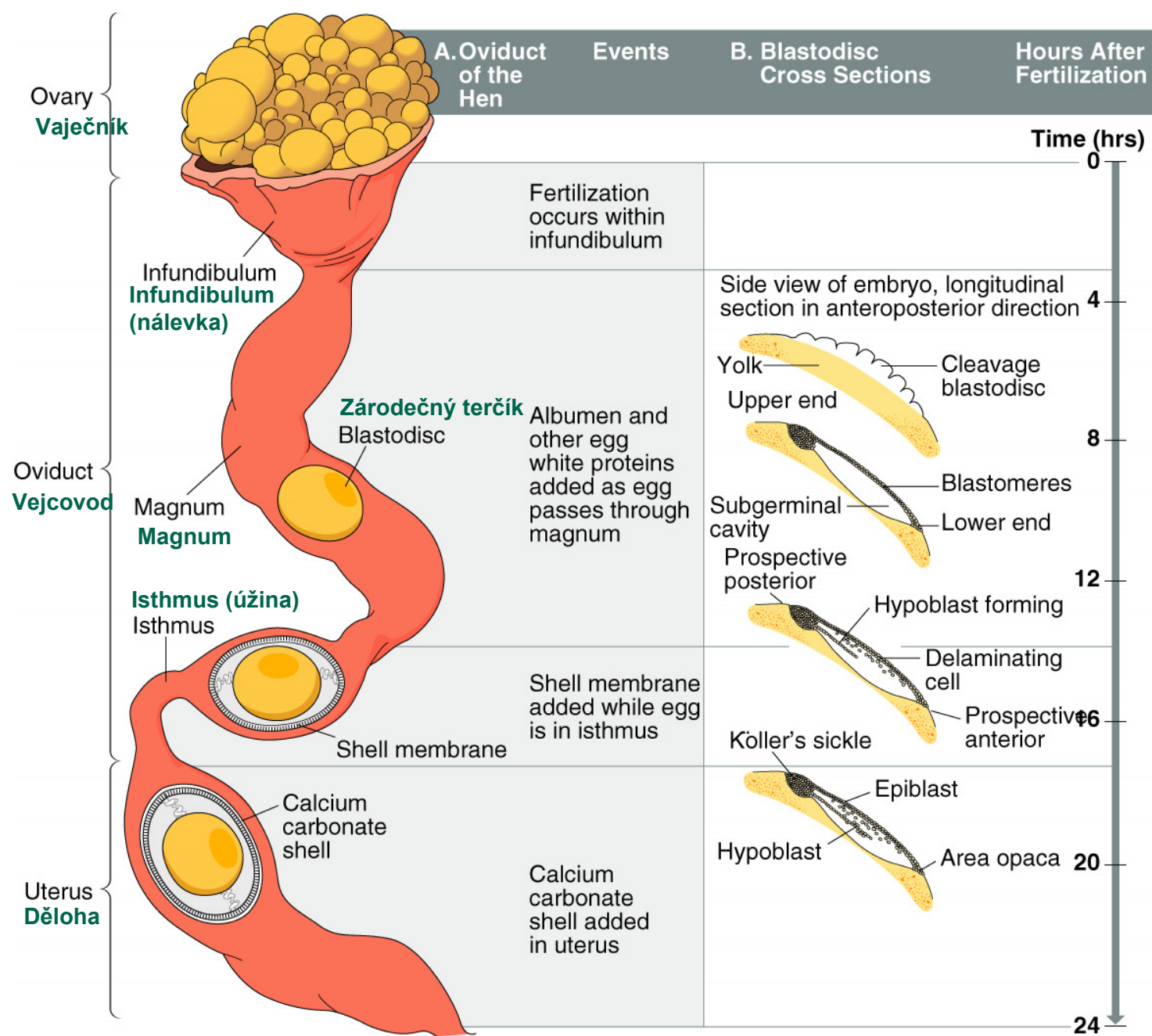




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 - gastrulation of amphibians (video)
- Neurulation
 - neurulation in *Xenopus* (video)
- Oogenesis in amniotes - chicken



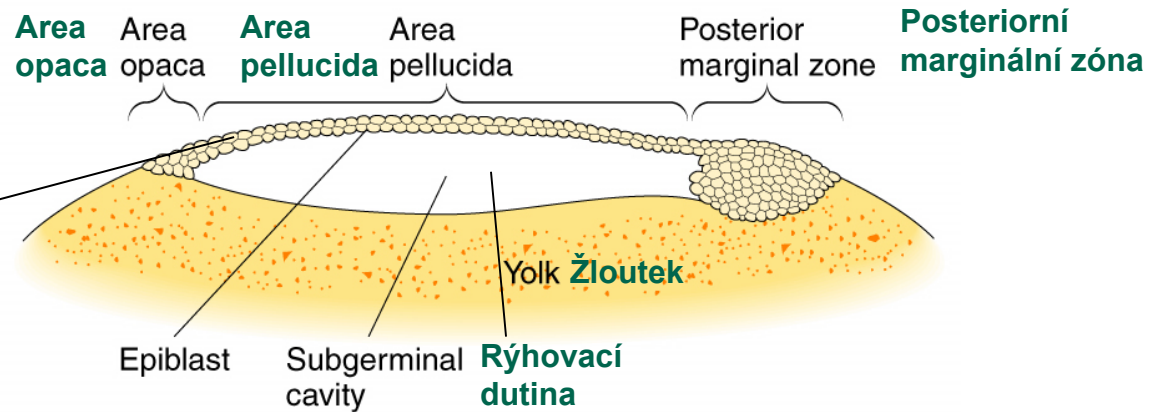


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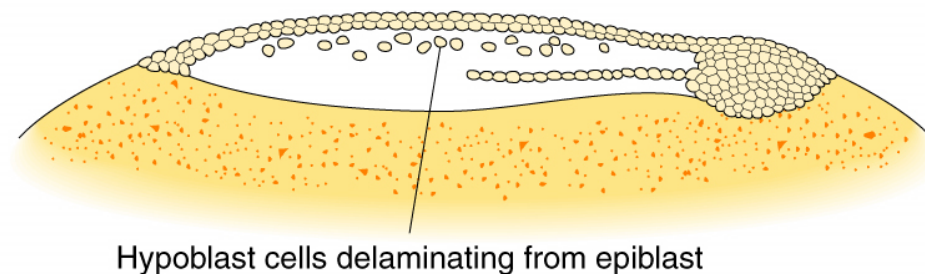
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- Blastula formation in amniotes - chicken

A. Egg before formation of hypoblast

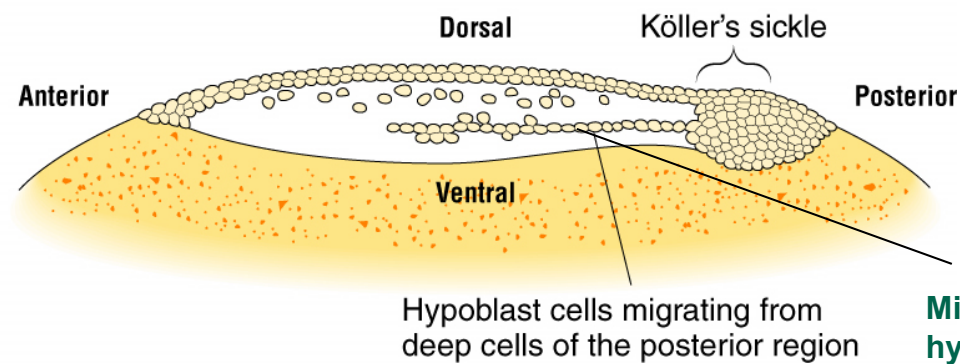


Egg laying:
60,000 cells,
about 1 mm in
diameter

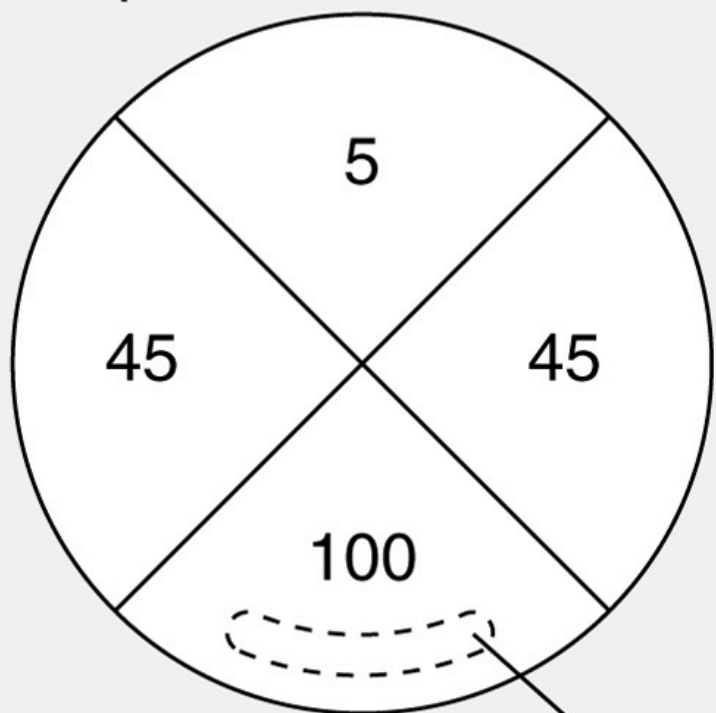
B. Primary hypoblast **Primární hypoblast**



C. Secondary hypoblast **Sekundární hypoblast**

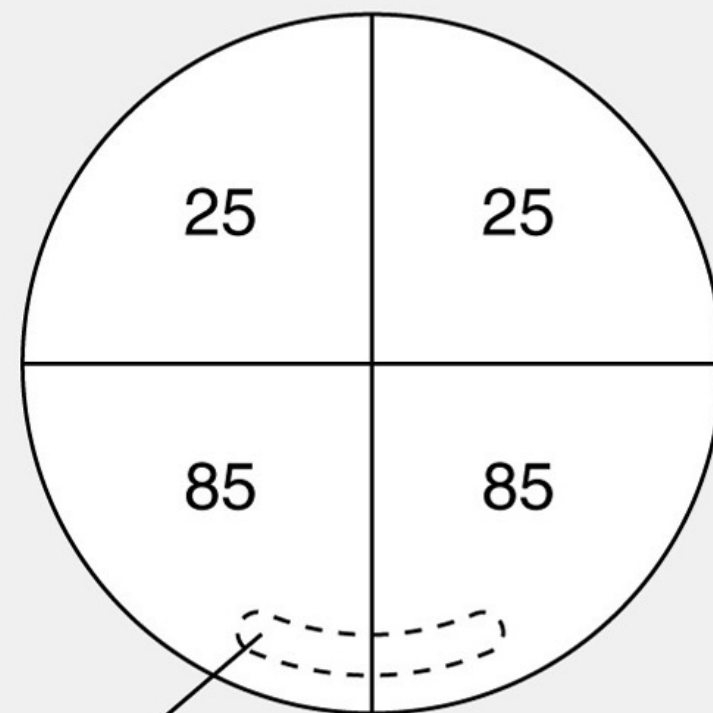


Cut blastoderm in pieces like this...



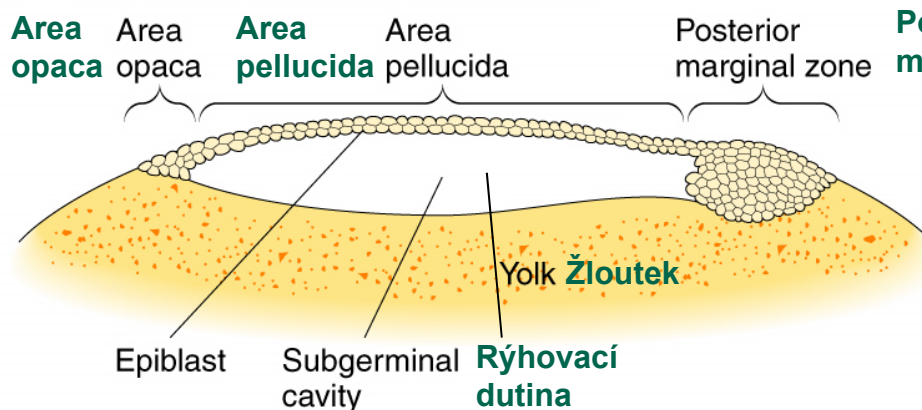
Numbers show percentage of total pieces from a given region that could form an axis

...or like this



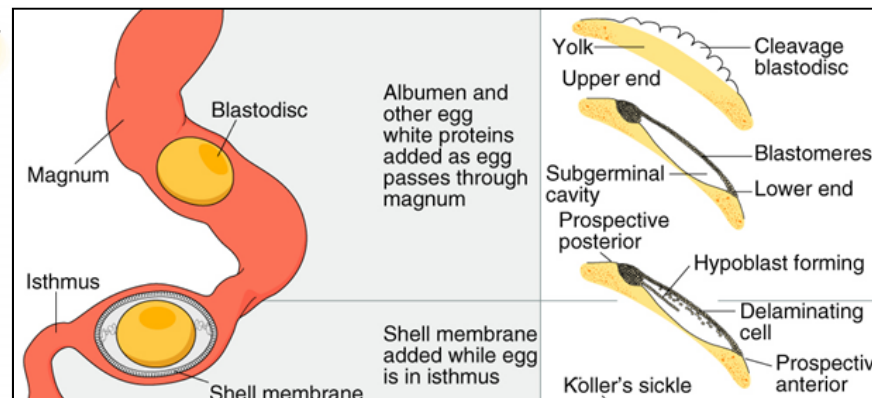
Posterior marginal zone

A. Egg before formation of hypoblast

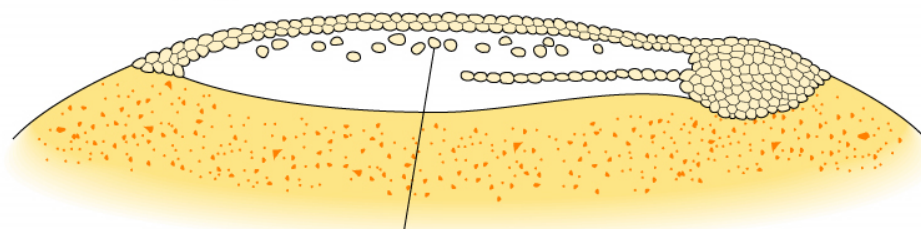


Posteriorní marginální zóna

There is a role of gravitropism in the anteroposterior axis formation in birds

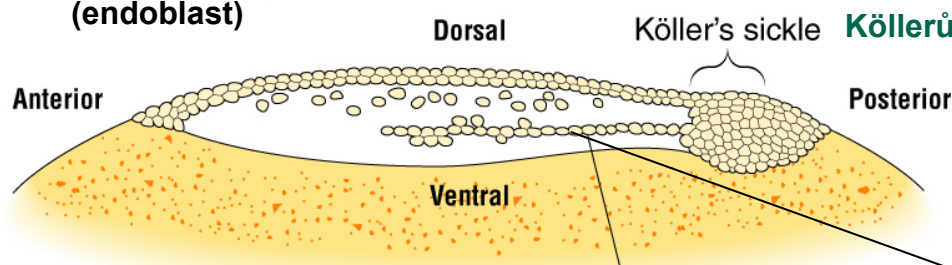


B. Primary hypoblast Primární hypoblast



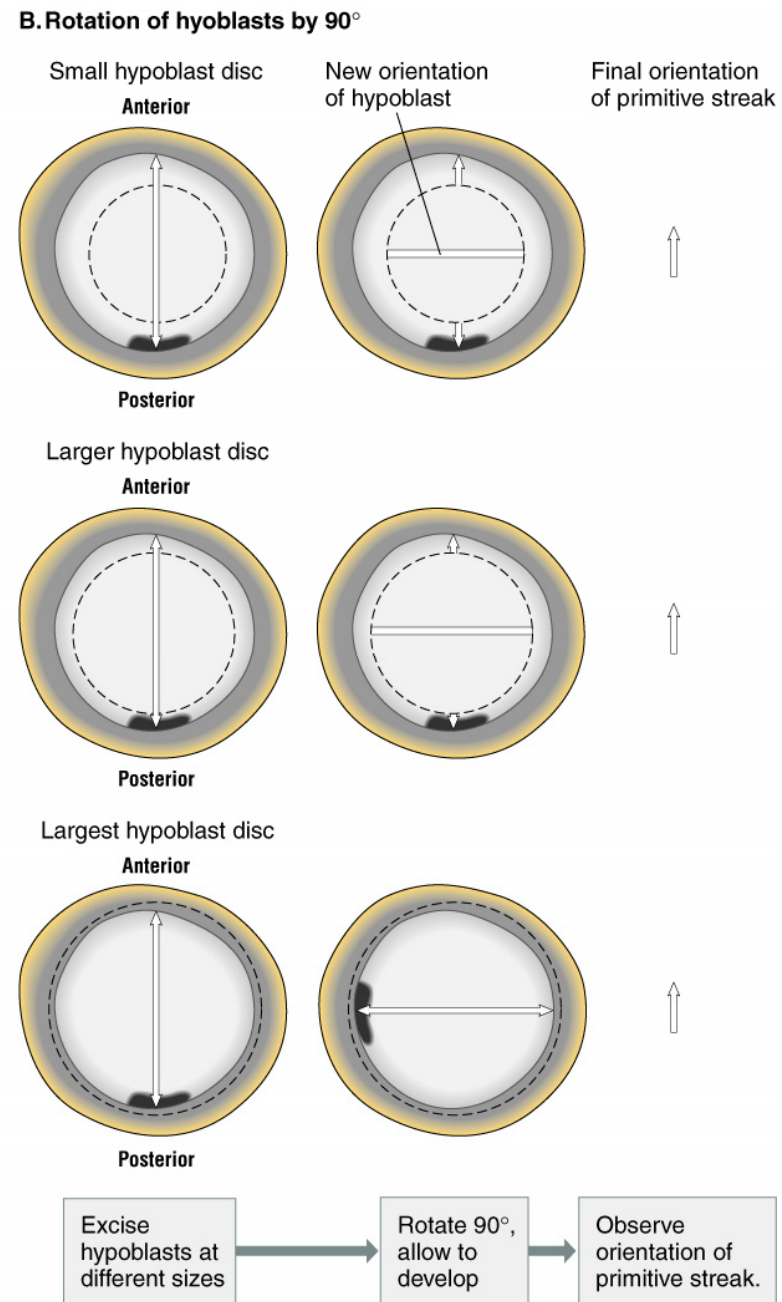
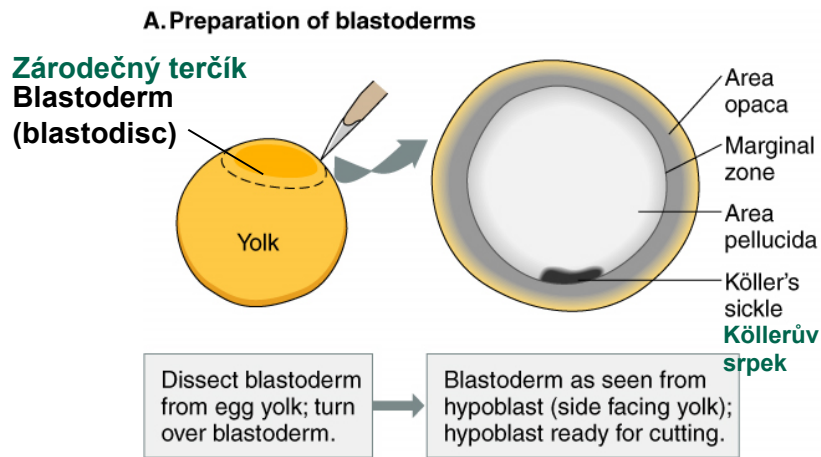
Hypoblast cells delaminating from epiblast

C. Secondary hypoblast (endoblast) Sekundární hypoblast



Hypoblast cells migrating from deep cells of the posterior region

Migrující buňky hypoblastu



Does hypoblast determine the anteroposterior axis of epiblast?



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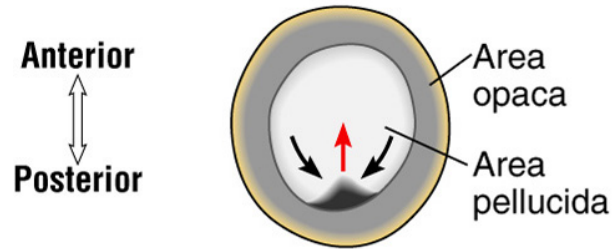
- Gastrulation in amniotes – chicken



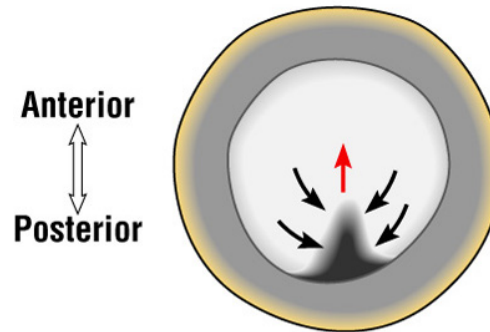
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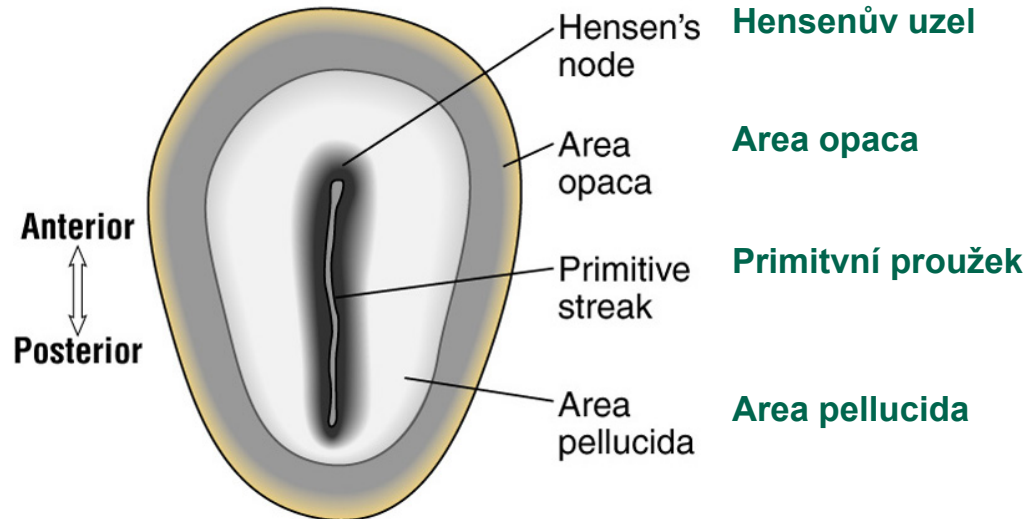
A. After 3 – 4h of incubation



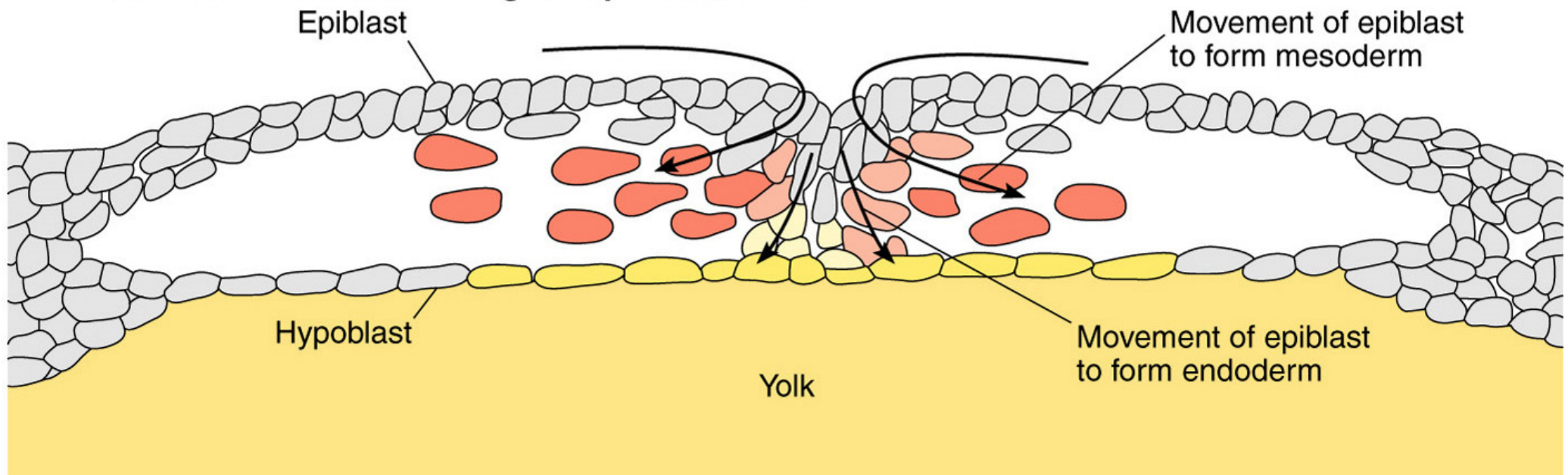
B. 10 – 12h of incubation

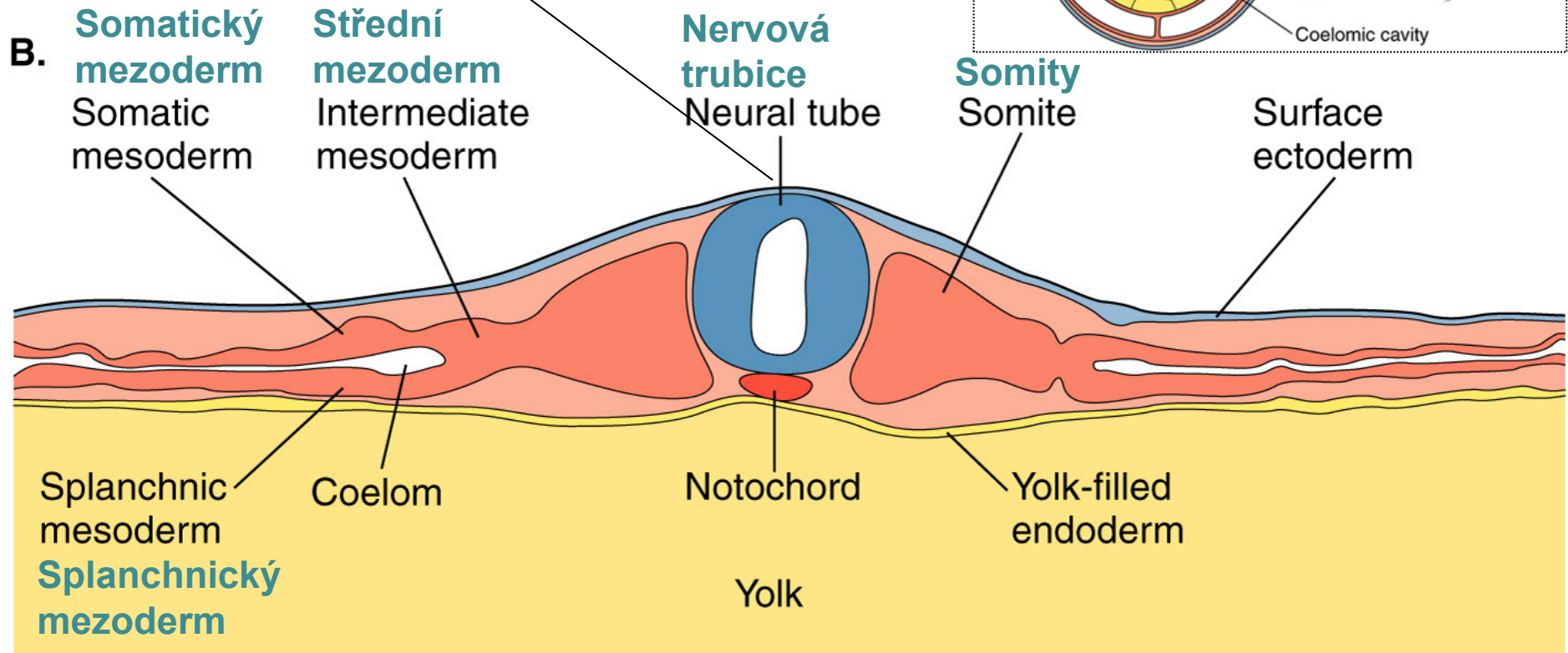
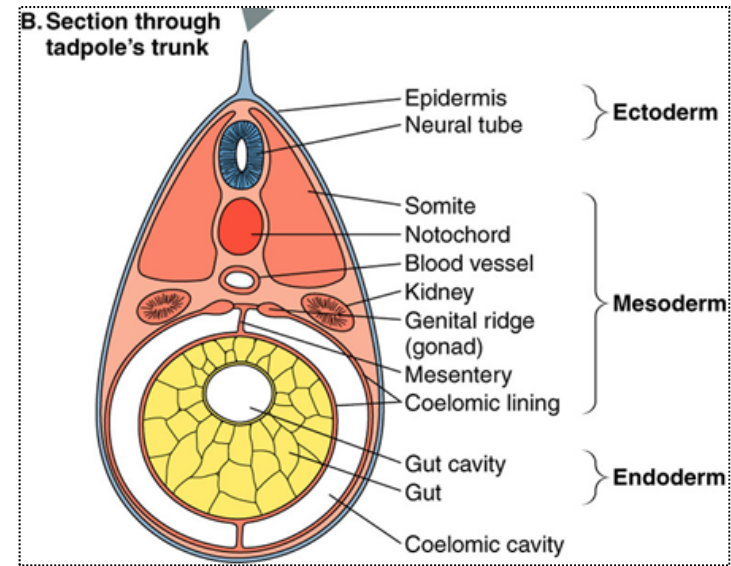


C. 18 – 20h of incubation



D. Schematic of movements through the primitive streak







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- Gastrulation in amniotes – chicken
 - early and late gastrulation in chicken (video)

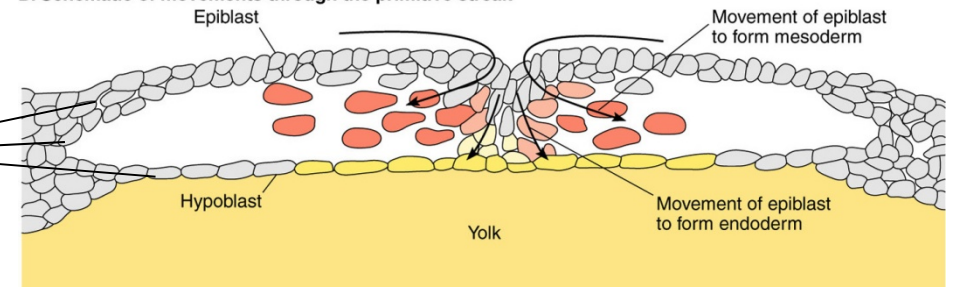


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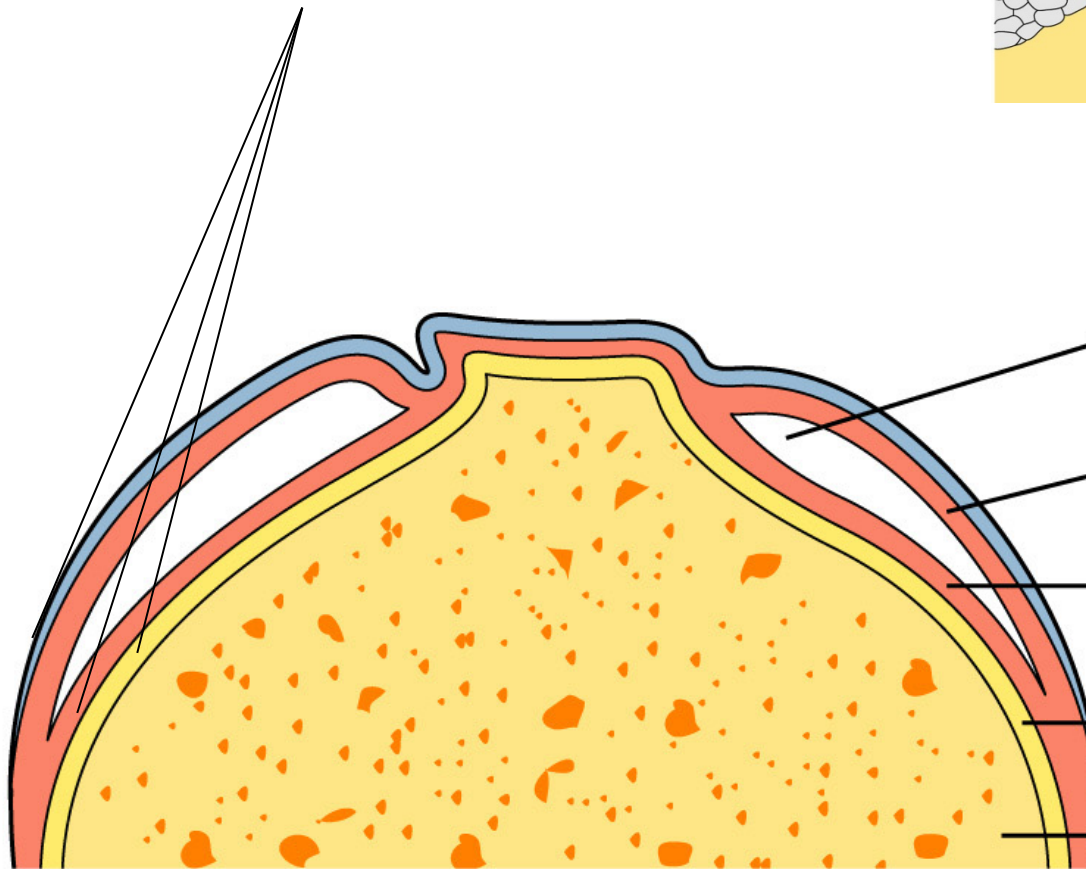
- Gastrulation in amniotes – chicken
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- Formation of extraembryonic tissues in amniotes - chicken

D. Schematic of movements through the primitive streak



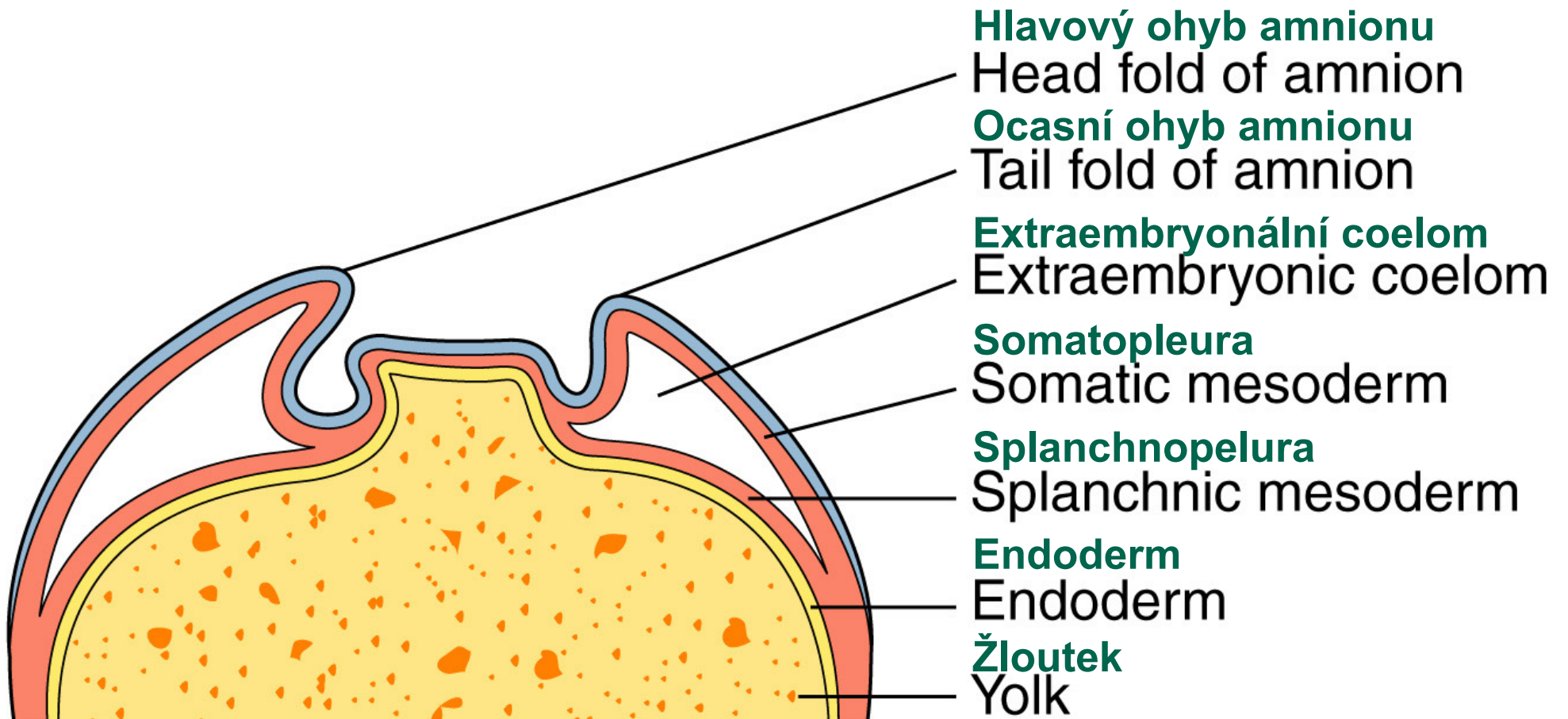
Origin of extraembryonic tissue

A.

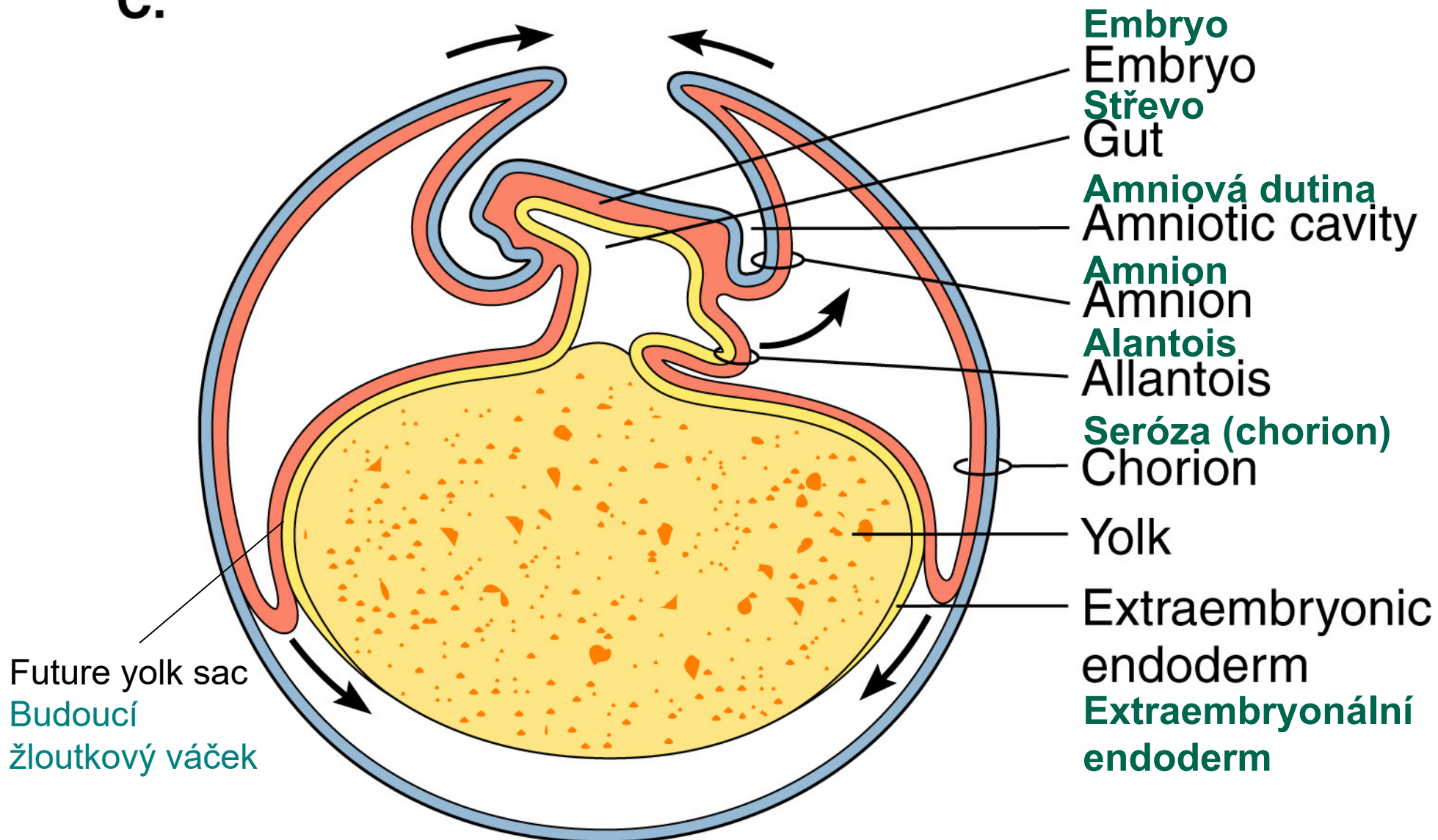


- Extraembryonální coelom
- Extraembryonic coelom
- Somatopleura
- Somatic mesoderm
- Splanchnopleura
- Splanchnic mesoderm
- Endoderm
- Endoderm
- Žloutek
- Yolk

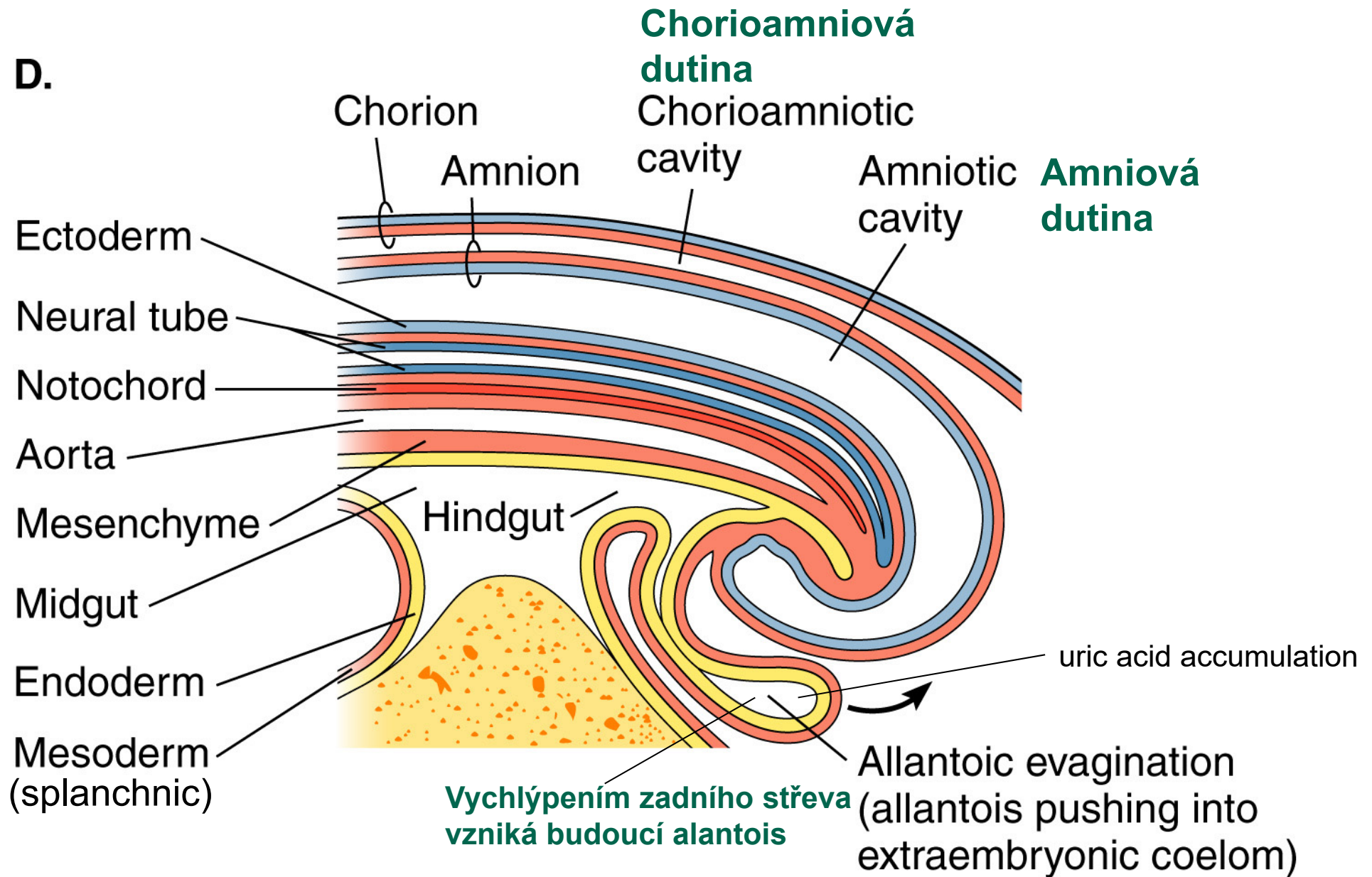
B.



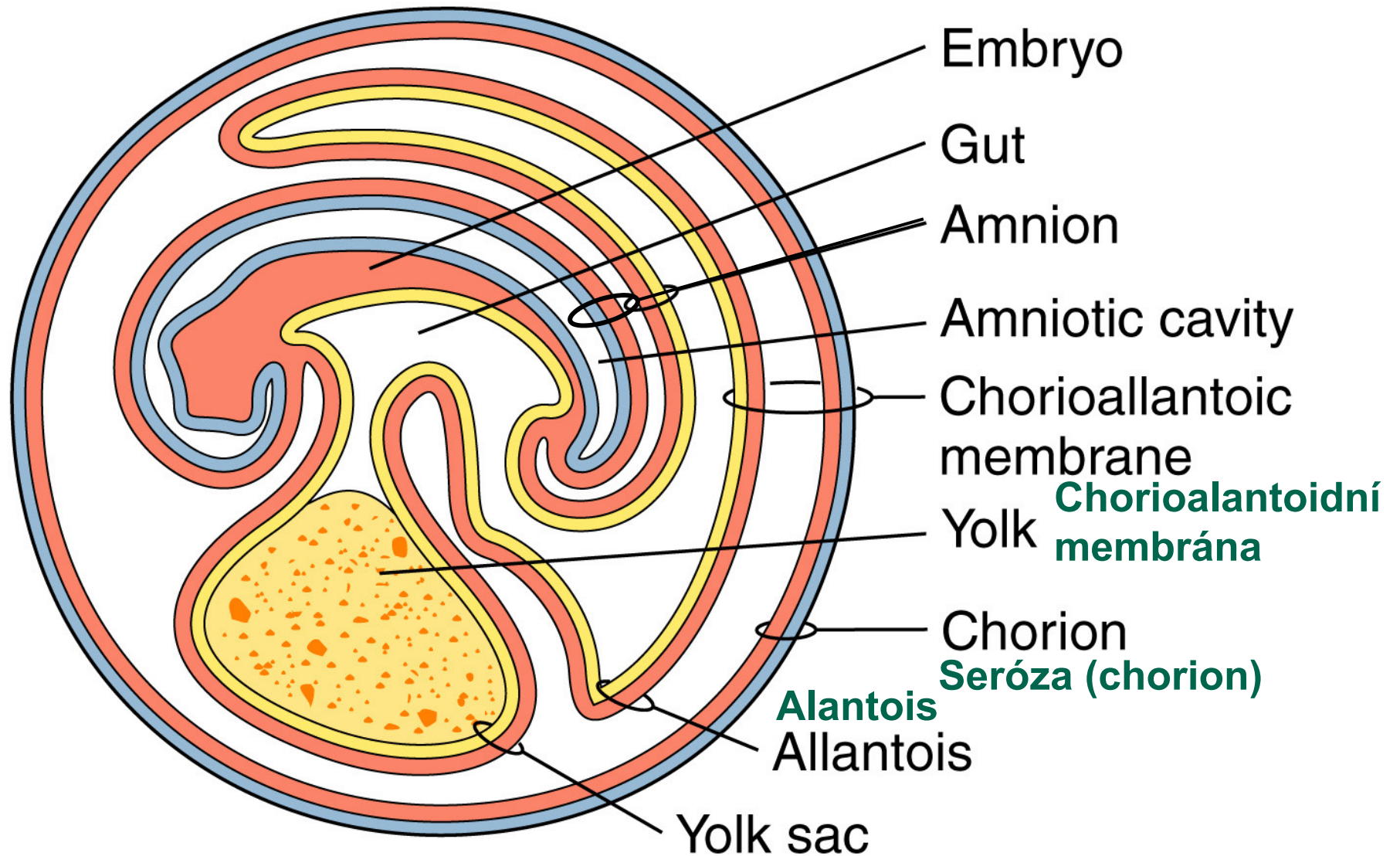
C.



D.



E.



Key Concepts

- First source of **asymmetry originates from the oogenesis** both in *Drosophila* and *Xenopus*.
- In *Xenopus*, another **important source of asymmetry** leading to breaking of the virtual radial symmetry of the egg and **dorsoventral axis specification** is the **sperm entry** that induces **cytoplasm rotation**.
- These processes result into **Speman organizer differentiation** and allow **specification of the cell fate** during **blastula formation**.
- **Gastrulation** allows **further delimitation of the developmental fate**.
- **Amniotes** developed **terrestrial adaptations** that are of **extraembryonic origin**.