Role of microtubules and microfilaments in cell division

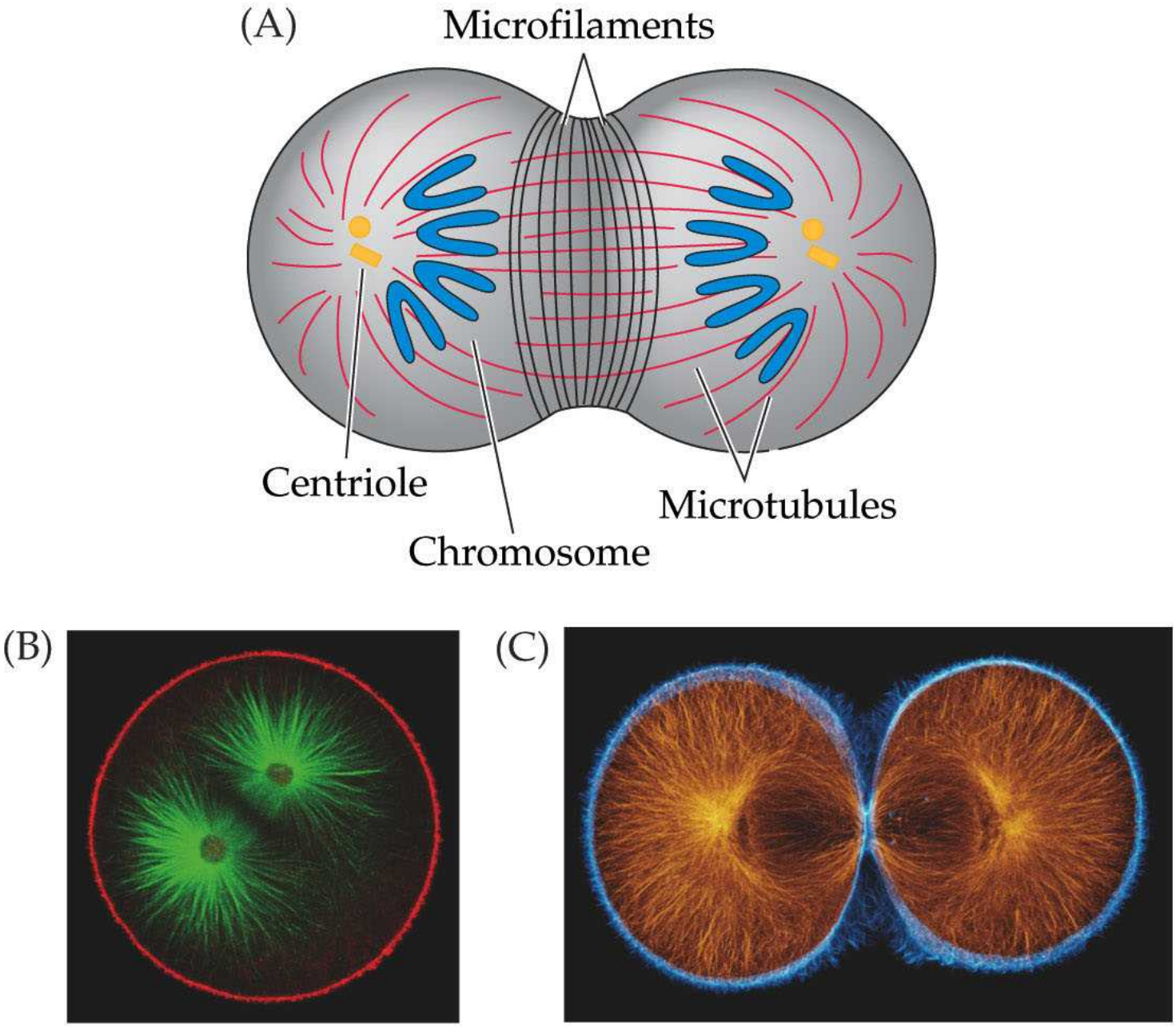

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TABLE 8.1 Karyokinesis and cytokinesis

Process	Mechanical agent	Major protein composition	Location	Major disruptive drug
Karyokinesis	Mitotic spindle	Tubulin microtubules	Central cytoplasm	Colchicine, nocodazole[a]
Cytokinesis	Contractile ring	Actin microfilaments	Cortical cytoplasm	Cytochalasin B

[a]Because colchicine has been found to independently inhibit several membrane functions, including osmoregulation and the transport of ions and nucleosides, nocodazole has become the major drug used to inhibit microtubule-mediated processes (see Hardin 1987).

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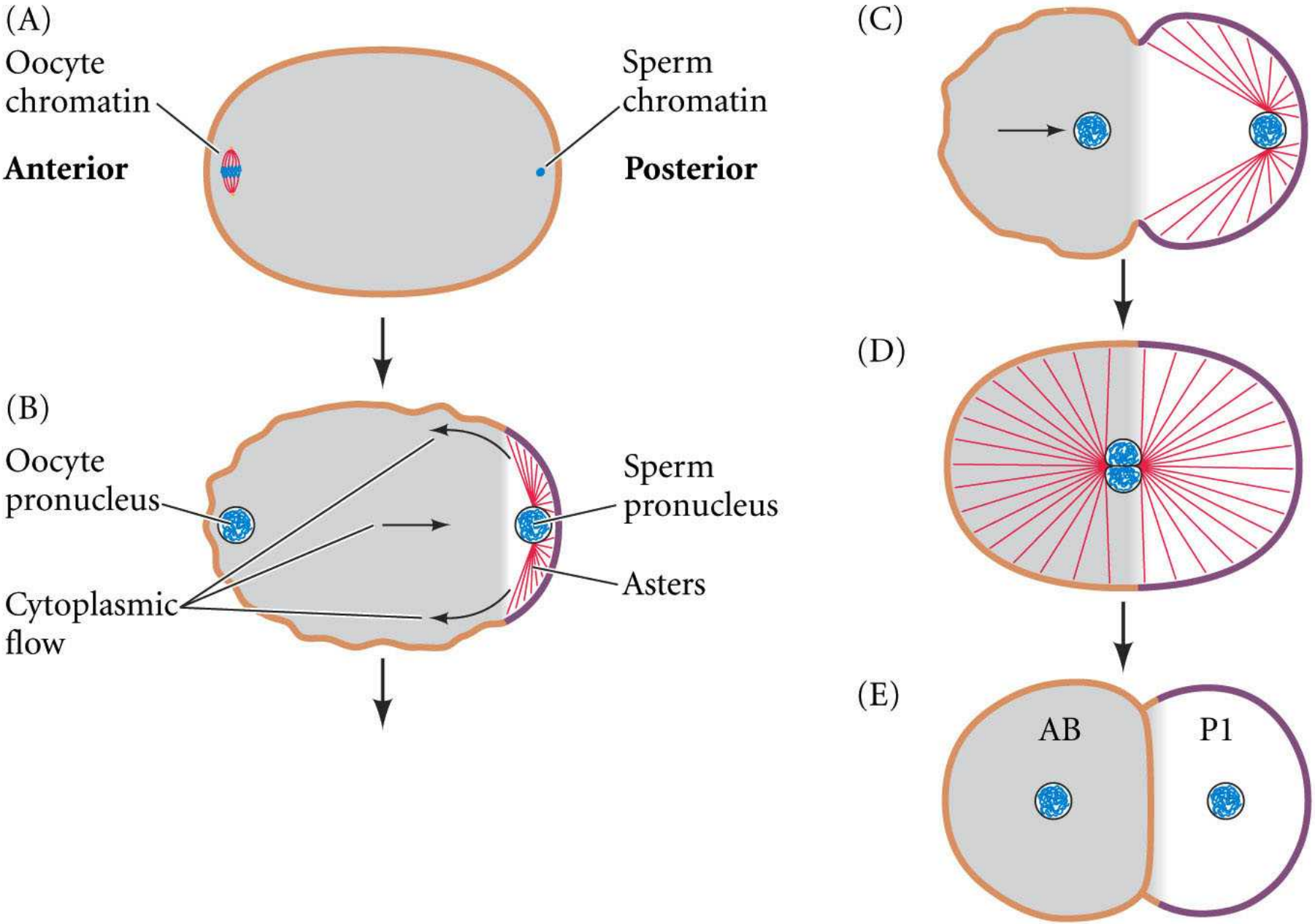
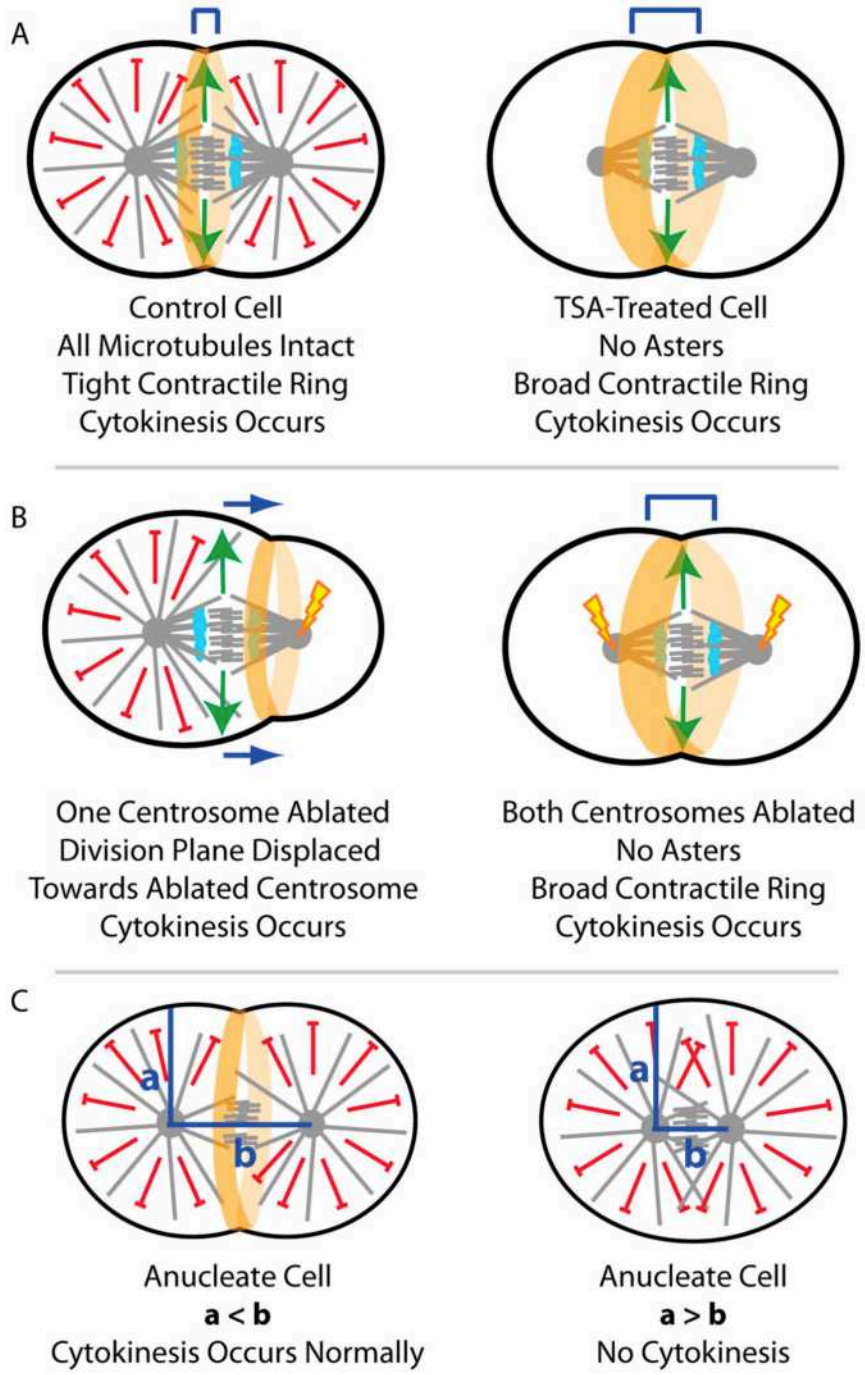
PAR proteins and the establishment of polarity

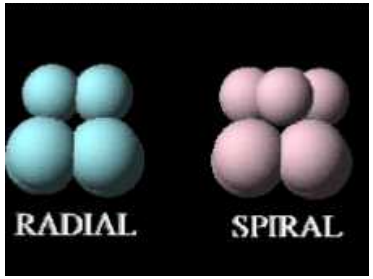


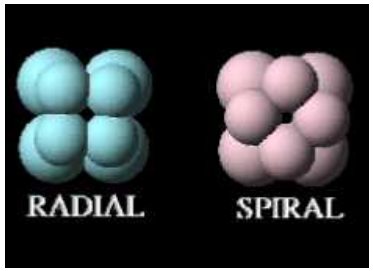
Examinando los planos de divisão (citoquinese) e su relacão com os microtúbulos

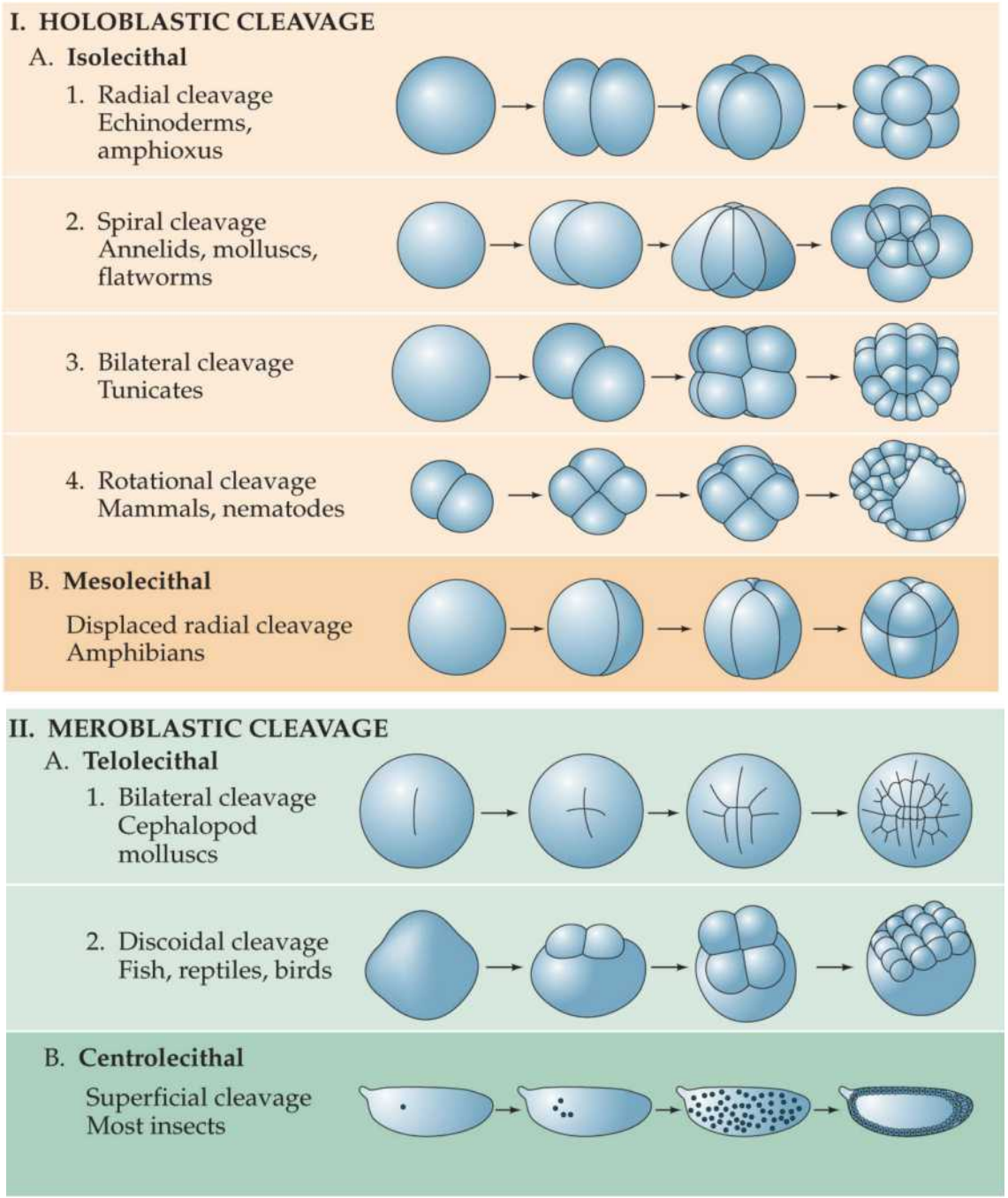


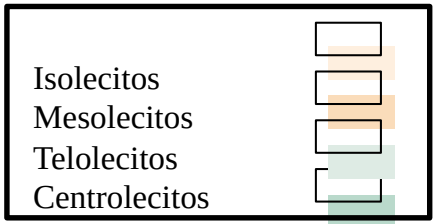
Canman 2009 acerca de von Dassow 2009

Embryological patterns of early development:

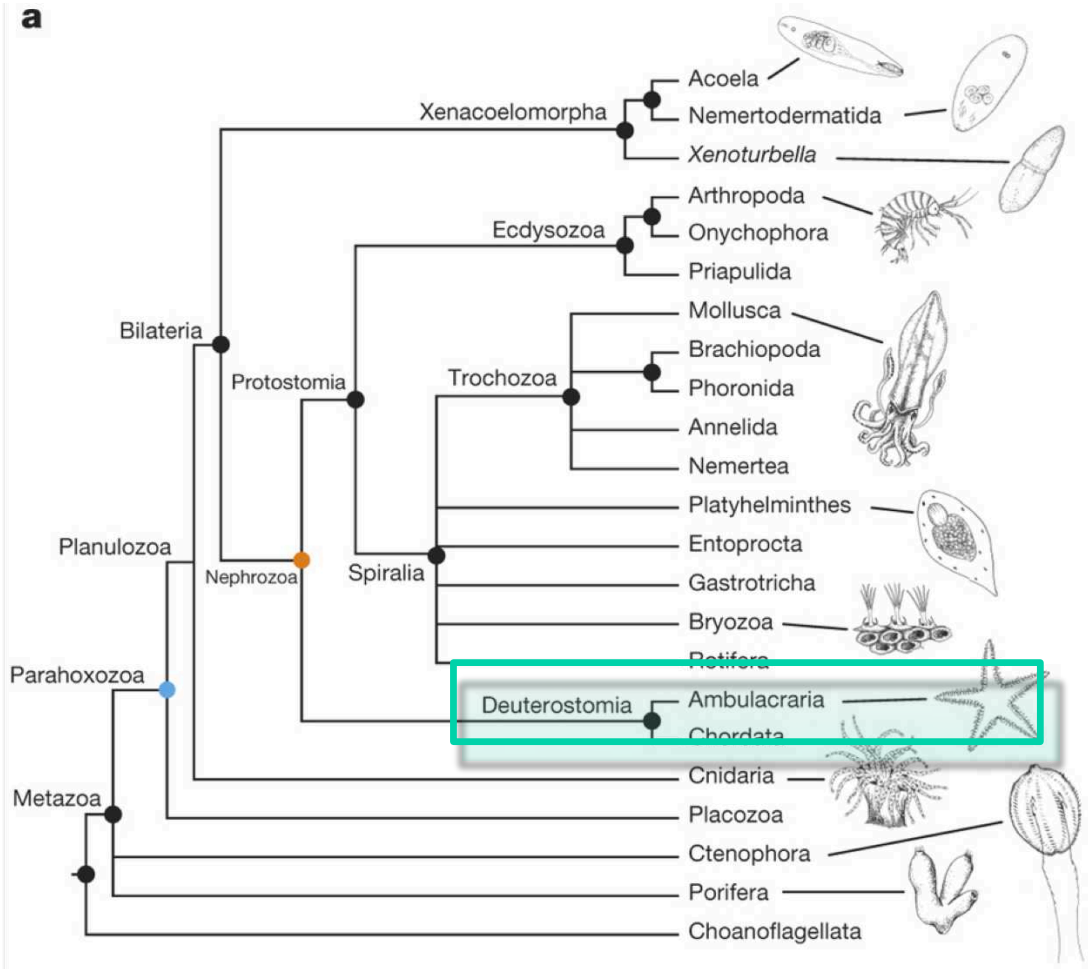




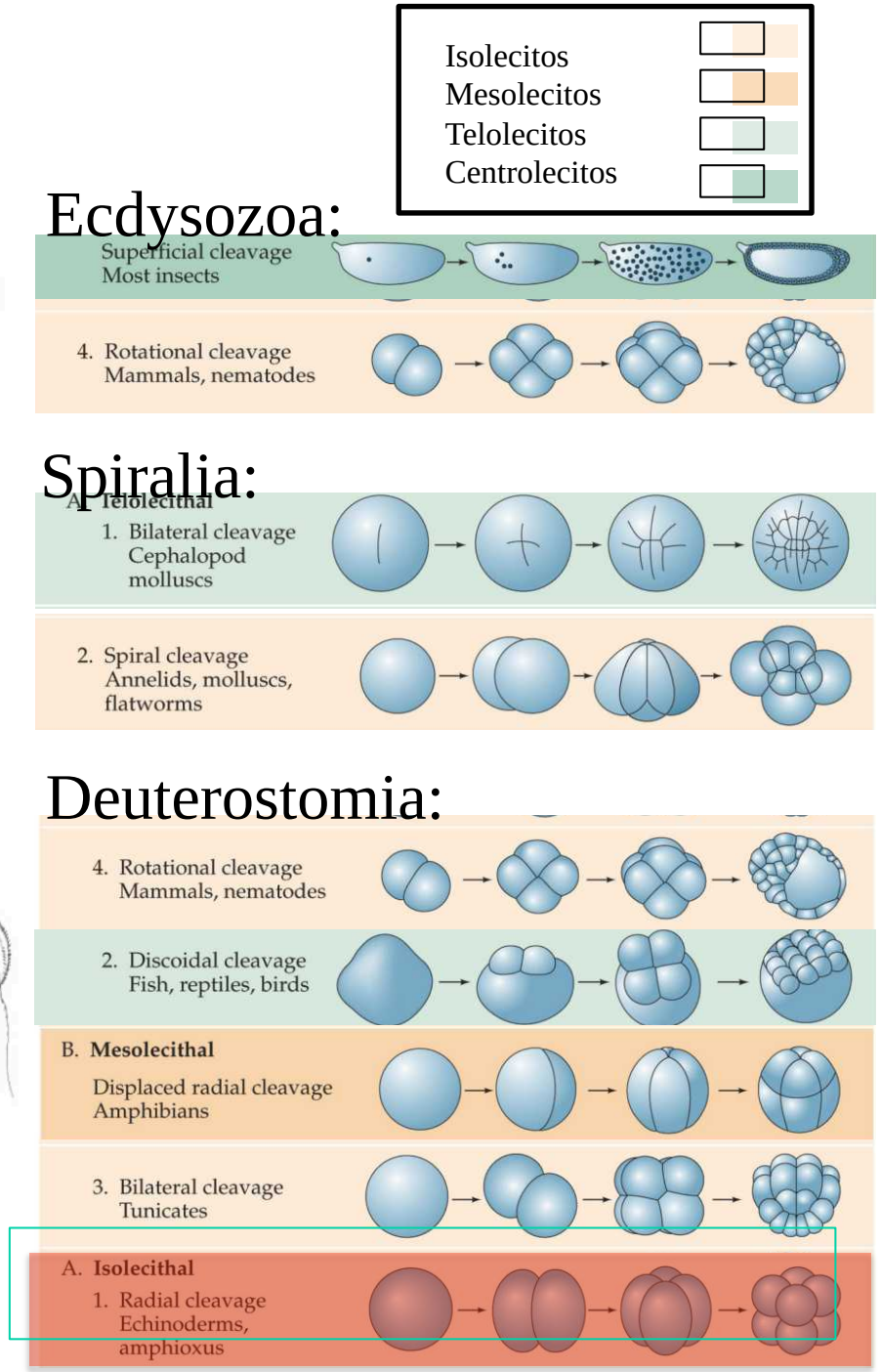




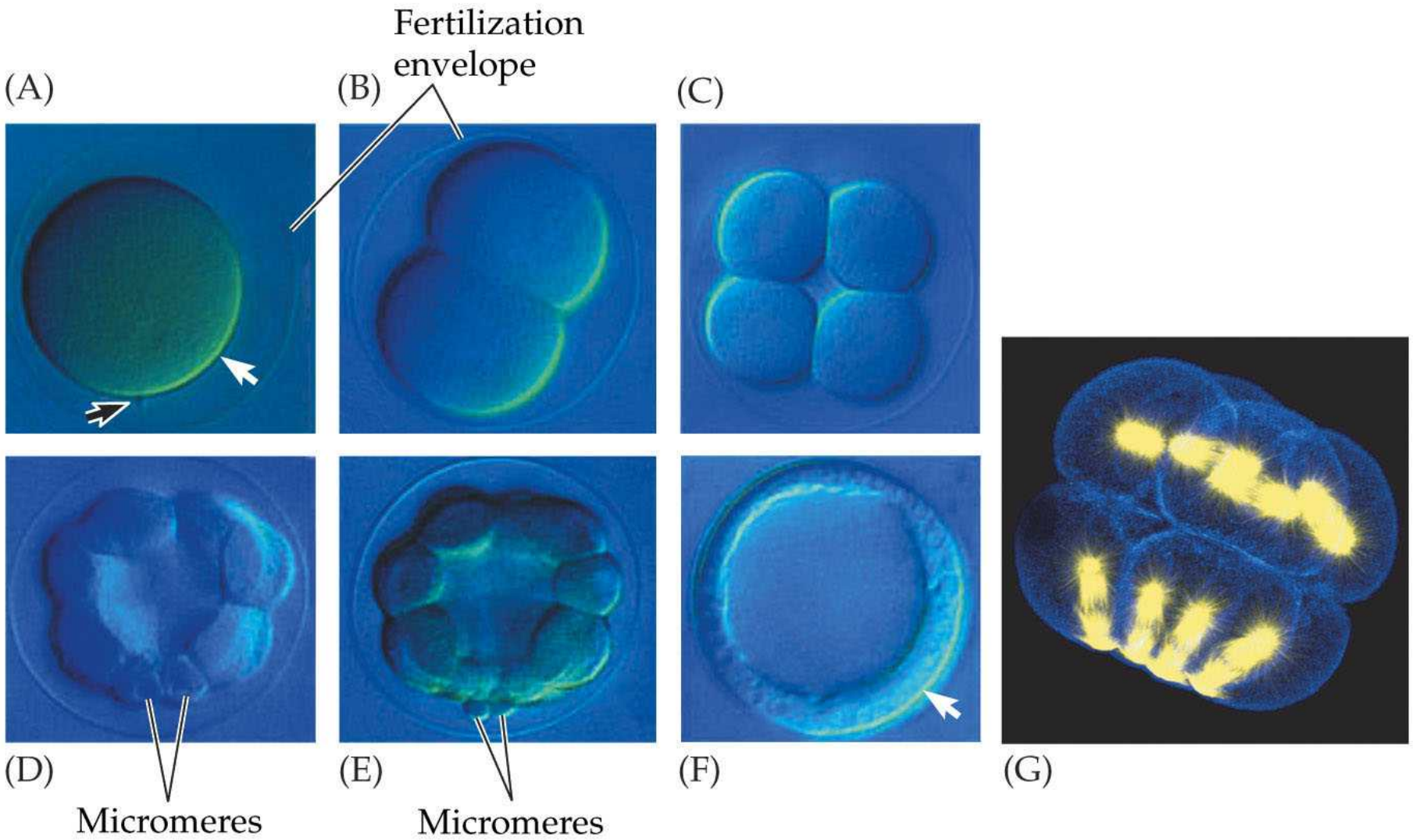
Pattern of development in the Metazoans:



Cannon et al. 2016



8.7 Cleavage in live embryos of the sea urchin *Lytechinus variegatus*, seen from the side



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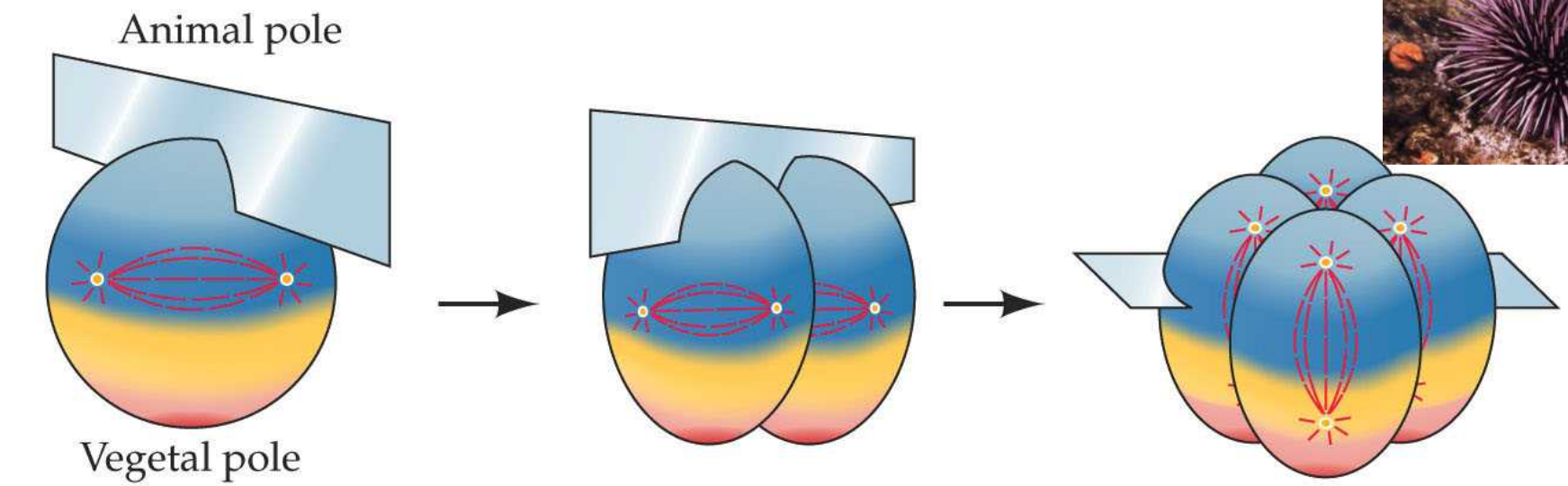
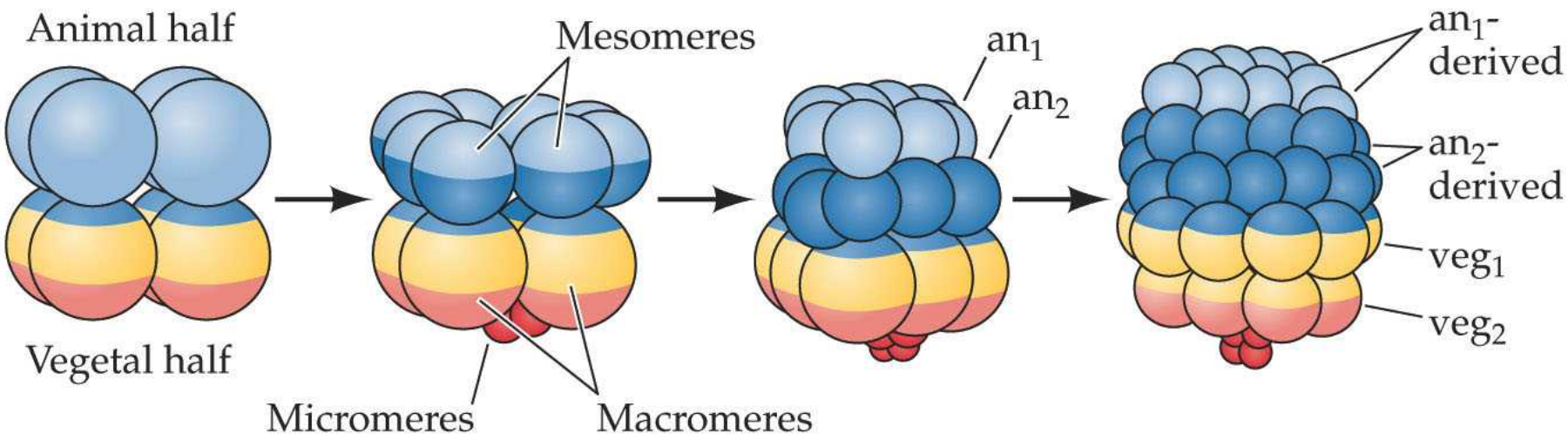
8.6 Cleavage in the sea urchin





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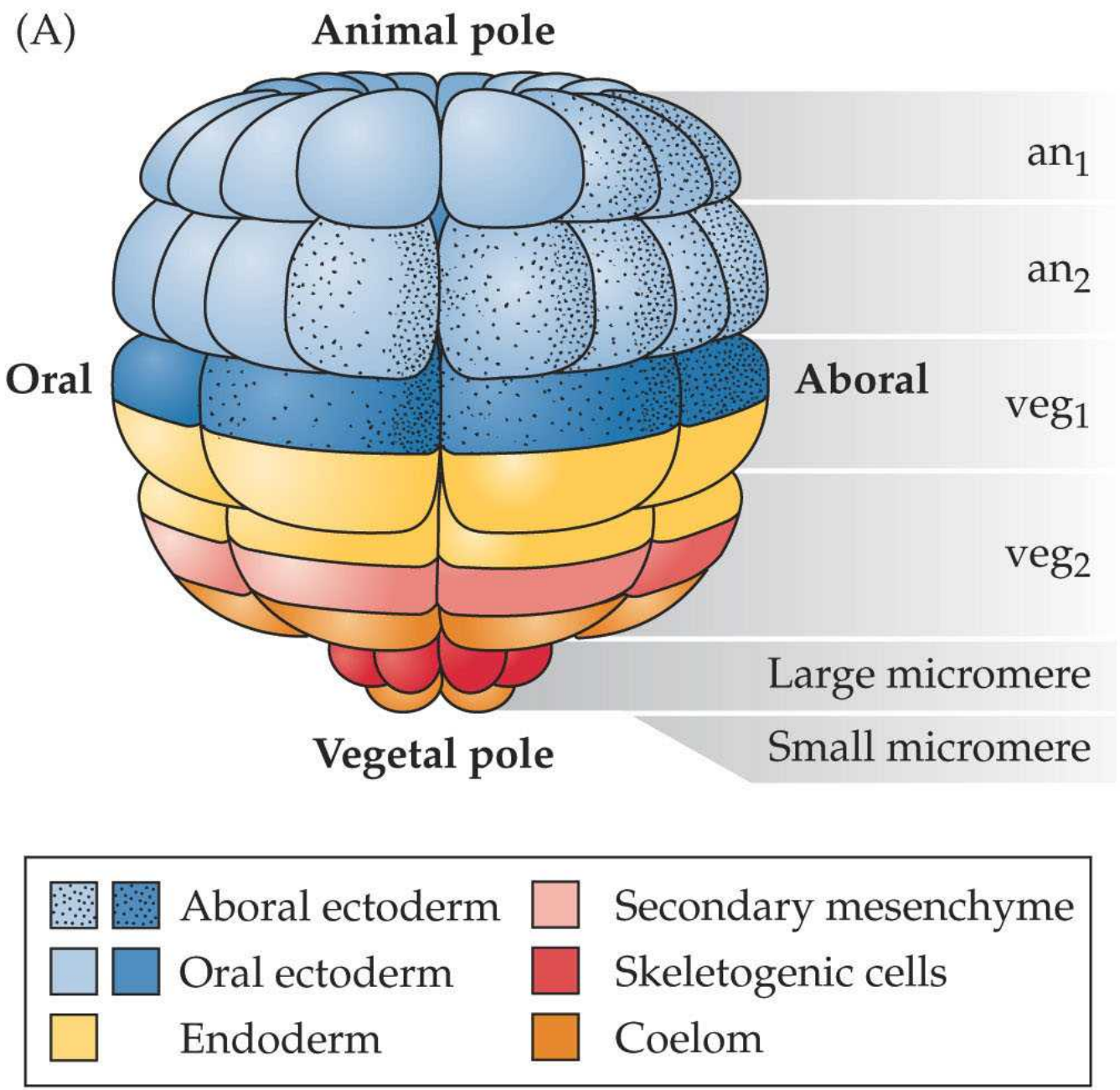
8.8 Fate map and cell lineage of the sea urchin *Strongylocentrotus purpuratus* (Part 1)



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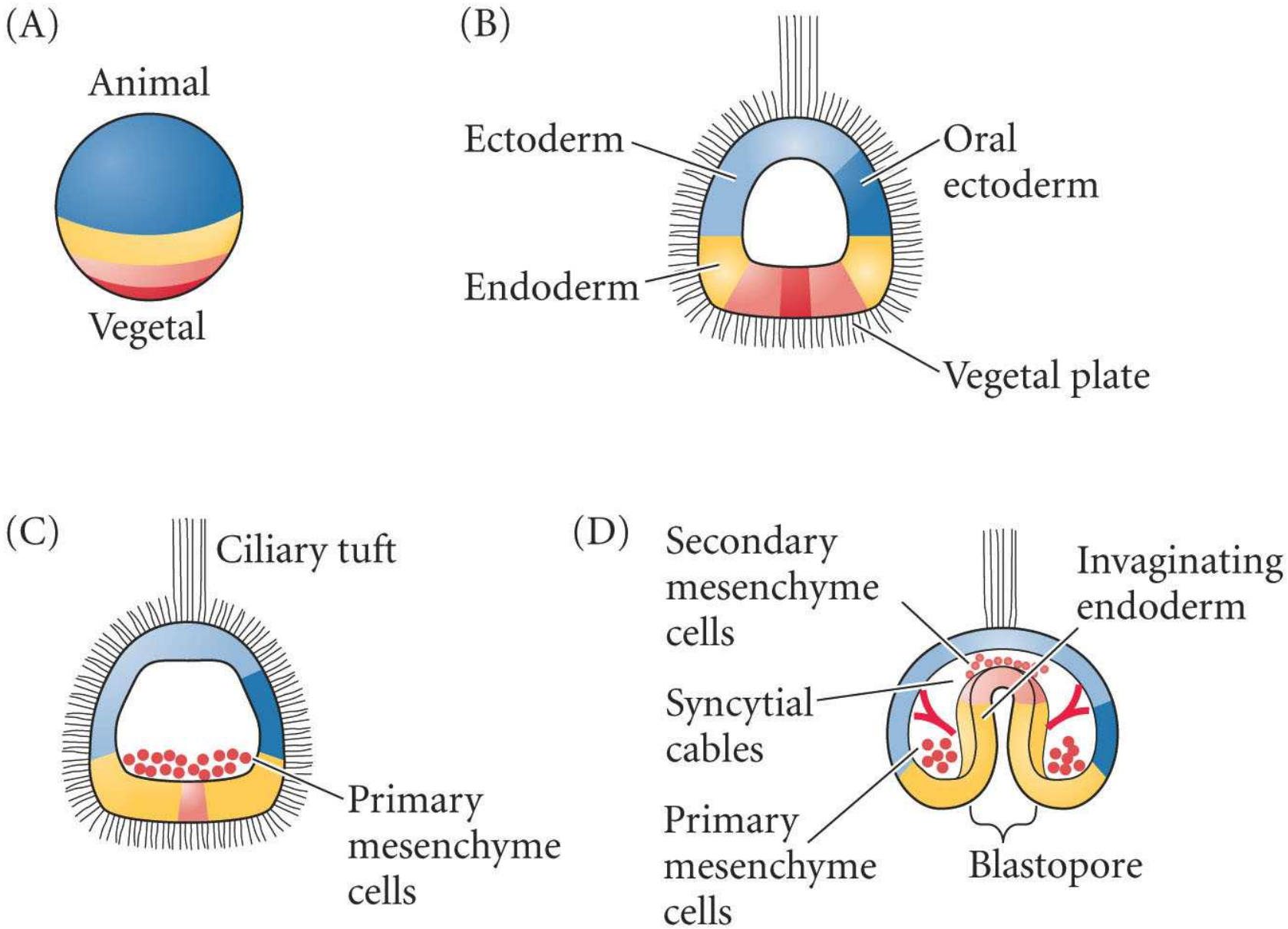
Normal sea urchin development, following the fate of the cellular layers of the blastula



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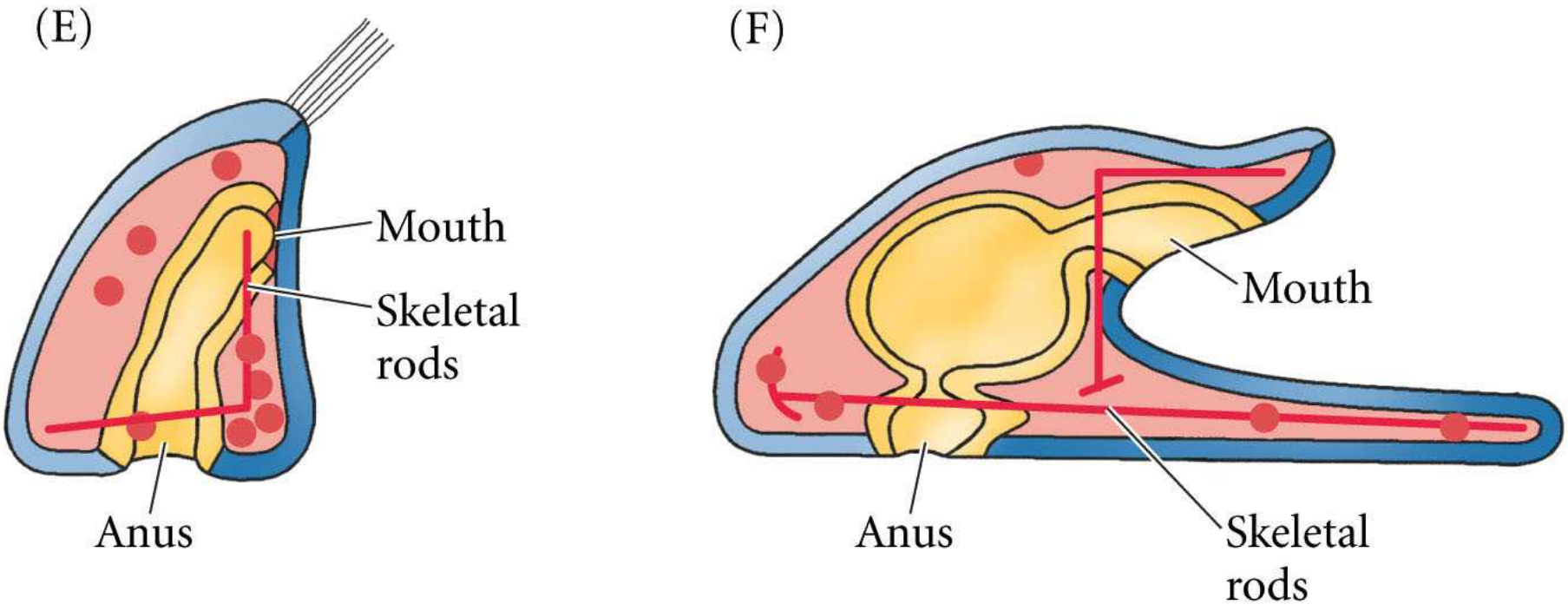
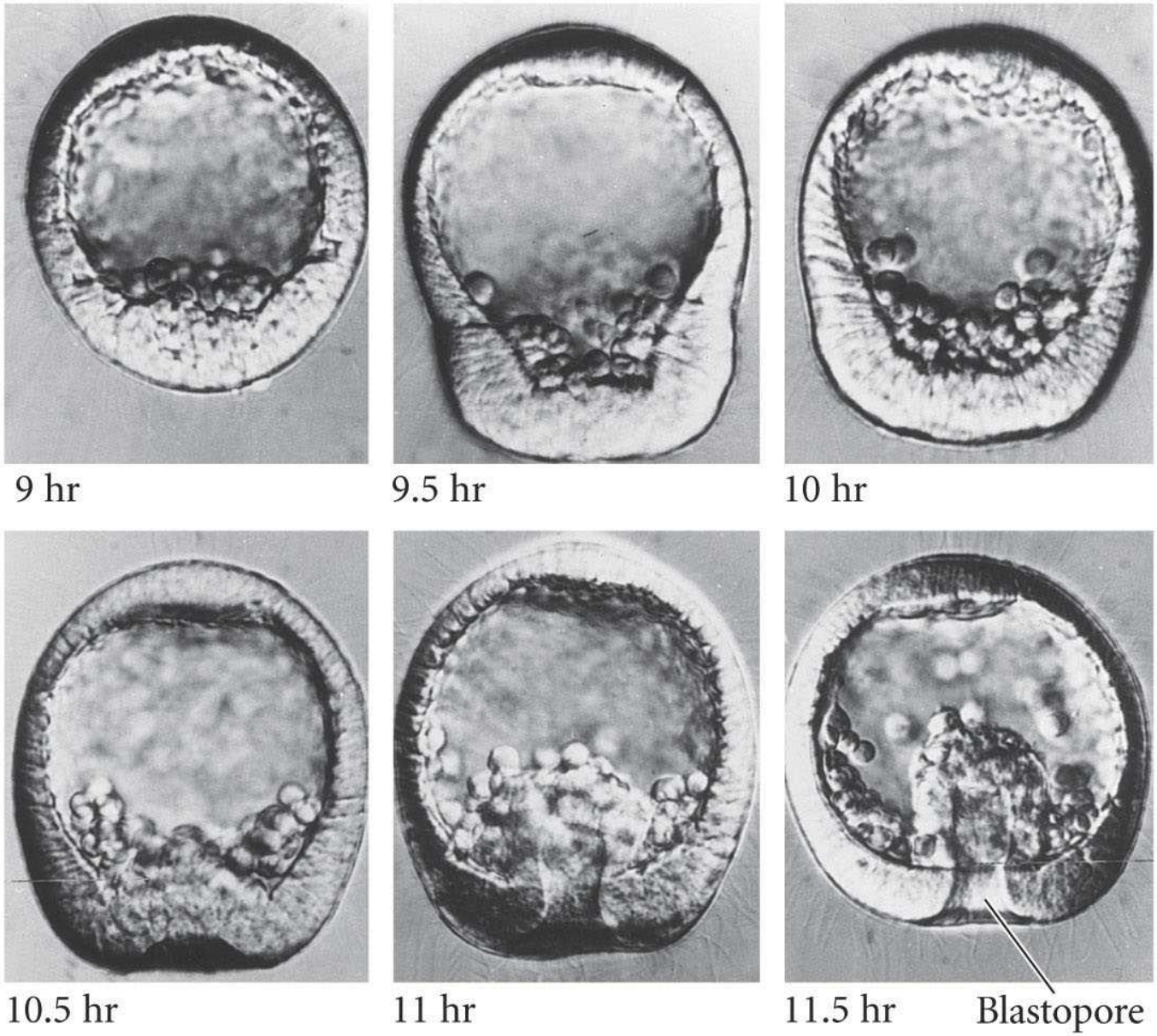
Normal sea urchin development, following the fate of the cellular layers of the blastula

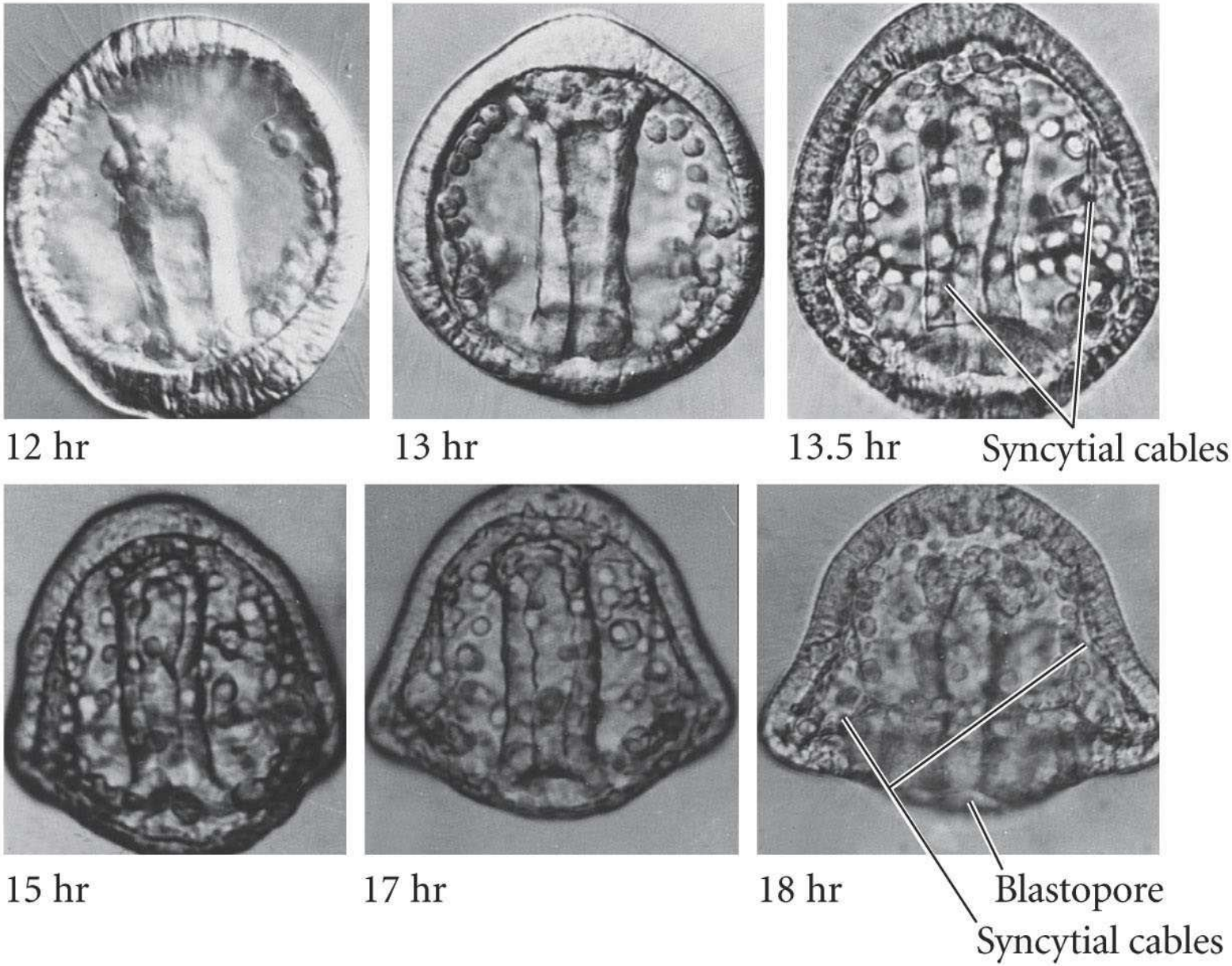


Entire sequence of gastrulation in *Lytechinus variegatus*



DEVELOPMENTAL BIOLOGY, Eighth Edition, Figure 8.15 (Part 1) © 2006 Sinauer Associates, Inc.

Entire sequence of gastrulation in *Lytechinus variegatus*



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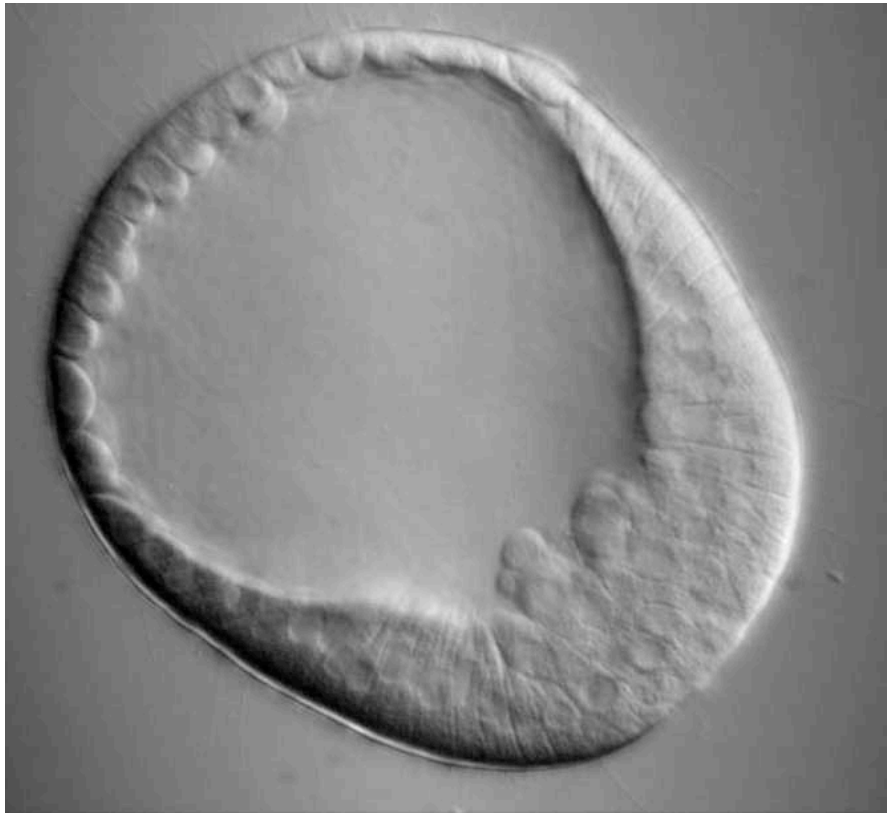
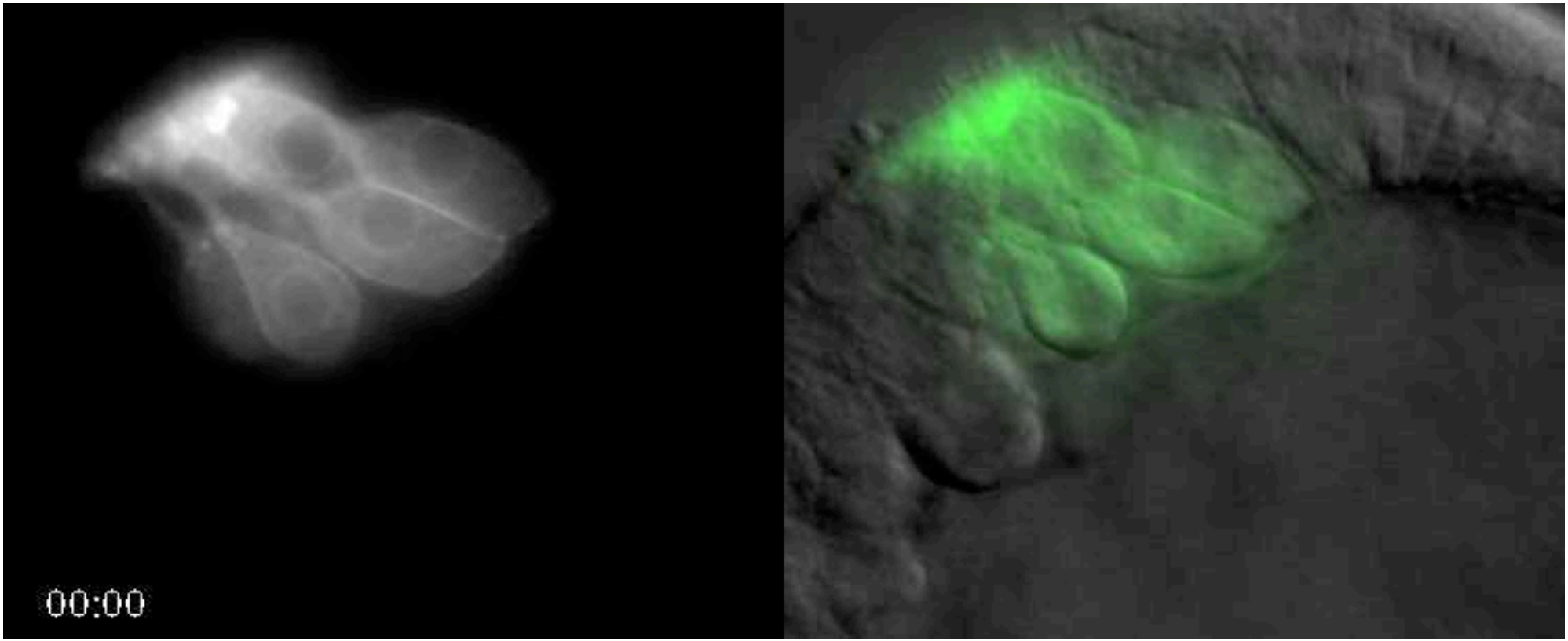
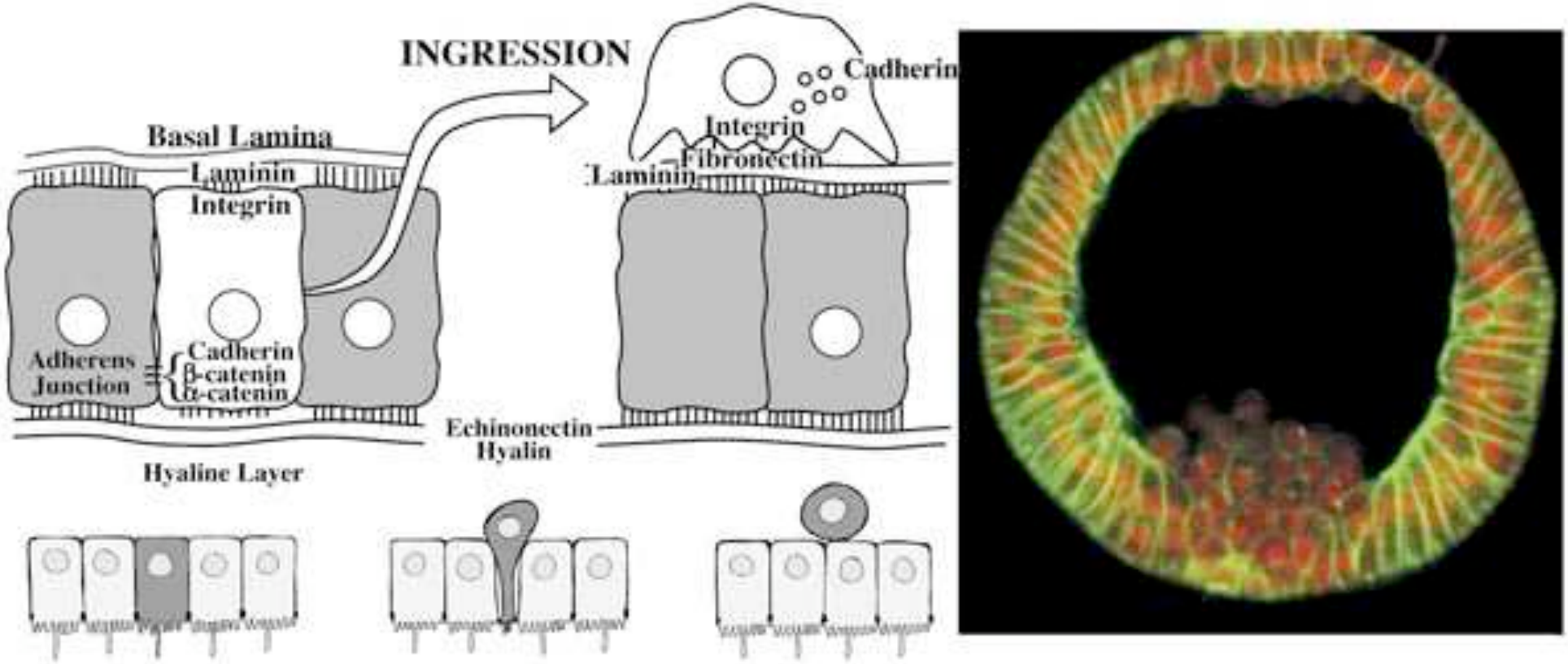
Urchin gastrulationm McClay et al.



Urchin gastrulation McClay et al.



Urchin gastrulation McClay et al.



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From *Gastrulation: From Cells to Embryo*
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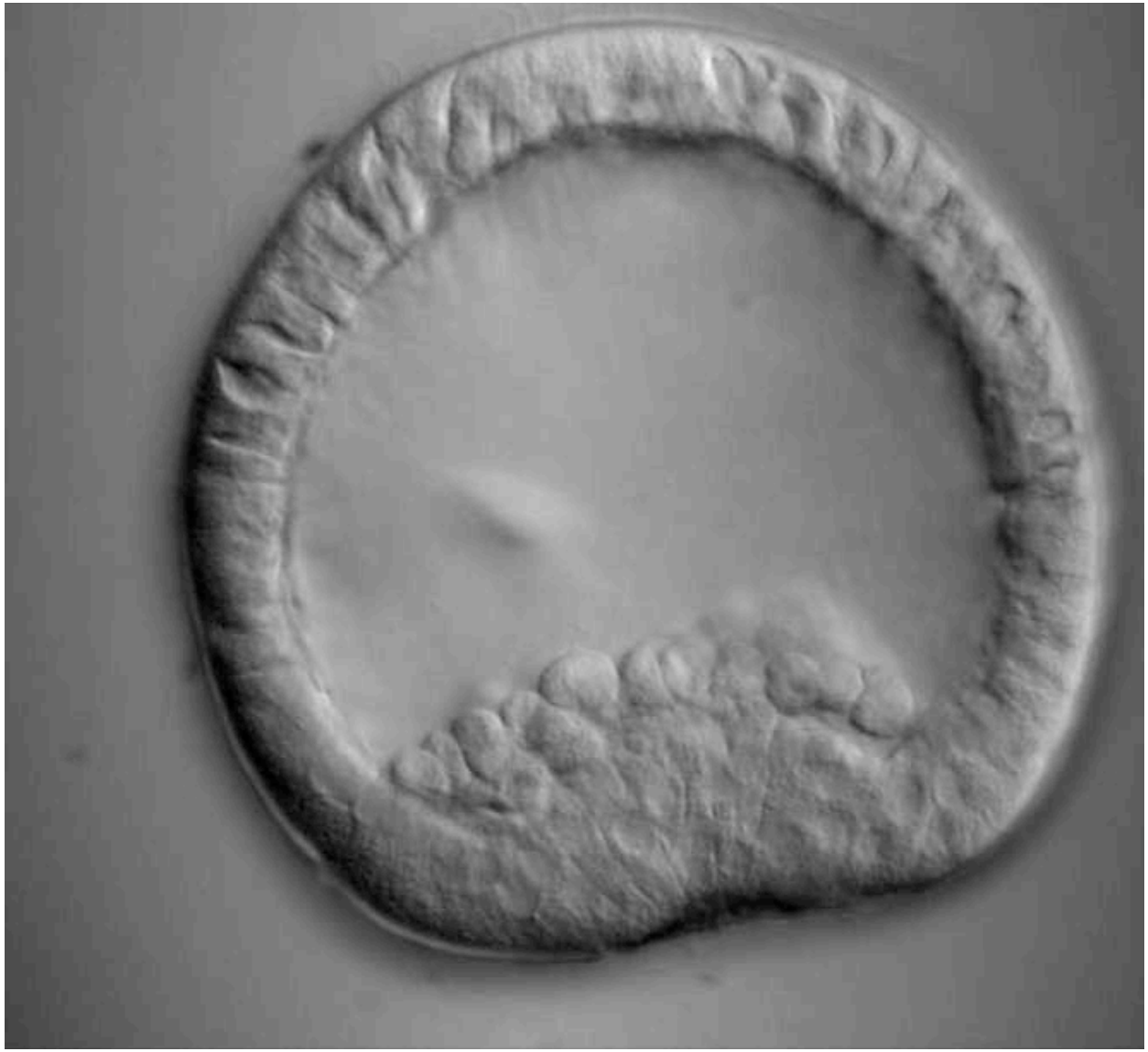
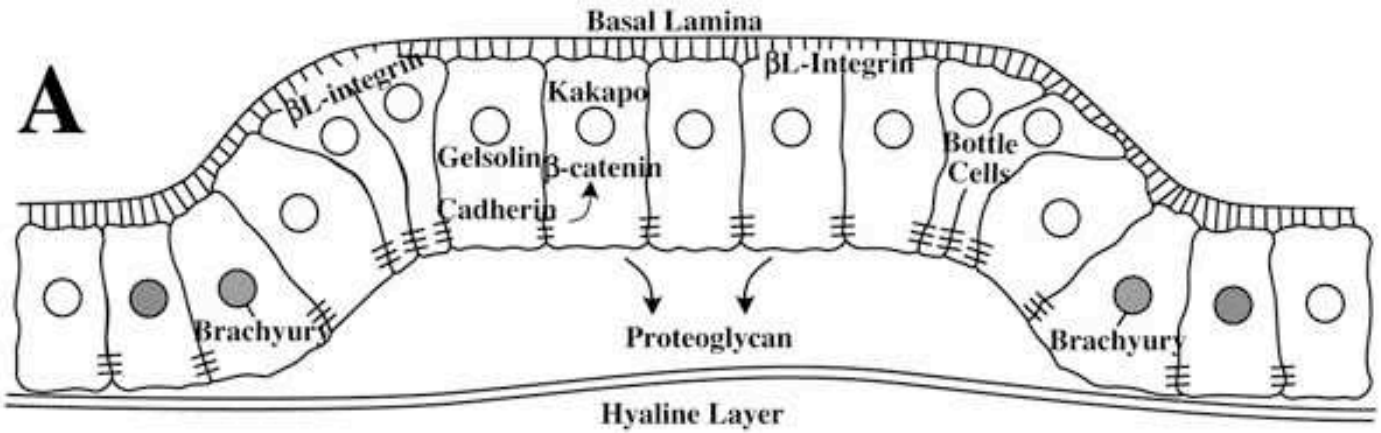
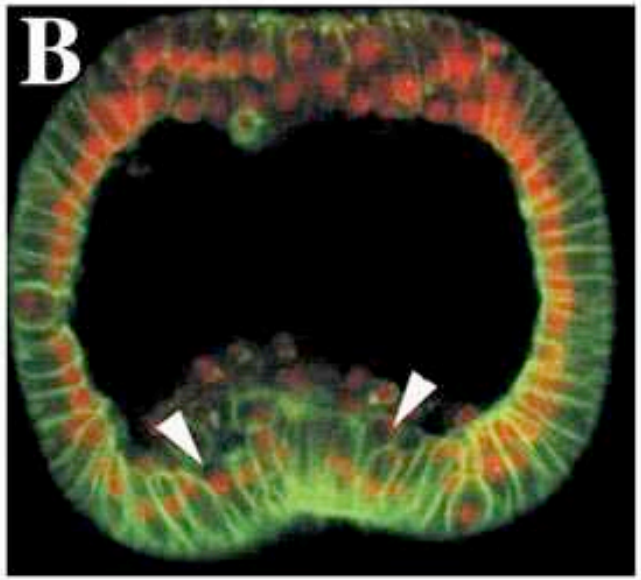
Chapter 9, Figure 3

Urchin gastrulation McClay et al.



Urchin gastrulation McClay et al.





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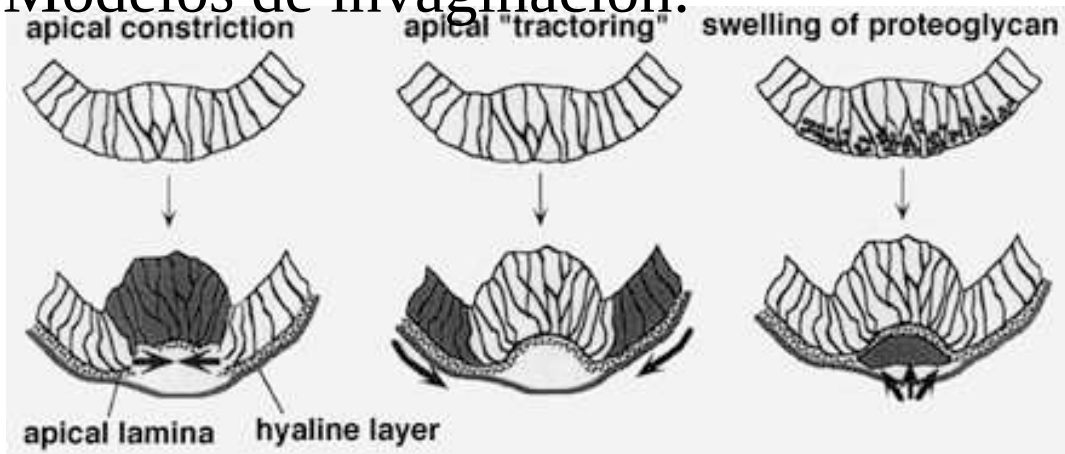

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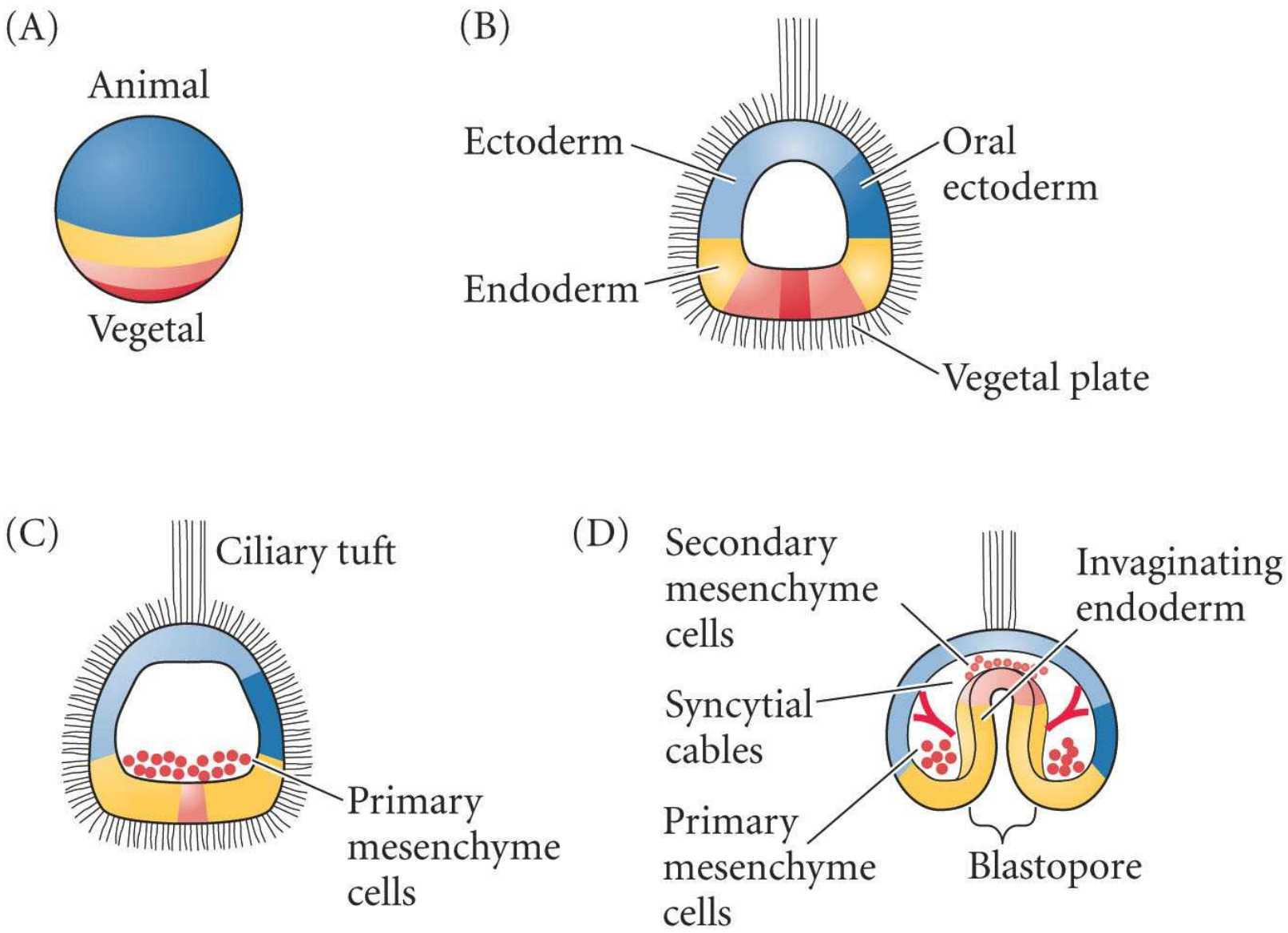
Urchin gastrulation



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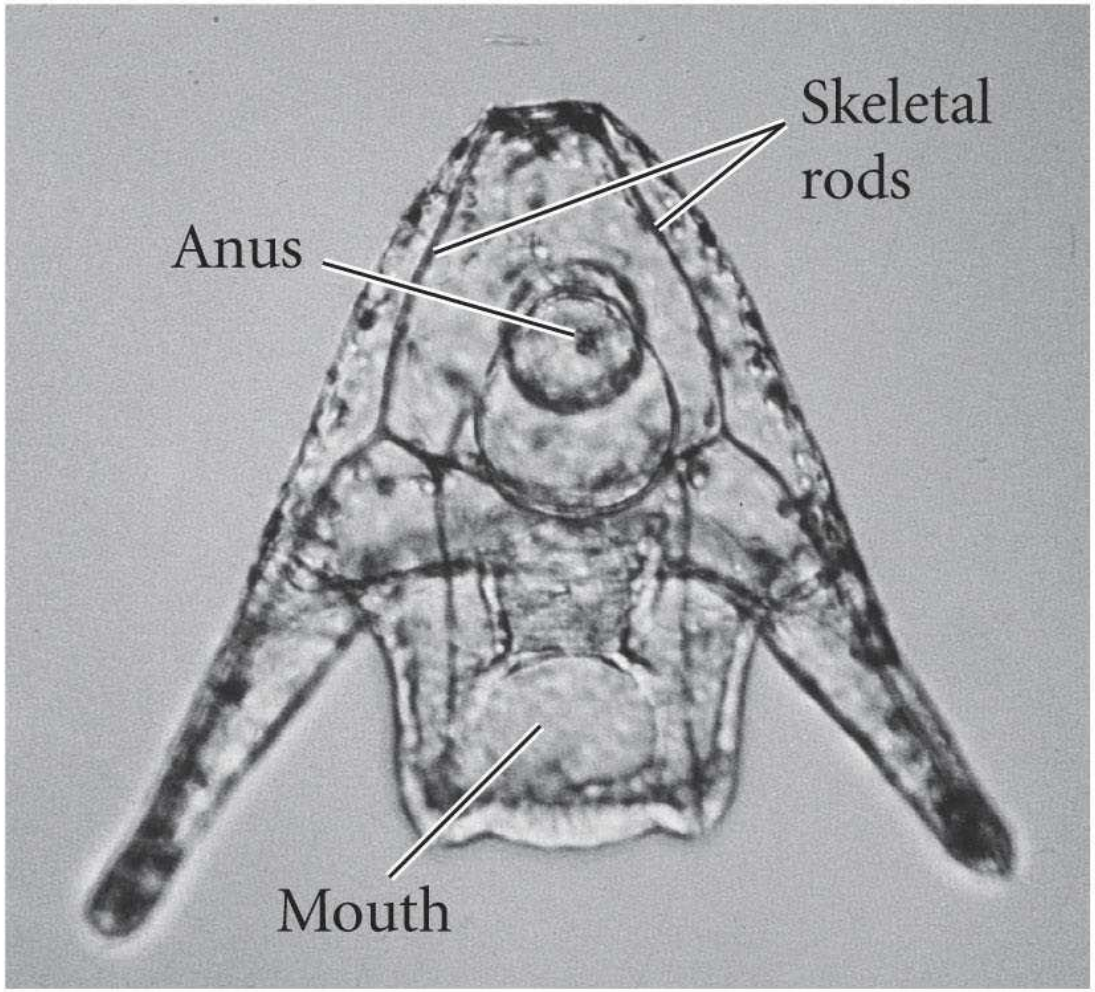
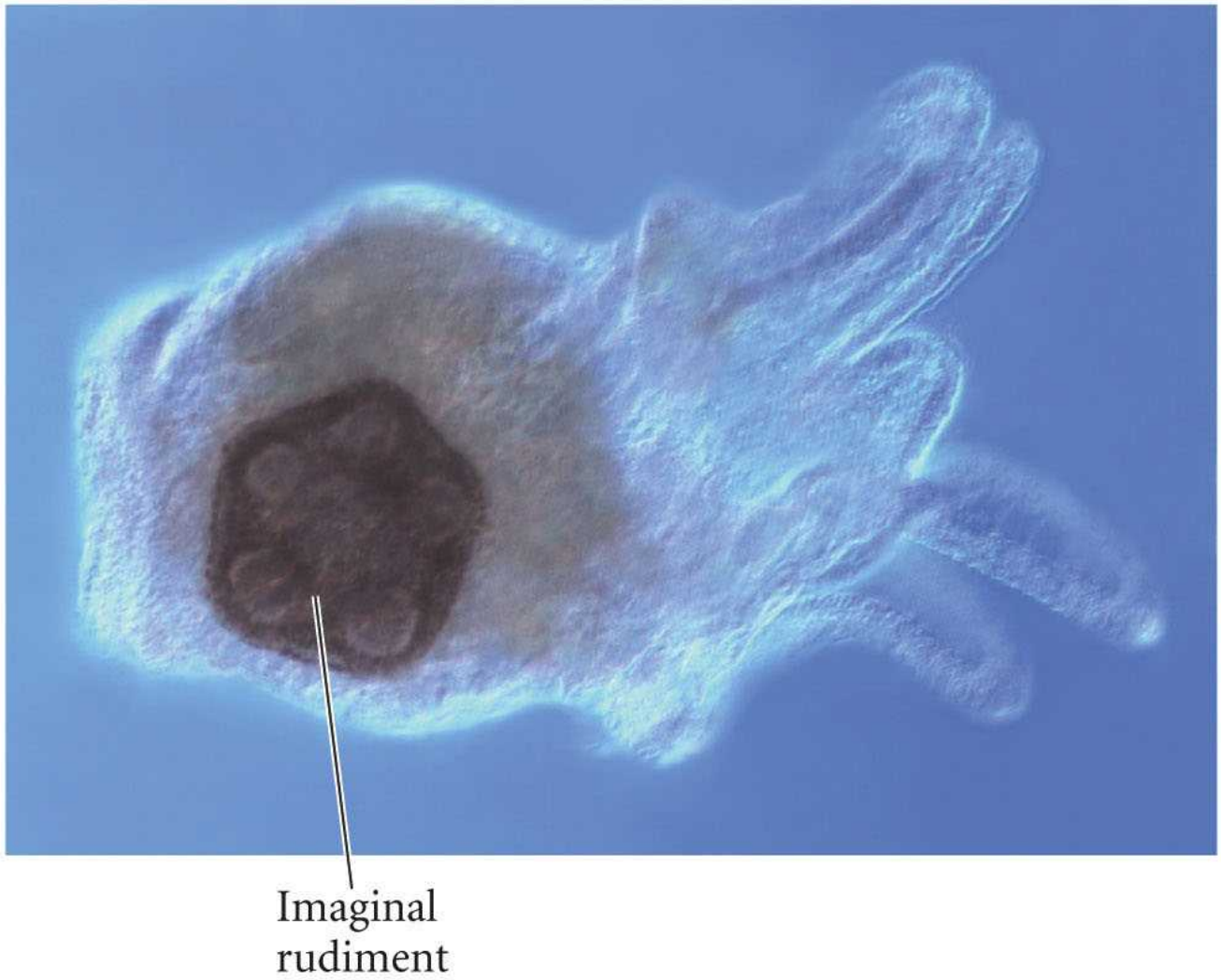
Entire sequence of gastrulation in *Lytechinus variegatus*

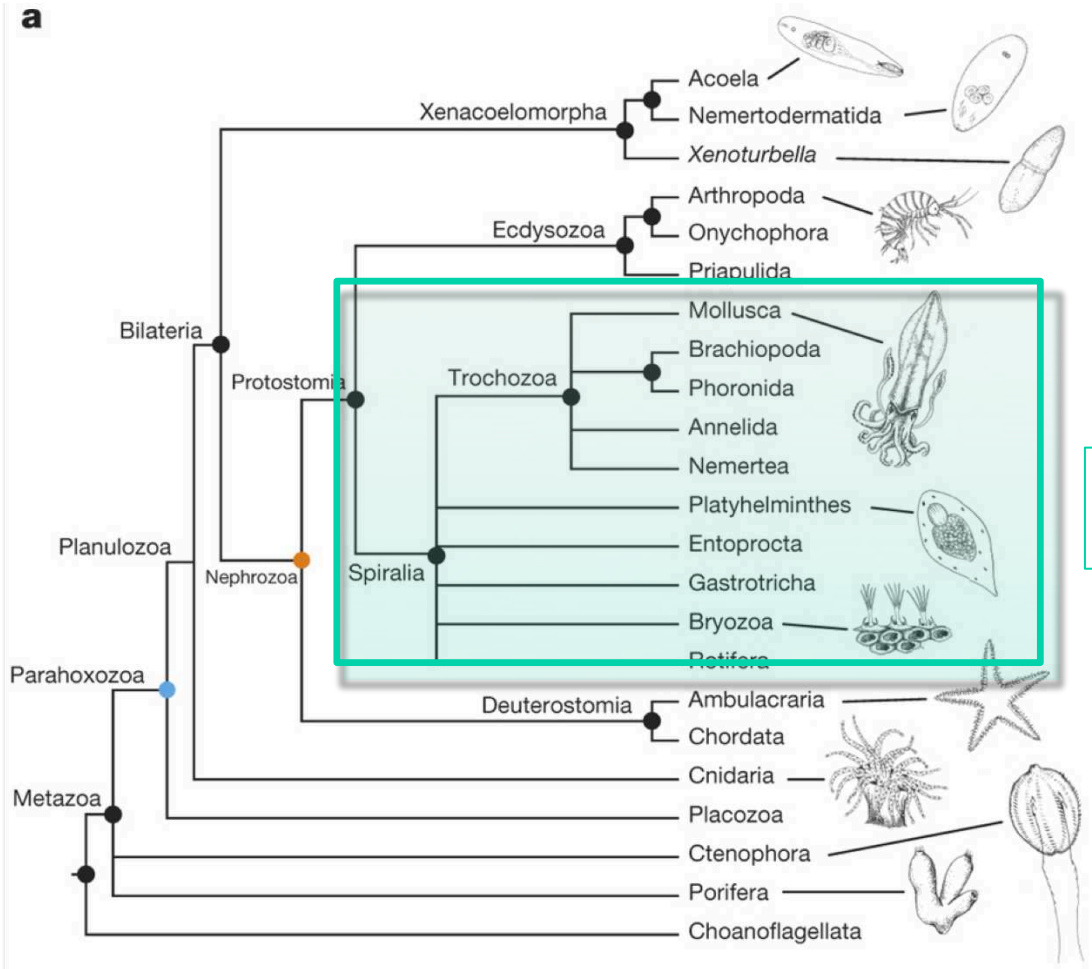


24 hr

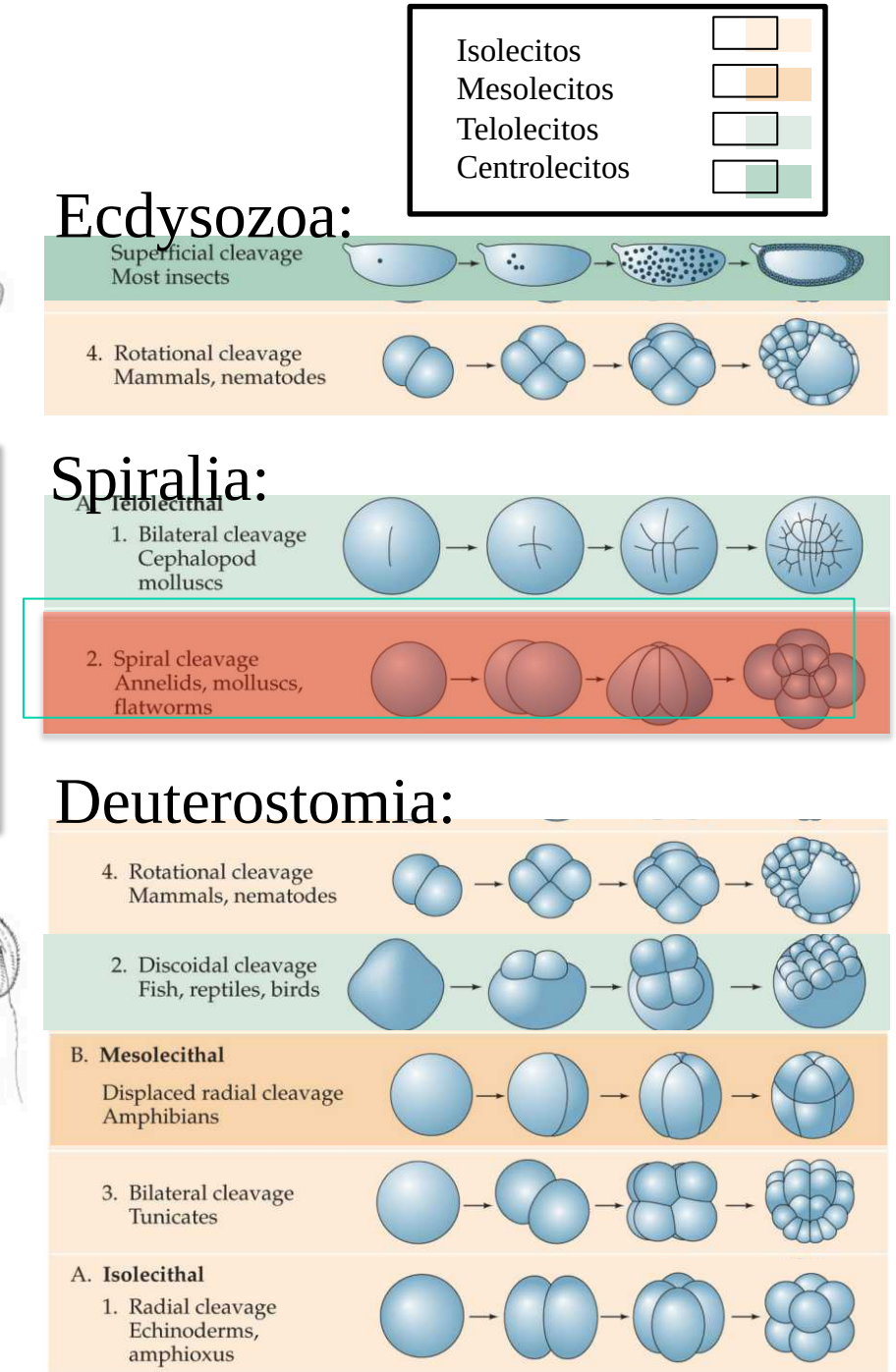
The imaginal rudiment growing in the left side of the pluteus larva of a sea urchin



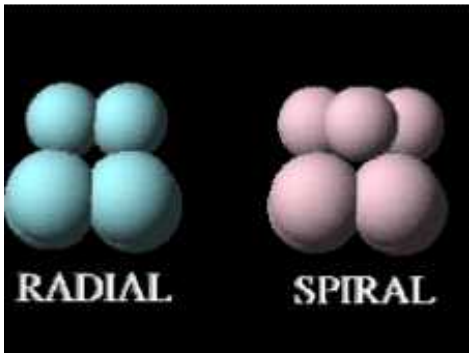
Pattern of development in the Metazoans:

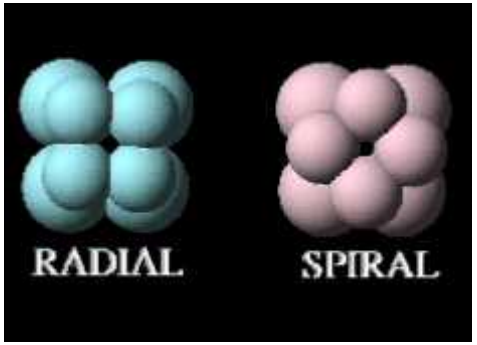


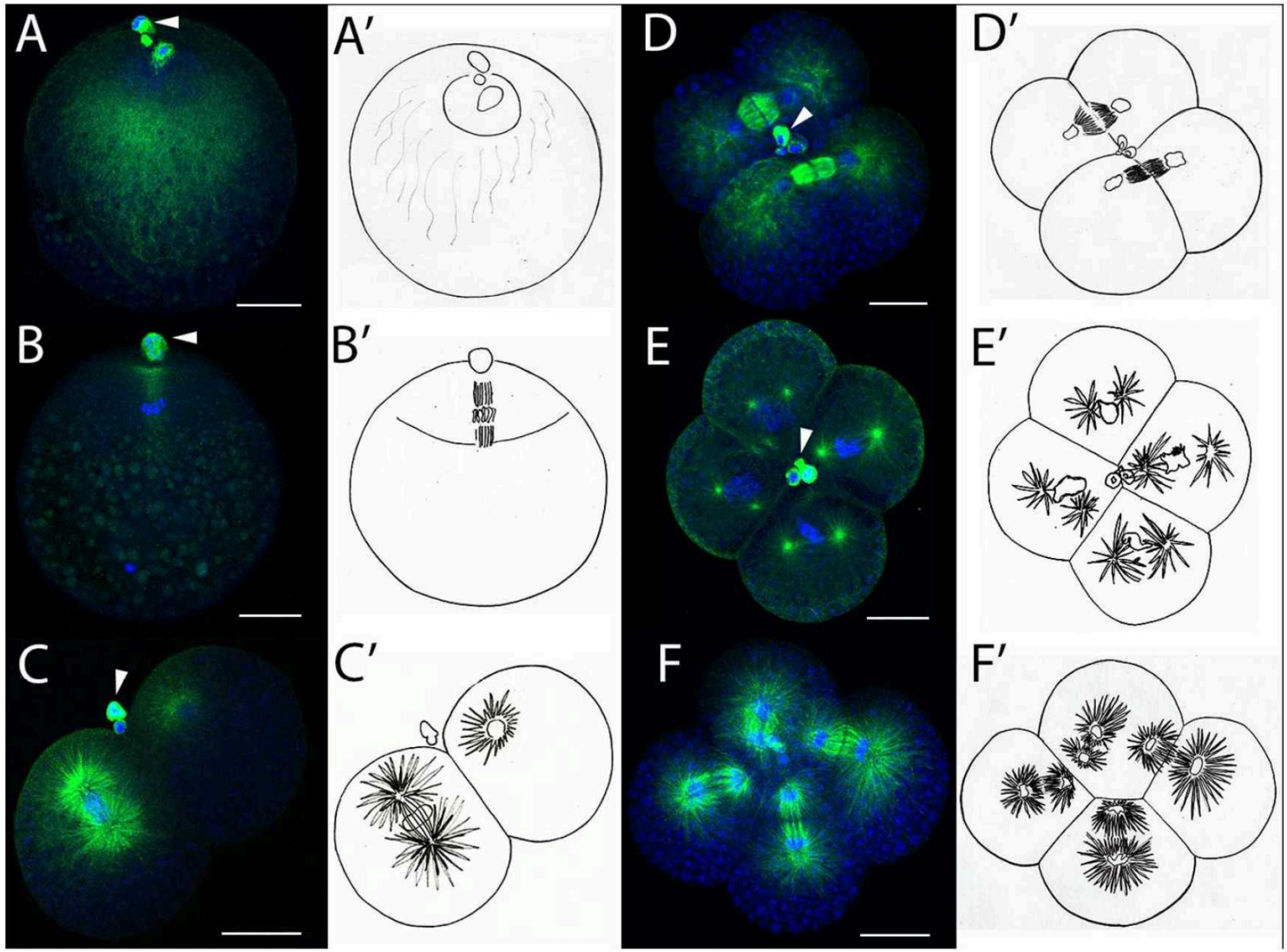
Cannon et al. 2016



Spiral cleavage in molluscs



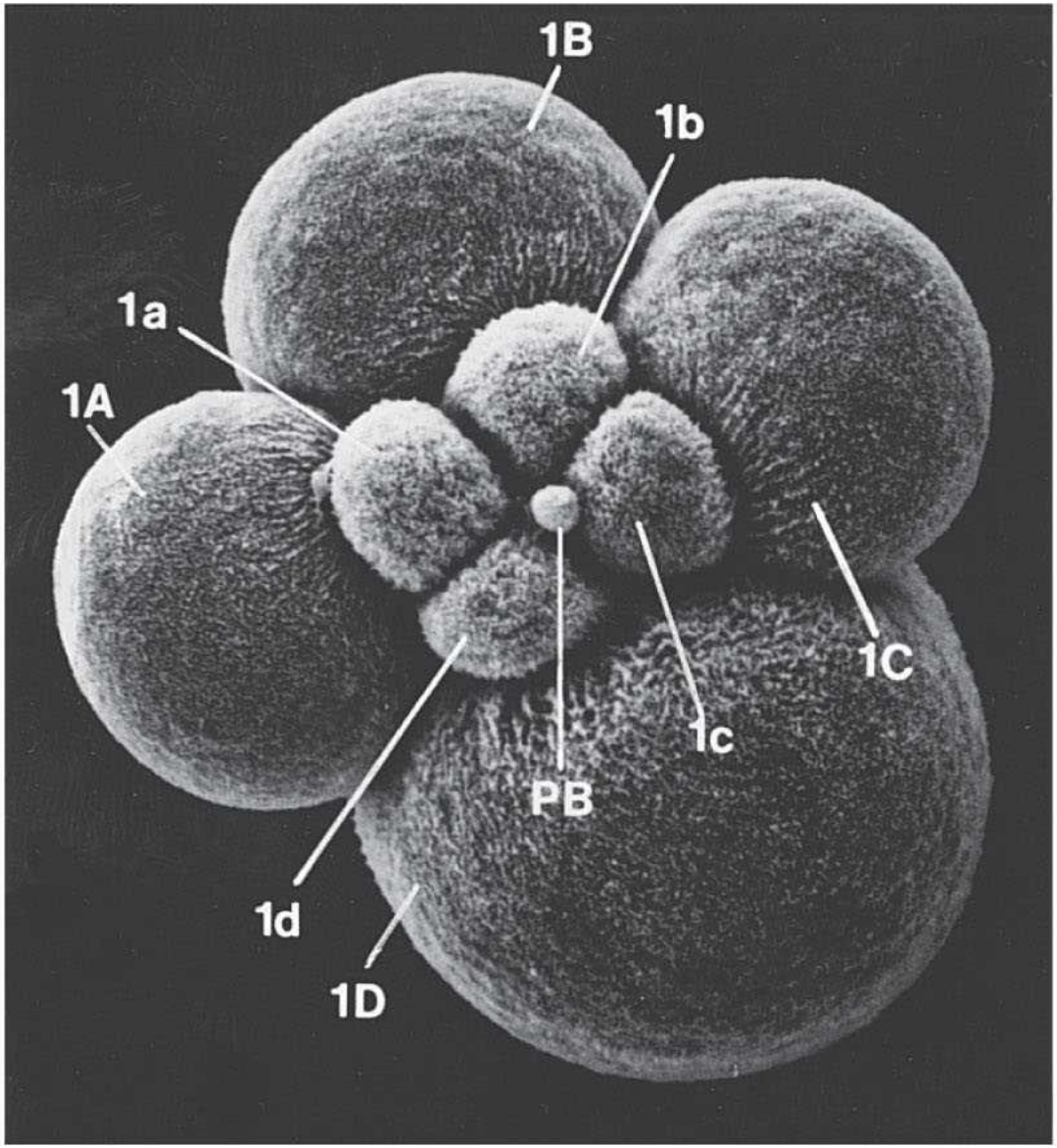




Opistobranch *Navanax enigmaticus* (Chavez et al. 2017)

8.24 Spiral cleavage in molluscs (Part 2)

(B)



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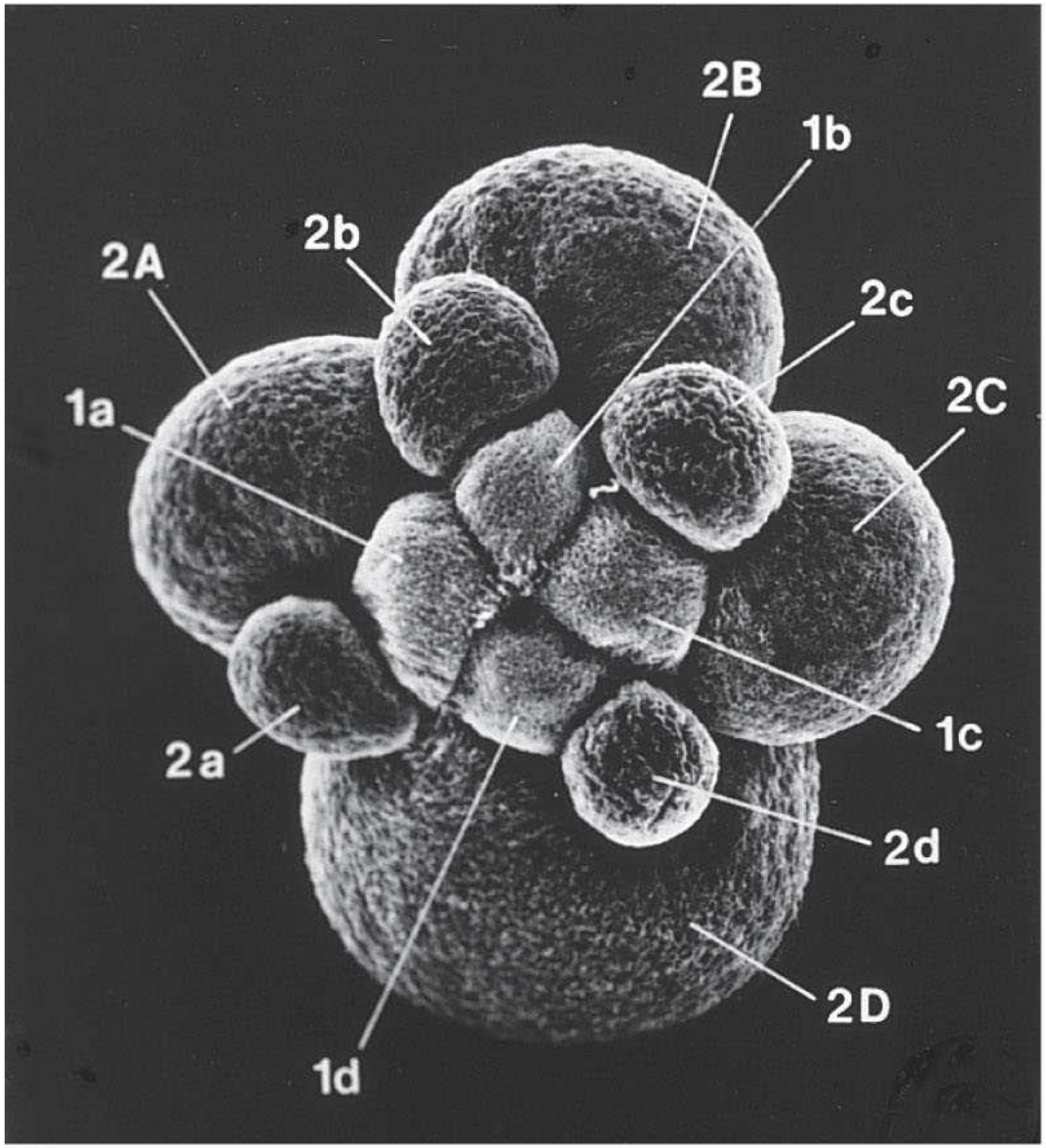
8.24 Spiral cleavage in molluscs (Part 3)

(C)



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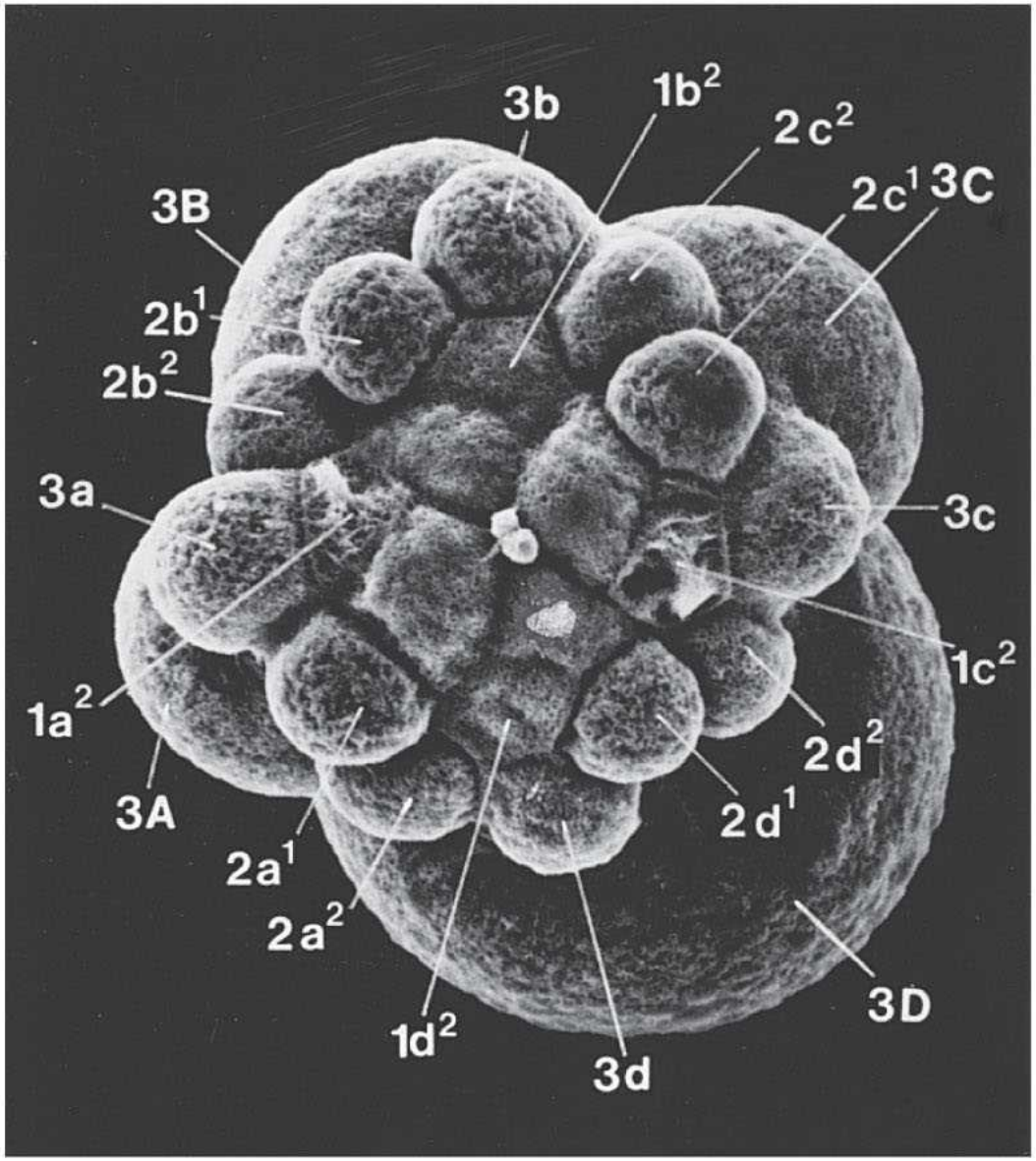
8.24 Spiral cleavage in molluscs (Part 4)

(D)



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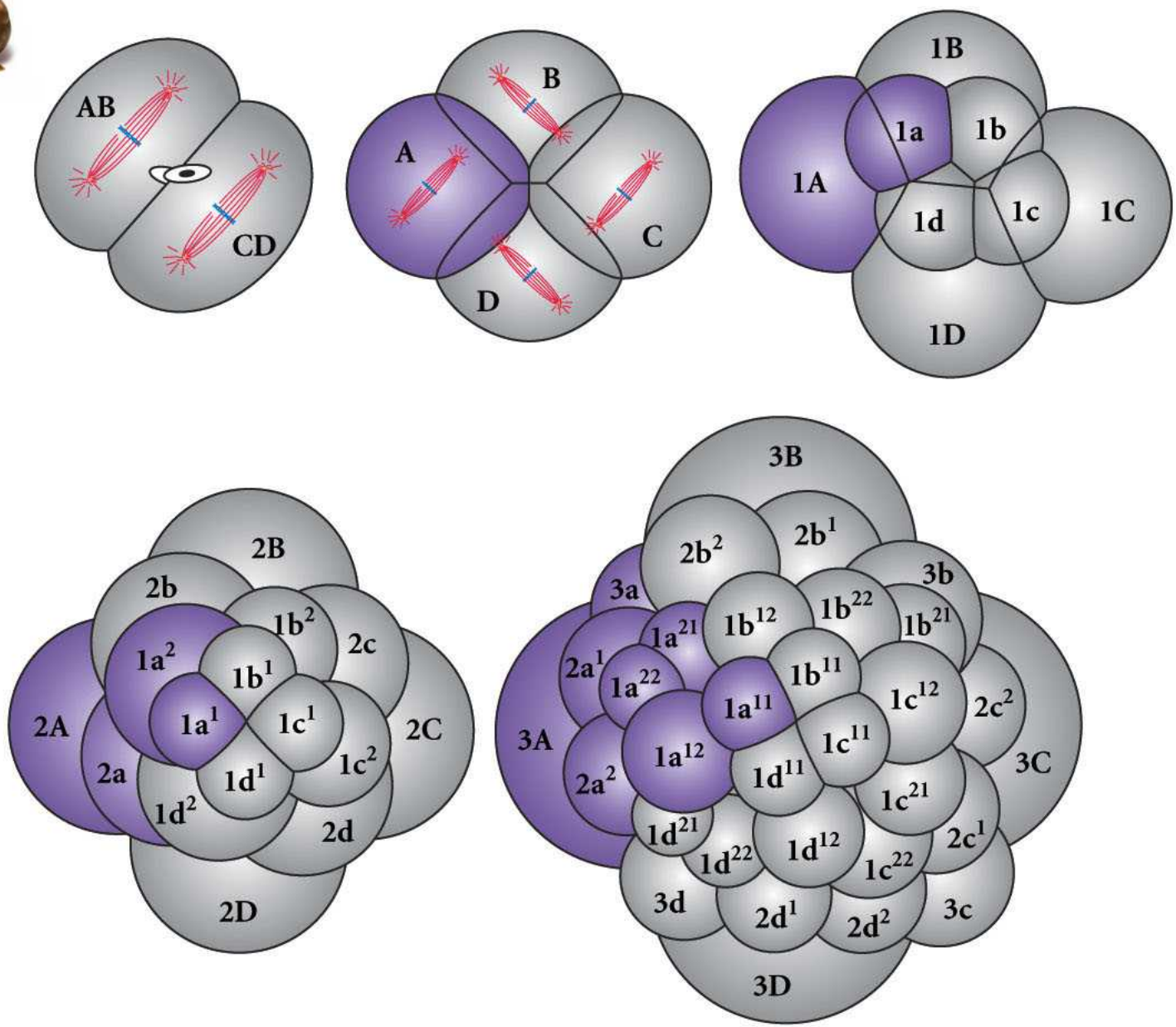
8.23 Spiral cleavage of the mollusc *Trochus* (Part 1)

A) View from animal pole



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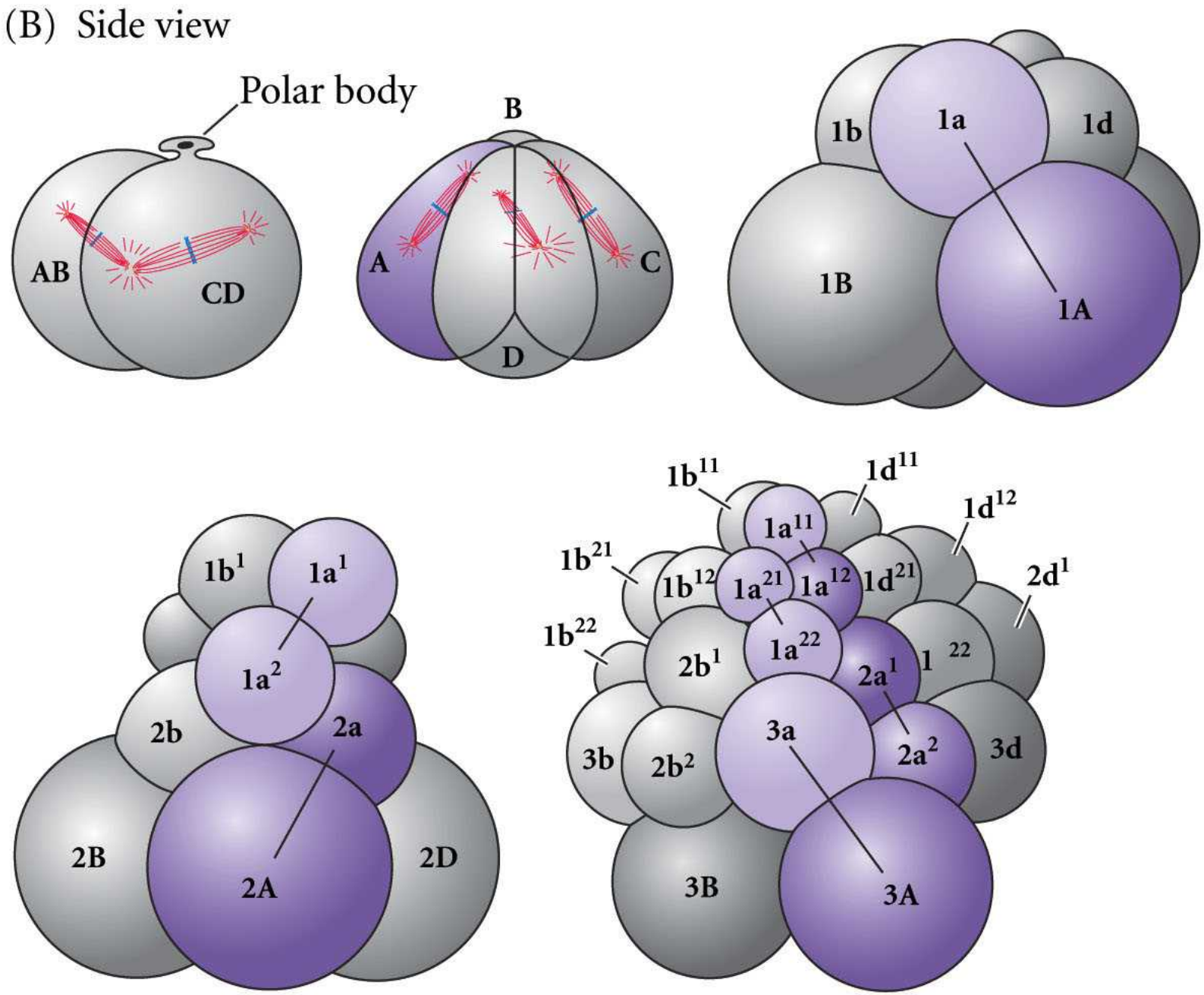
8.23 Spiral cleavage of the mollusc *Trochus* (Part 2)



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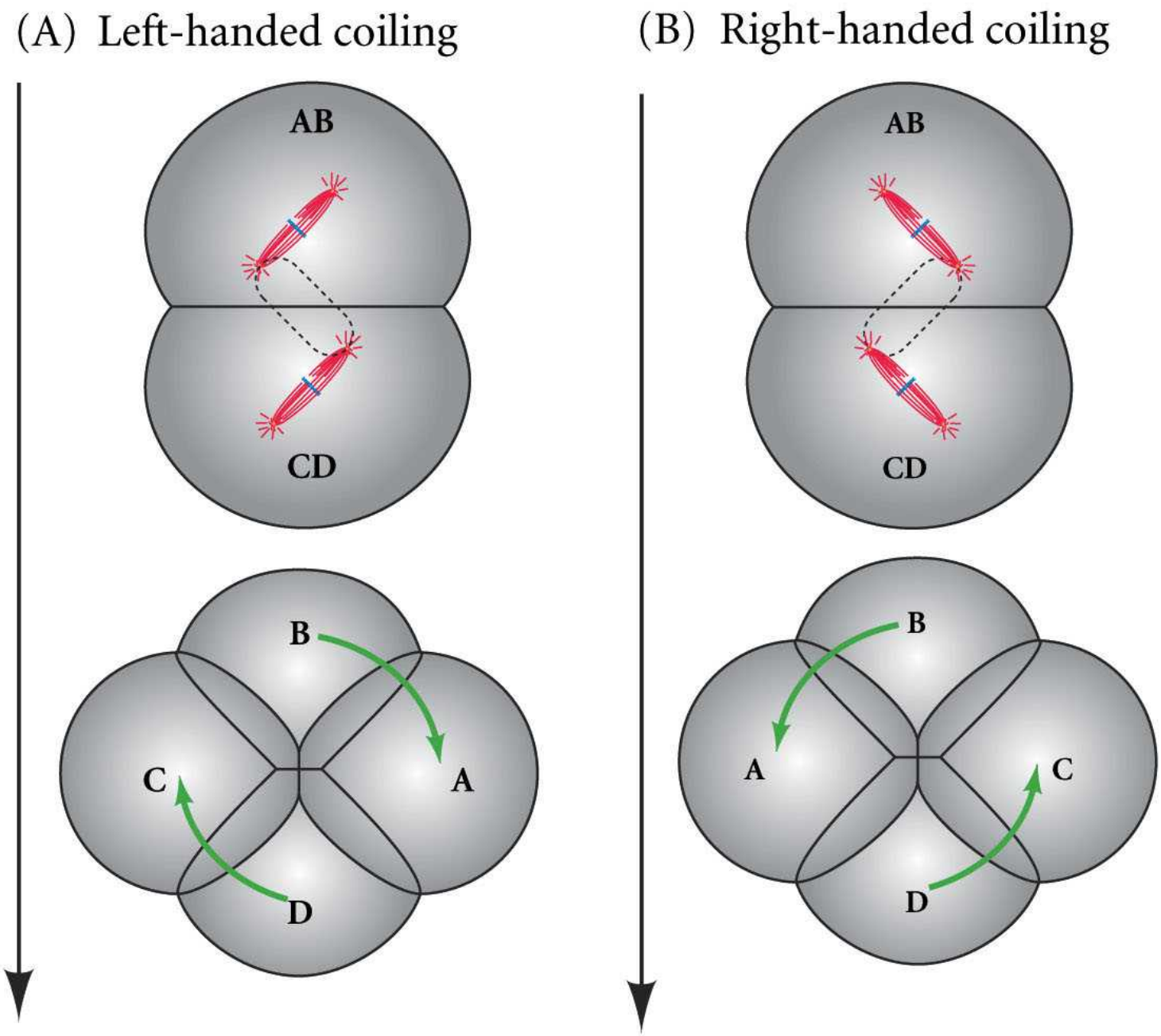
8.25 Looking down on the animal pole of (A) left-coiling and (B) right-coiling snails (Part 1)



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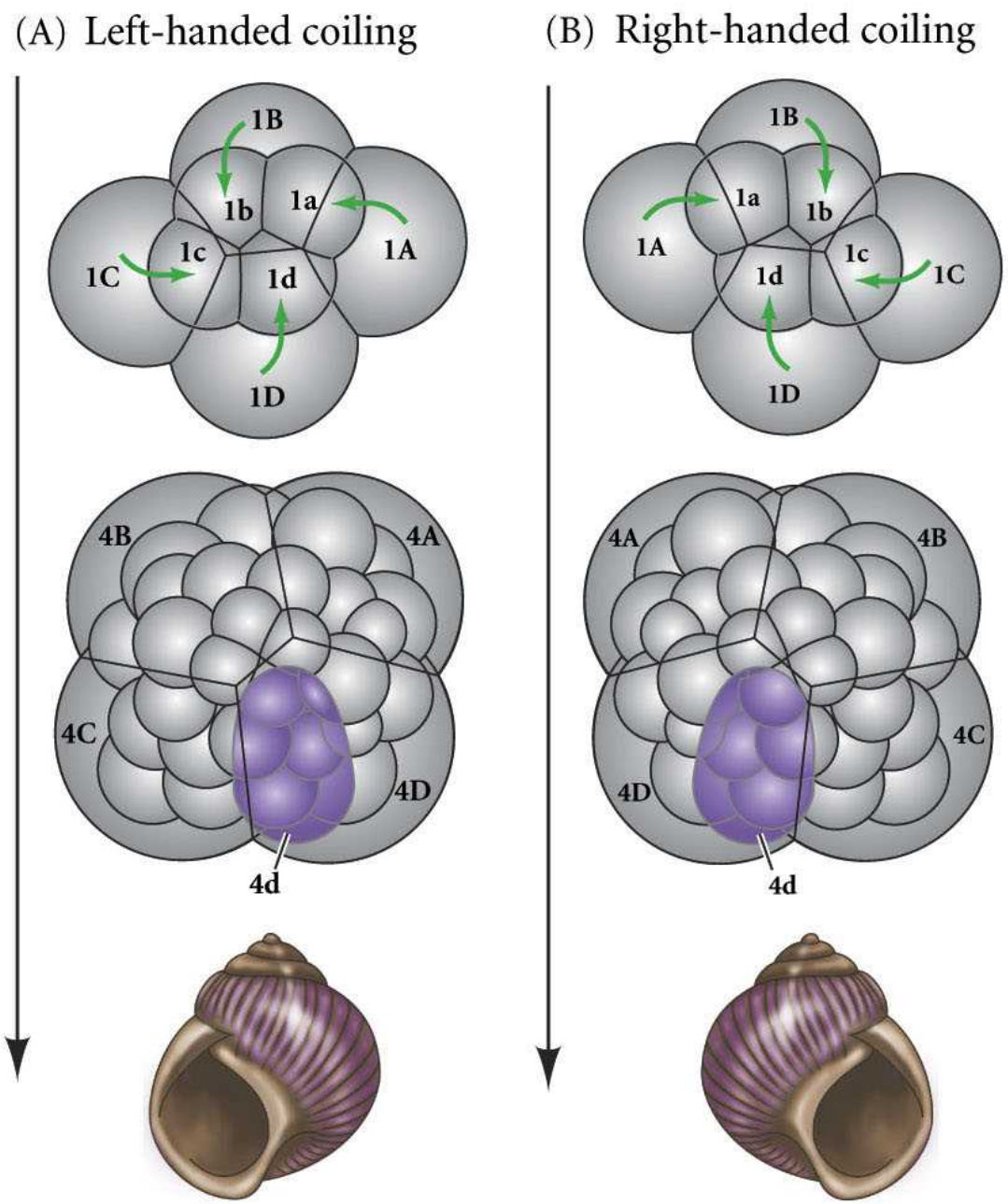
8.25 Looking down on the animal pole of (A) left-coiling and (B) right-coiling snails (Part 2)



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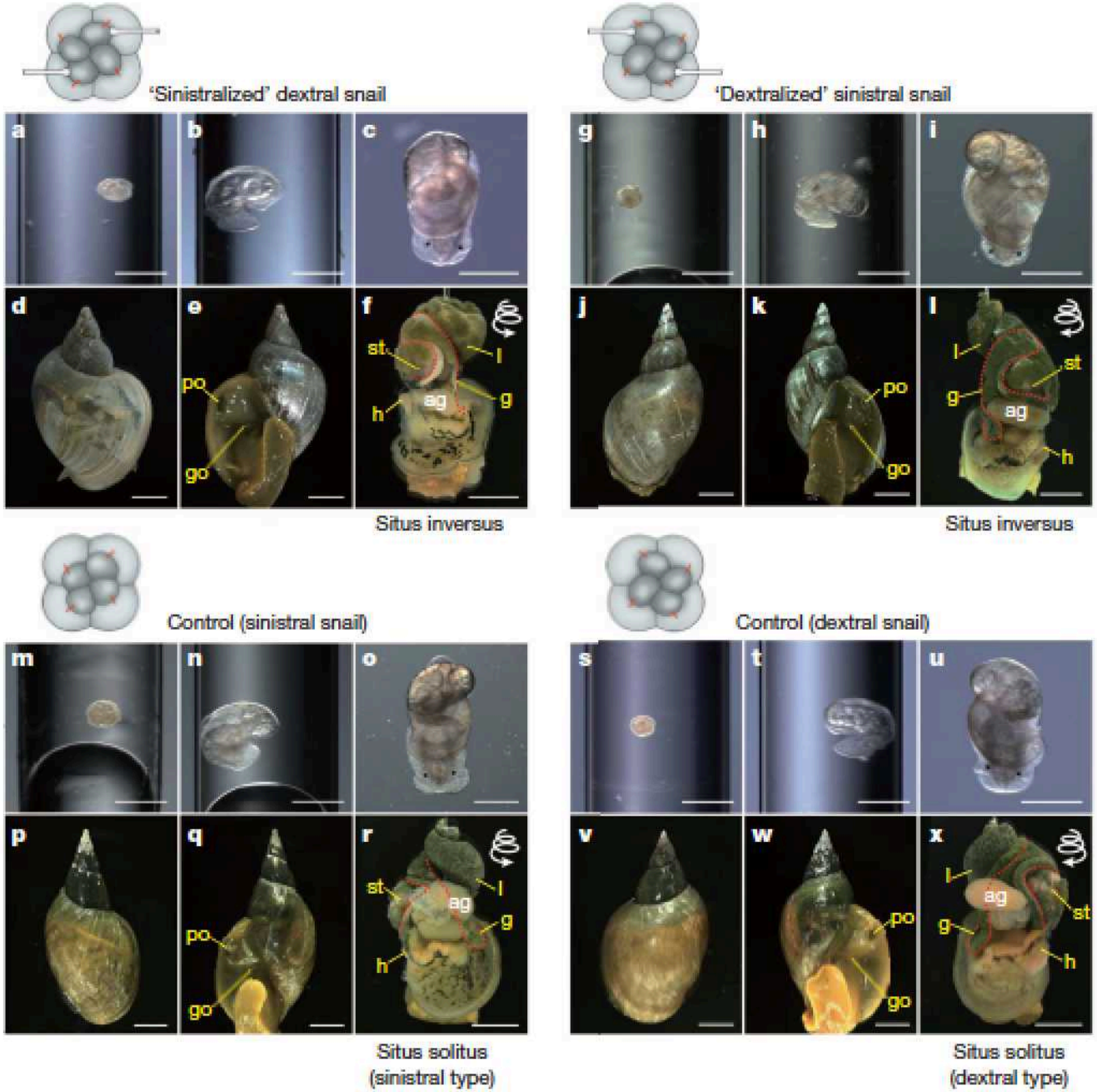
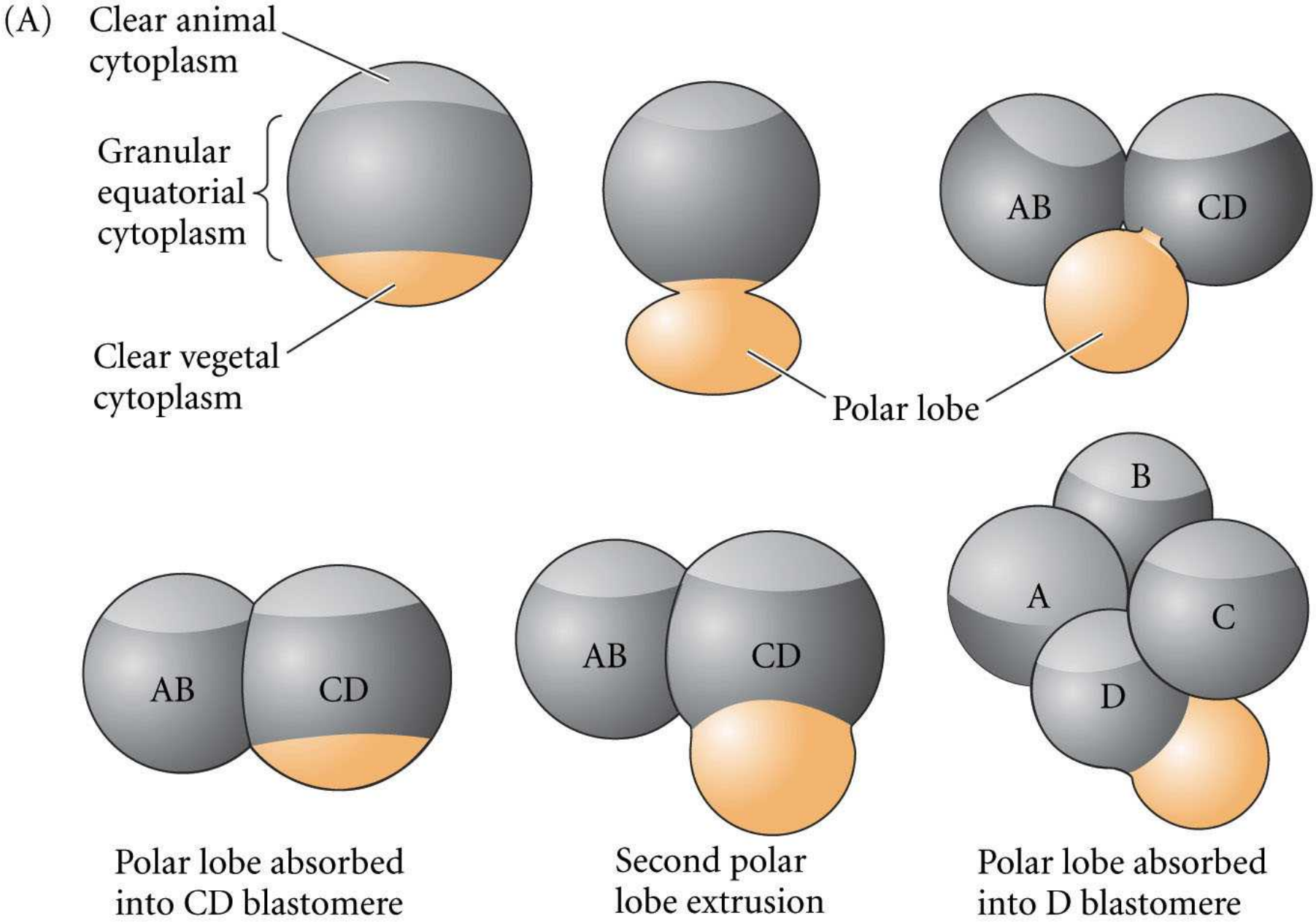
Kuroda 2009


'Sinistralized' dextral snail
'Dextralized' sinistral snail
a
b
c
d
e
f
g
h
i
j
k
l
st
l
po
ag
g
h
go
Situs inversus
Situs inversus
Control (sinistral snail)
Control (dextral snail)
m
n
o
p
q
r
s
t
u
v
w
x
Situs solitus
(sinistral type)
Situs solitus
(dextral type)

8.30 Polar lobe formation in certain mollusc embryos (Part 1)



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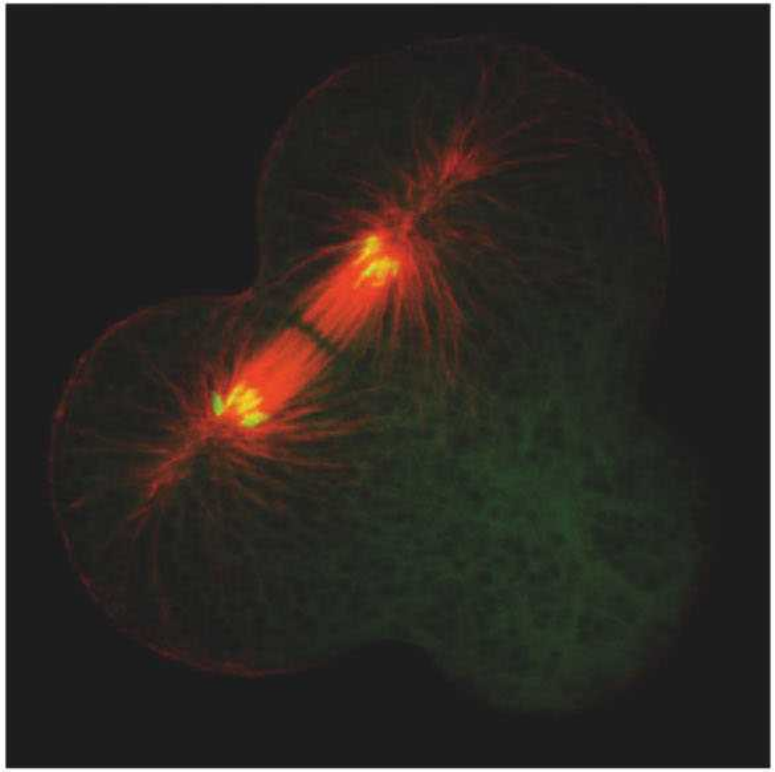
8.30 Polar lobe formation in certain mollusc embryos (Part 2)

(B)



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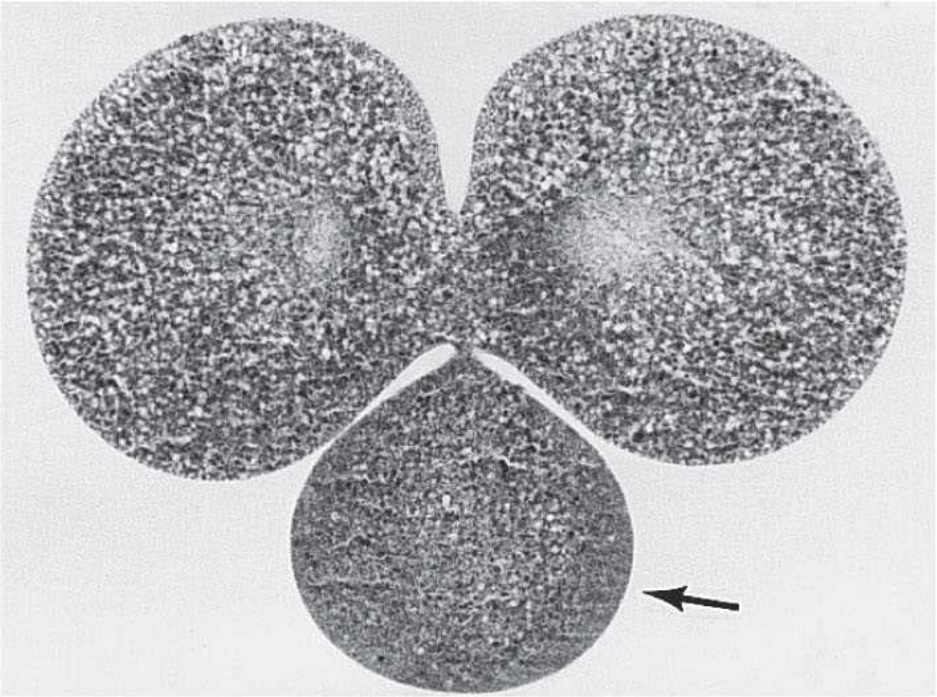

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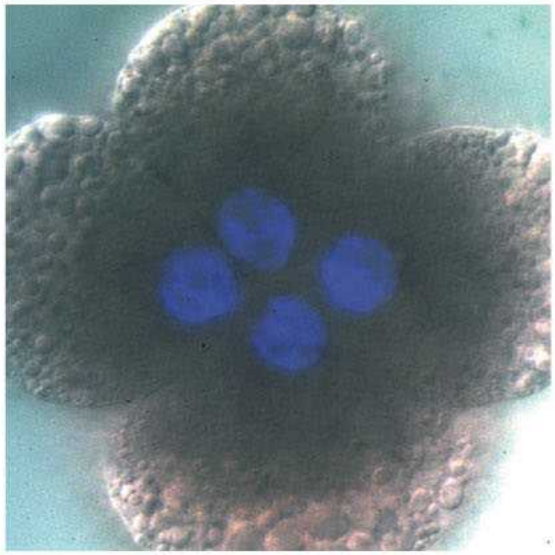
Determinate/autonomous development: decapentaplegic (dpp) mRNA association to centrosomes

Illyanasa:

(A)



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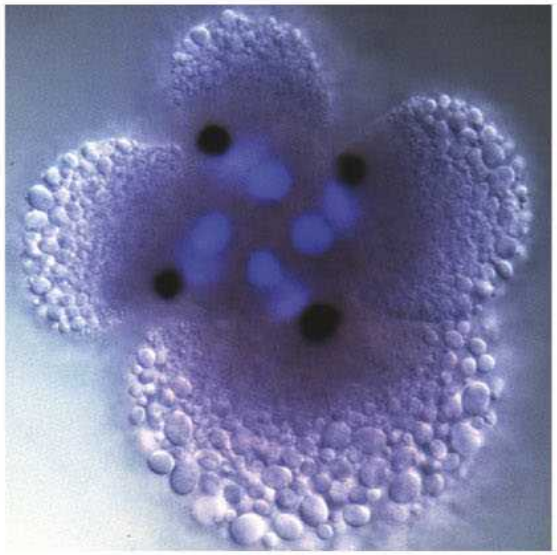
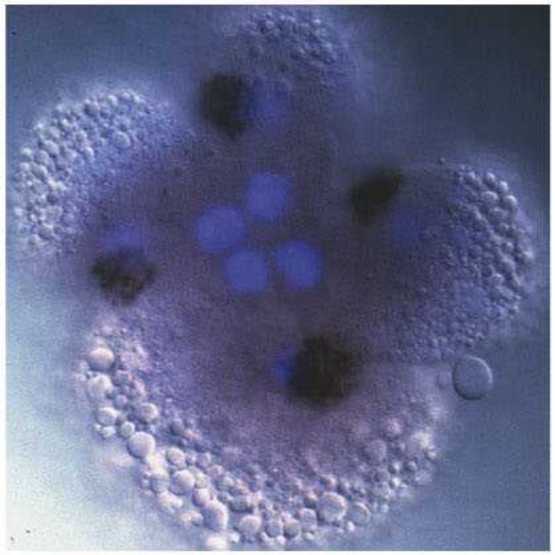
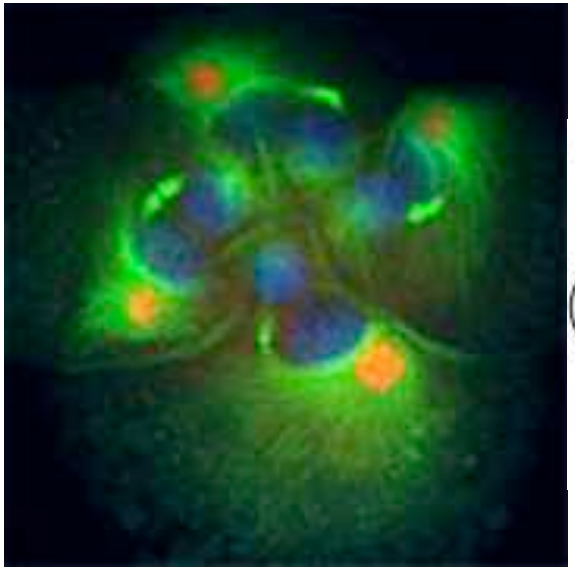
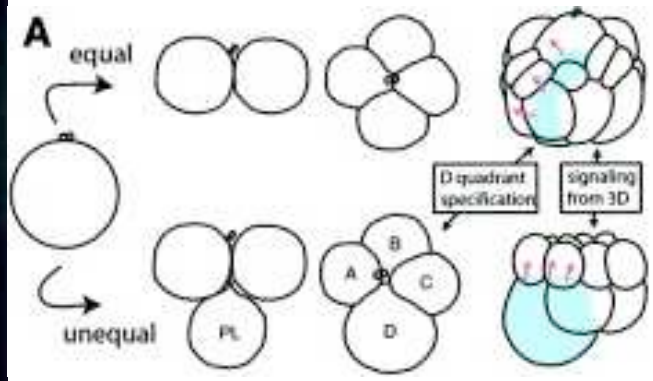


(C)



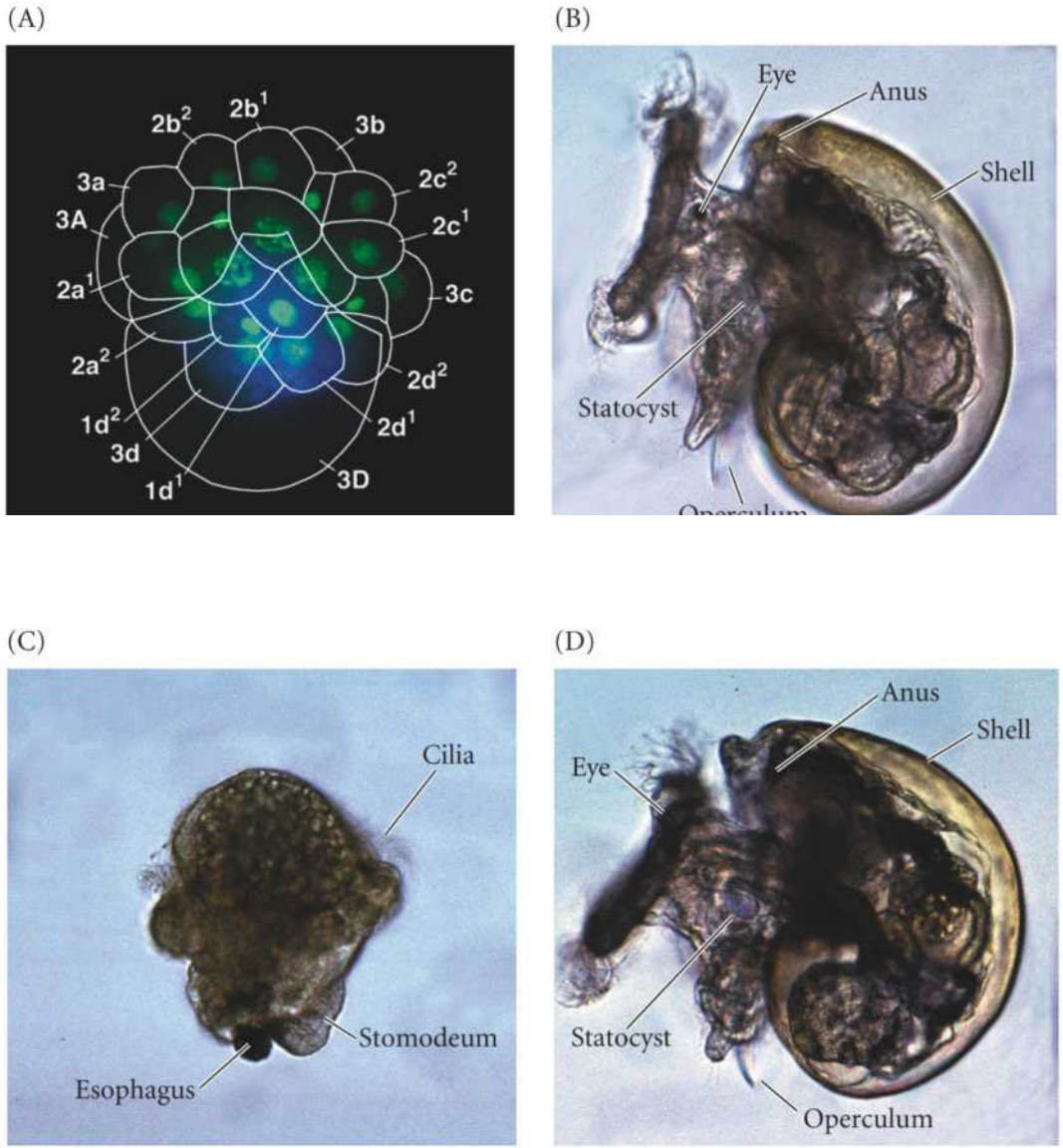


MAPK signalling

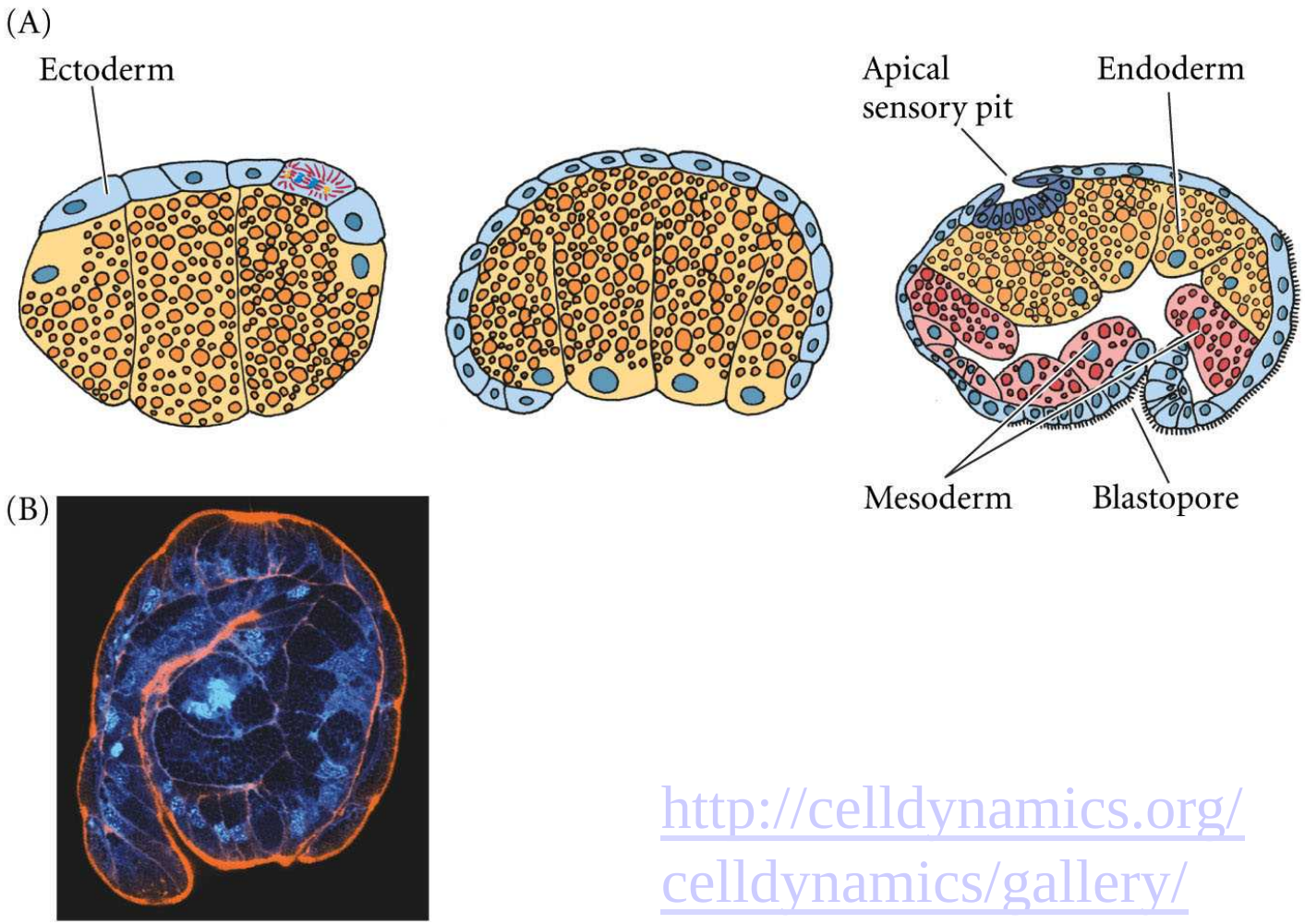


D quadrant: D/P structures

The 3D blastomere activates MAP kinase activity in adjacent micromeres



Gastrulacão en moluscos/espiralados



http://celldynamics.org/celldynamics/gallery/movieWindows/timelapse/nereis.html

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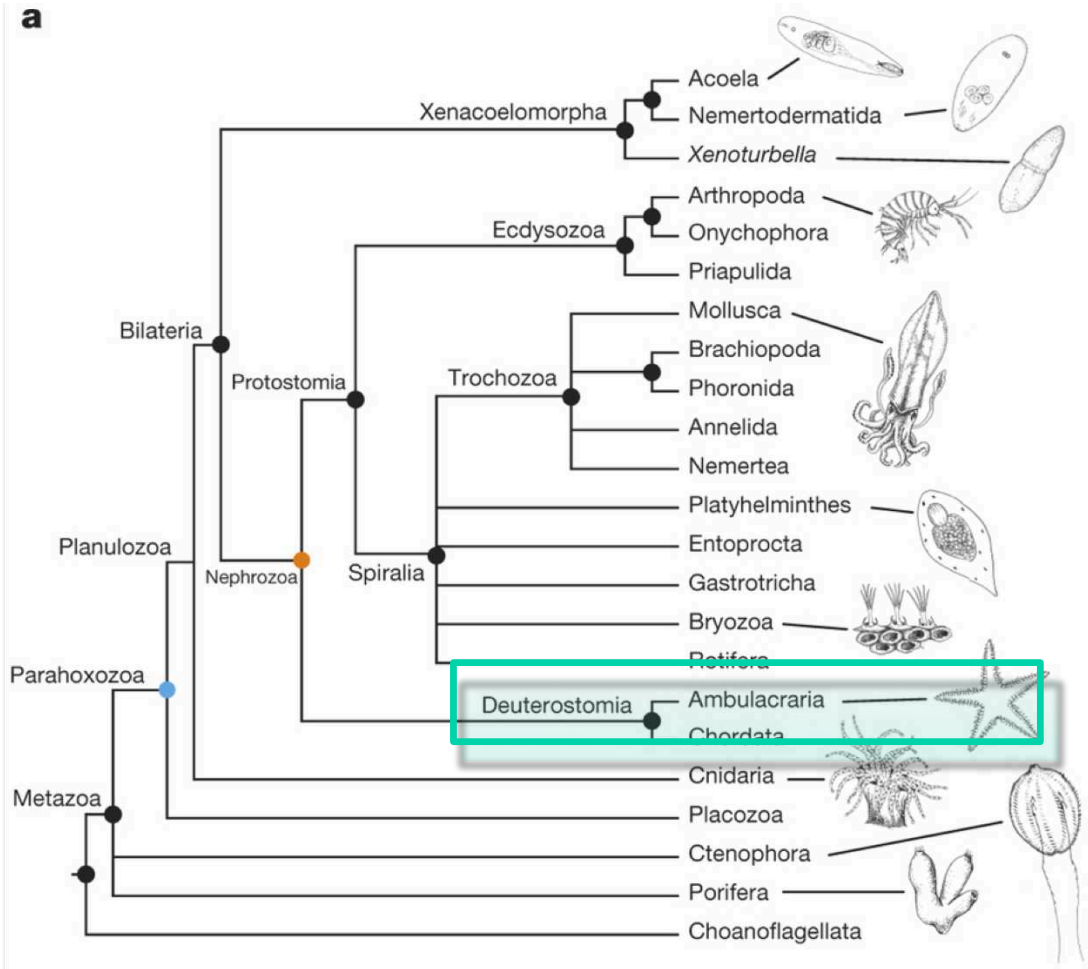
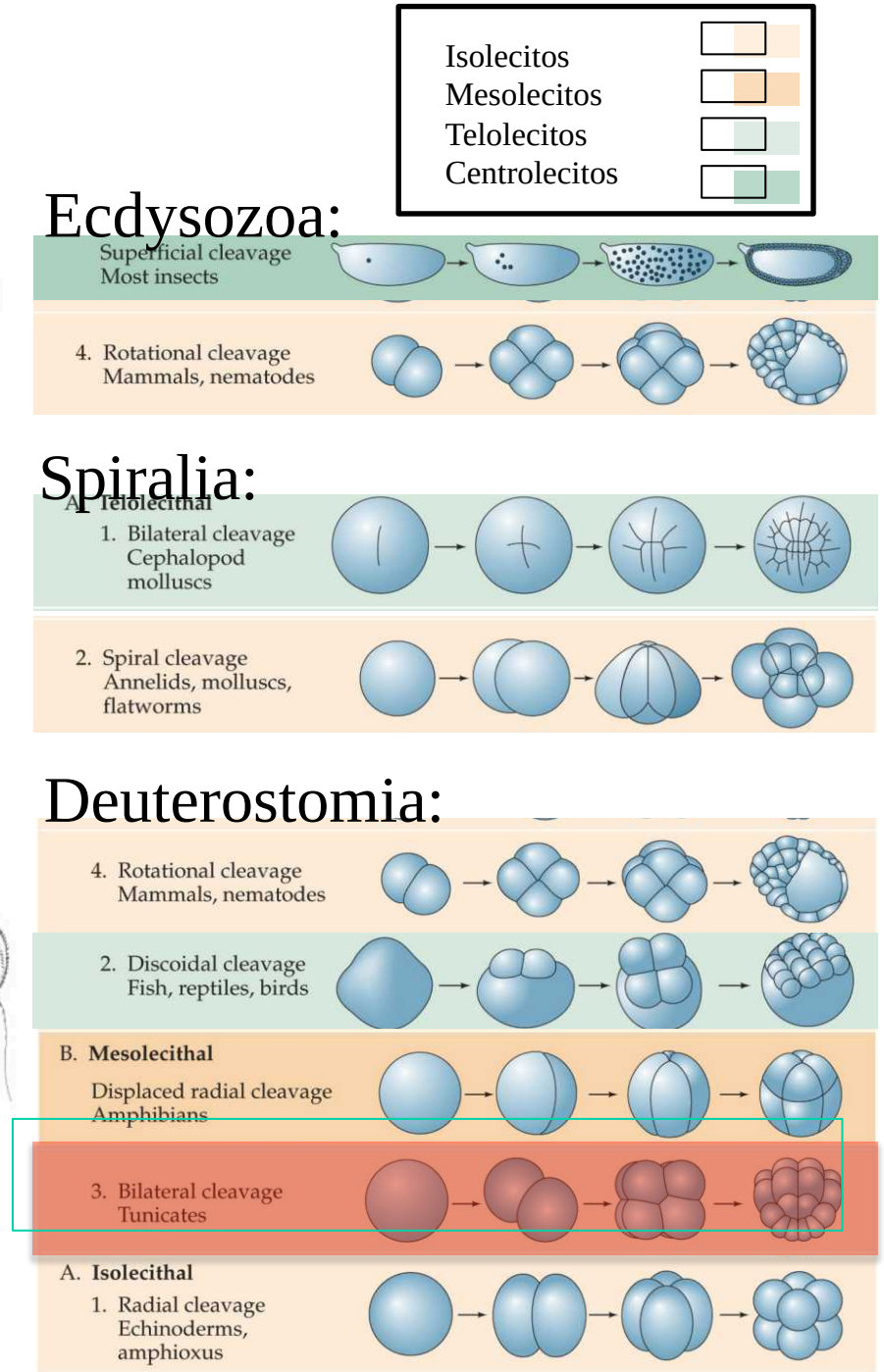
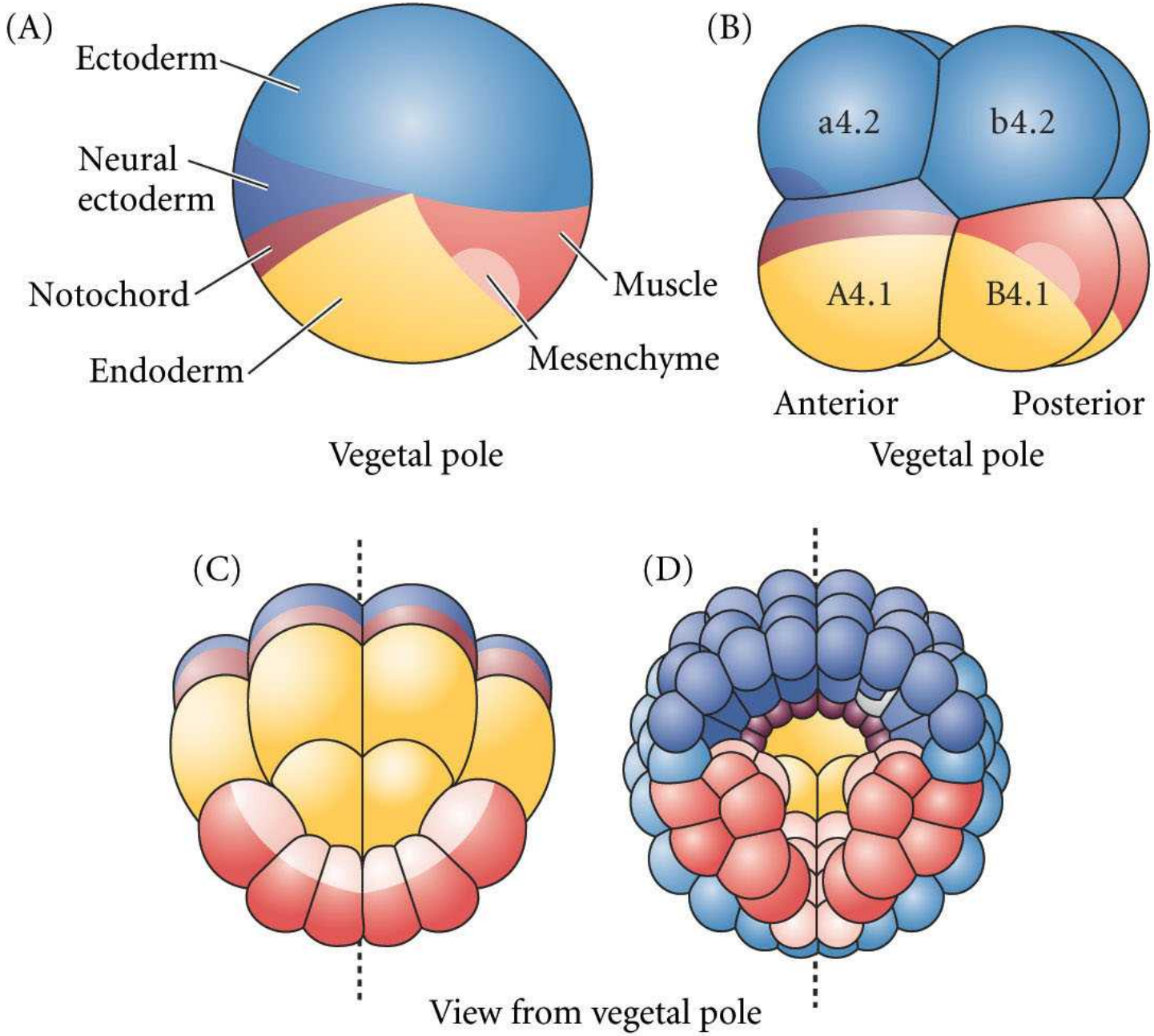
Pattern of development in the Metazoans:



Cannon et al. 2016



Bilateral symmetry in the egg of the ascidian tunicate *Styela partita*



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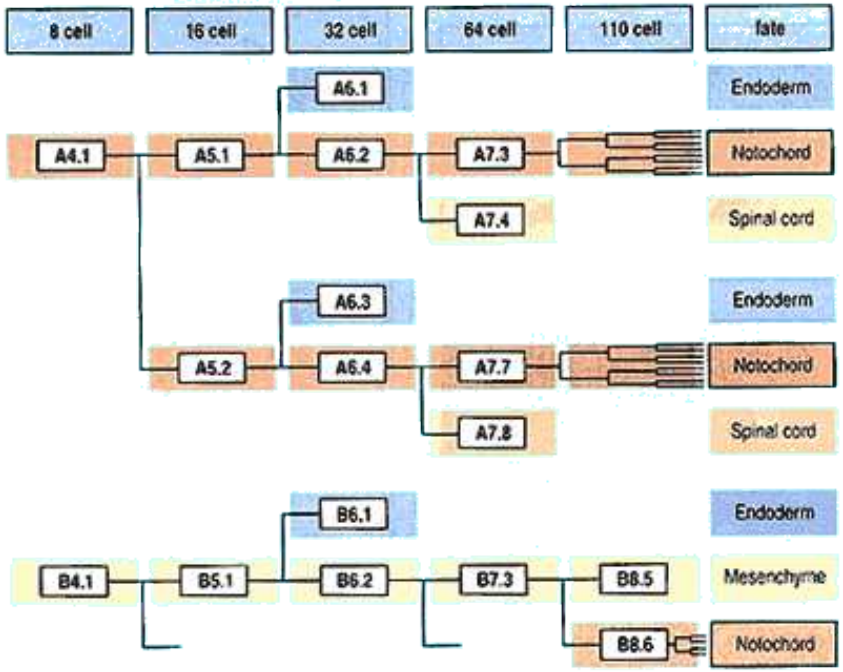
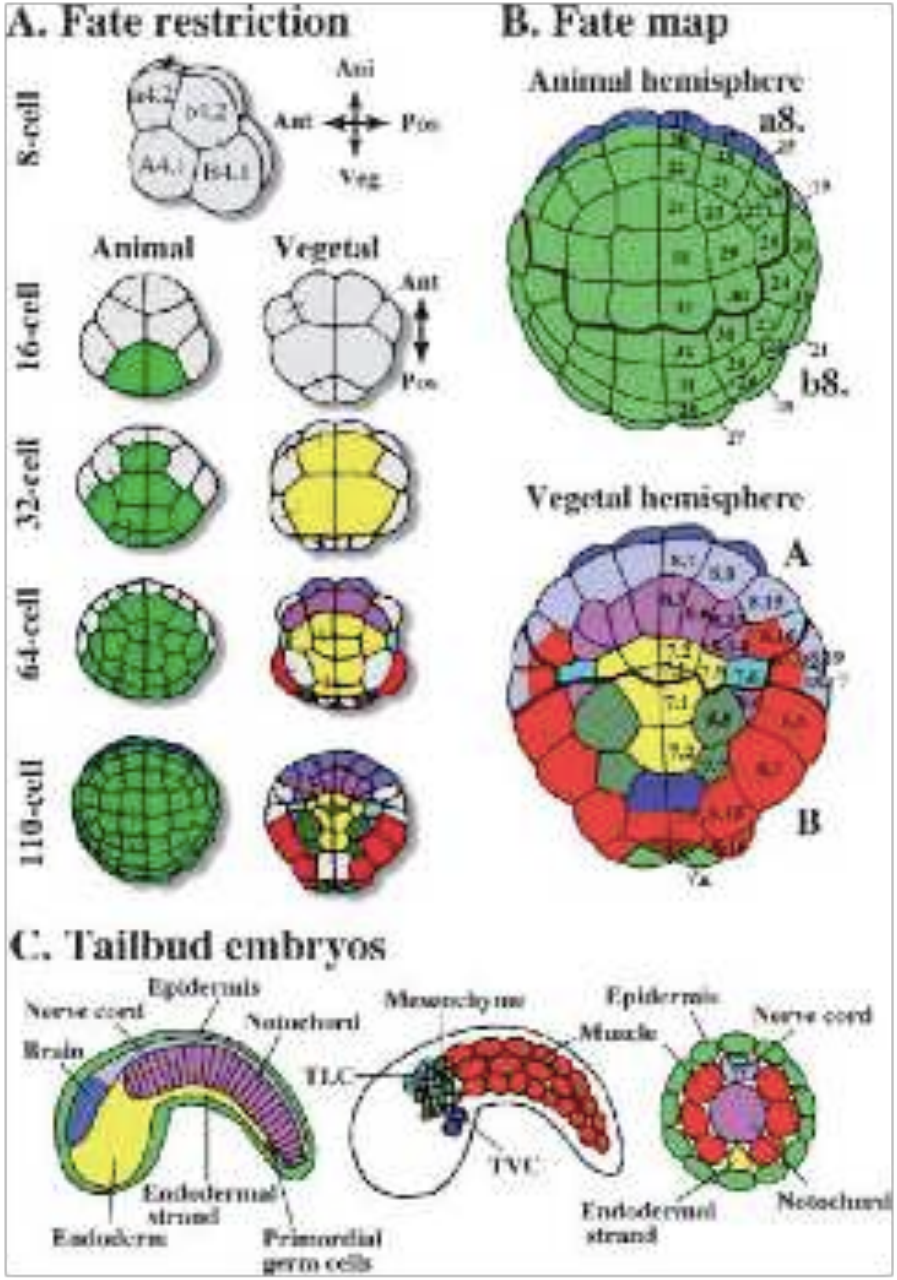
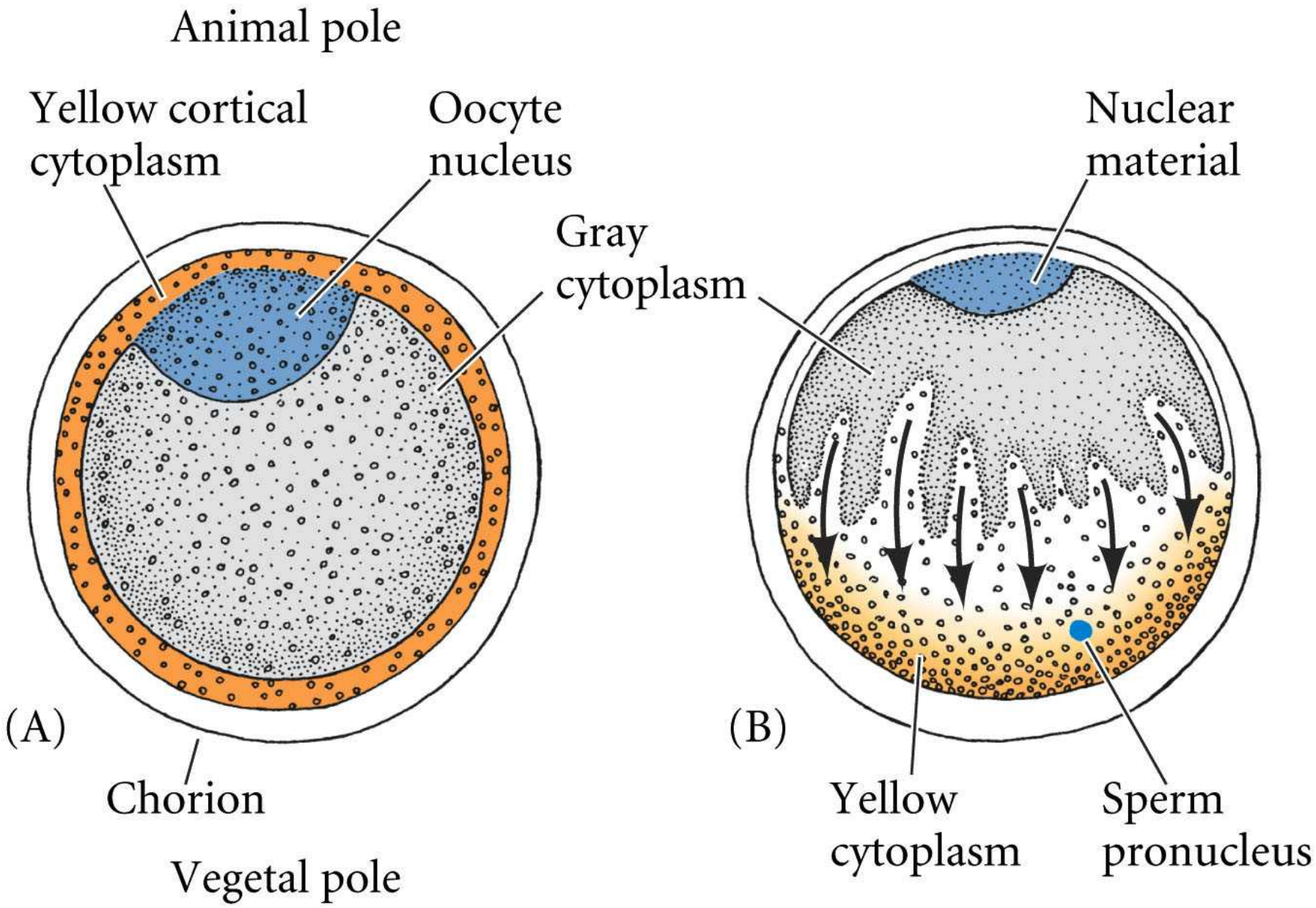
- Todos os embriões se desenvolvem de maneira idêntica
- Cada divisão celular ocorre da mesma maneira no mesmo momento em todos os indivíduos
- Cada célula tem uma identidade única e invariante





Hirano e Nishida 1997; Nishida 1987, 2005

Cytoplasmic rearrangement in the fertilized egg of *Styela partita* (Part 1)



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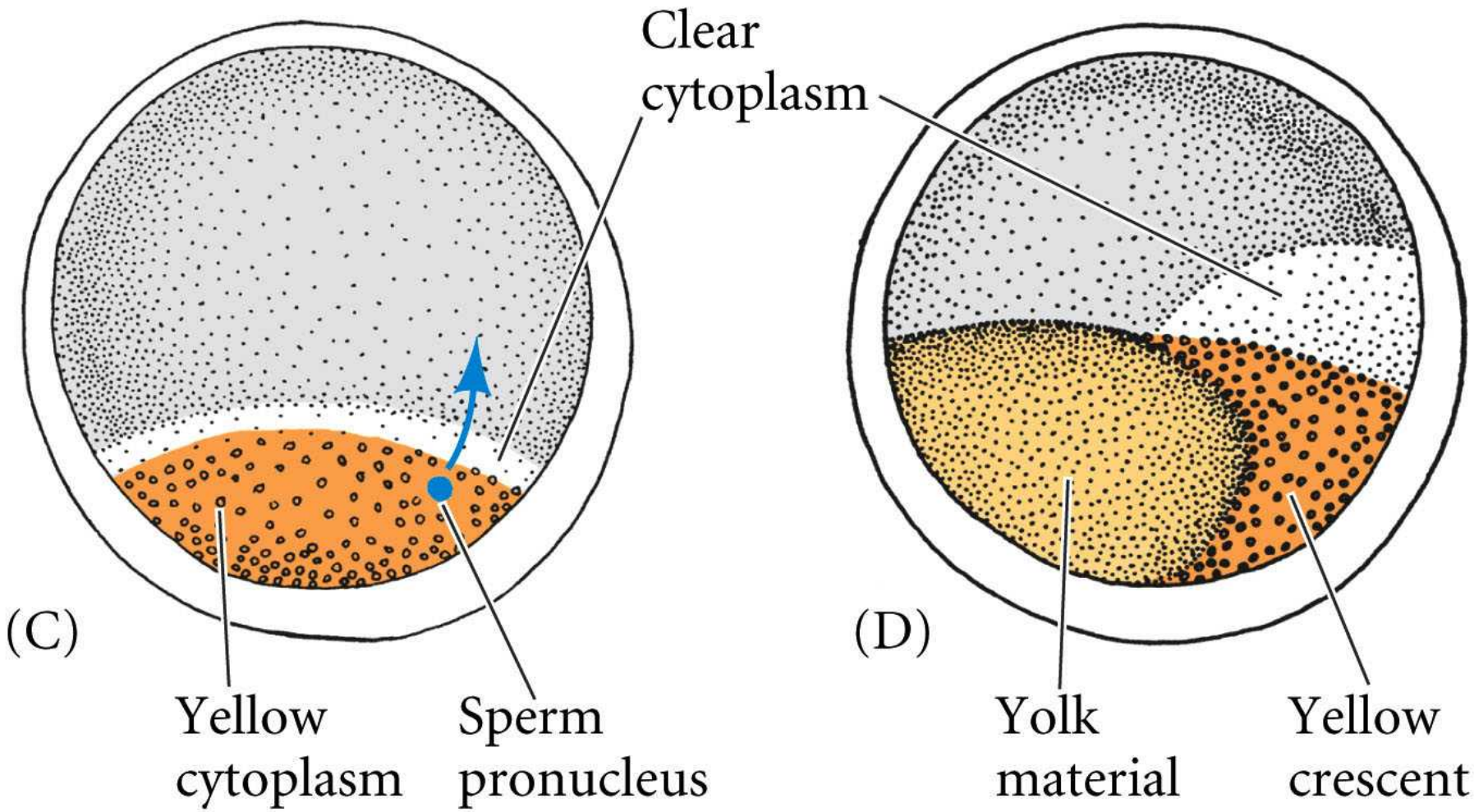
Cytoplasmic rearrangement in the fertilized egg of Styela partita (Part 2)



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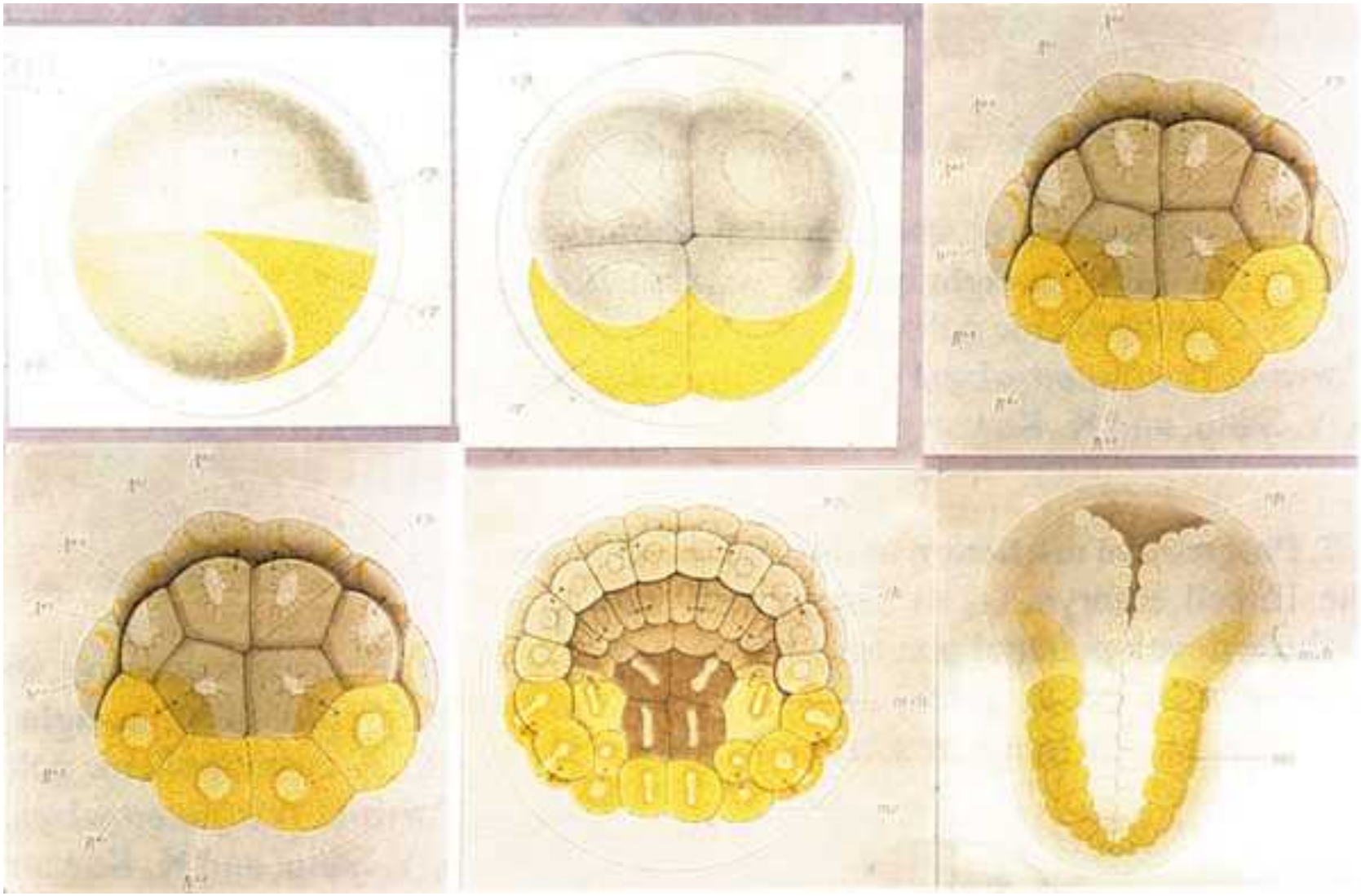
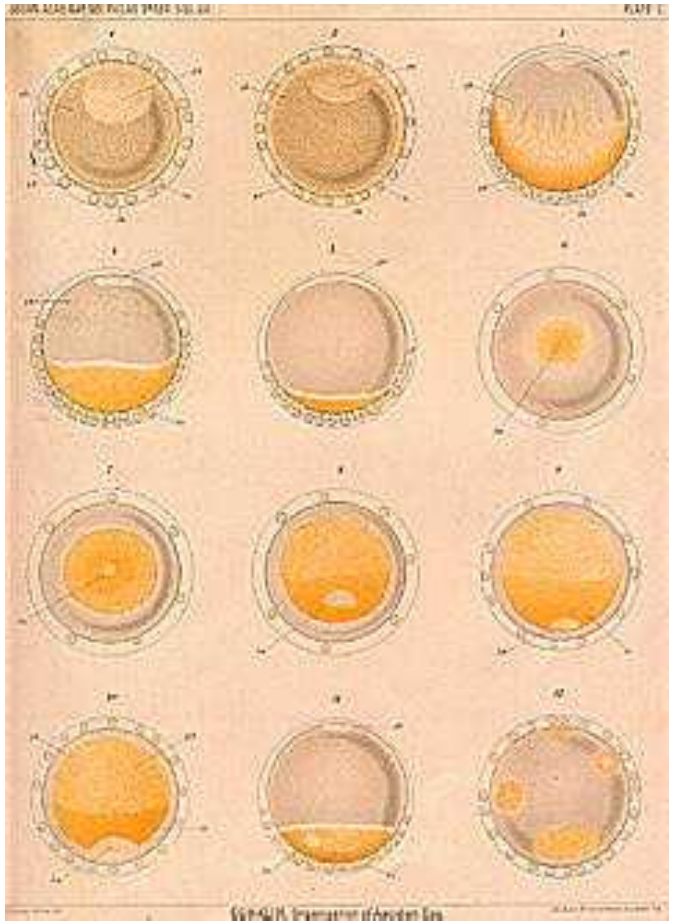
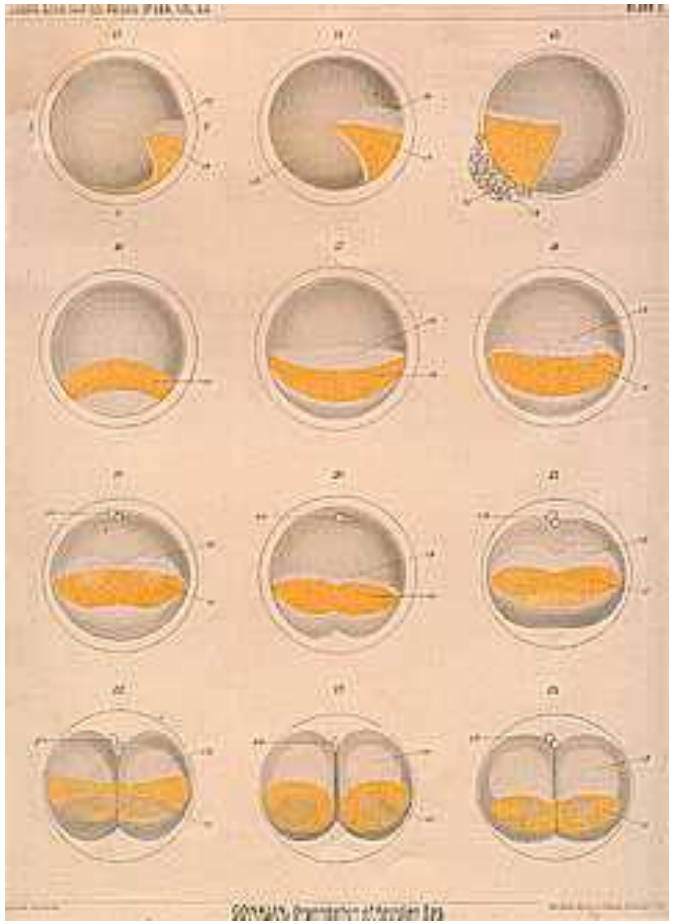


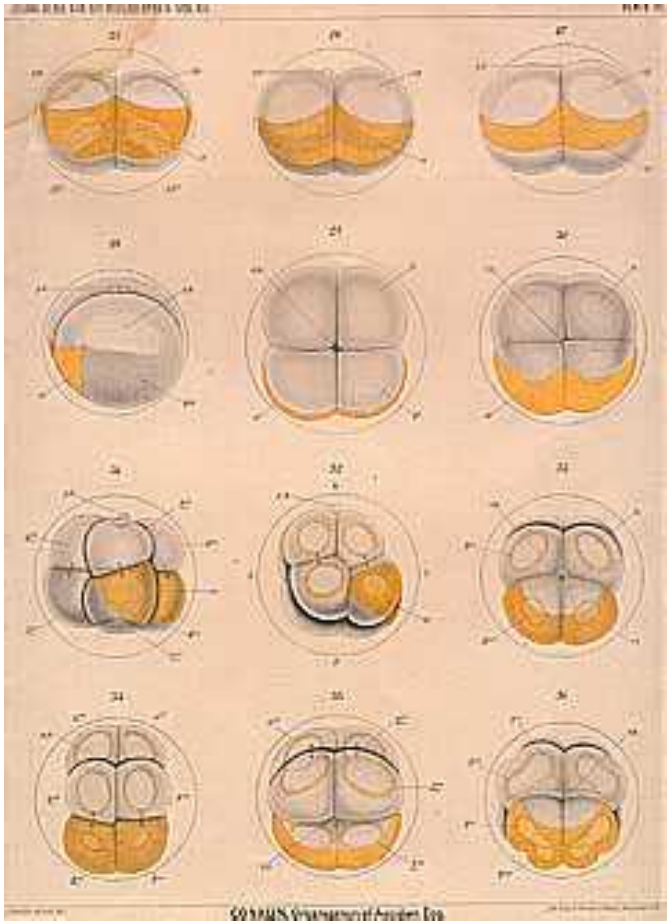
Styela partita Conklin 1905

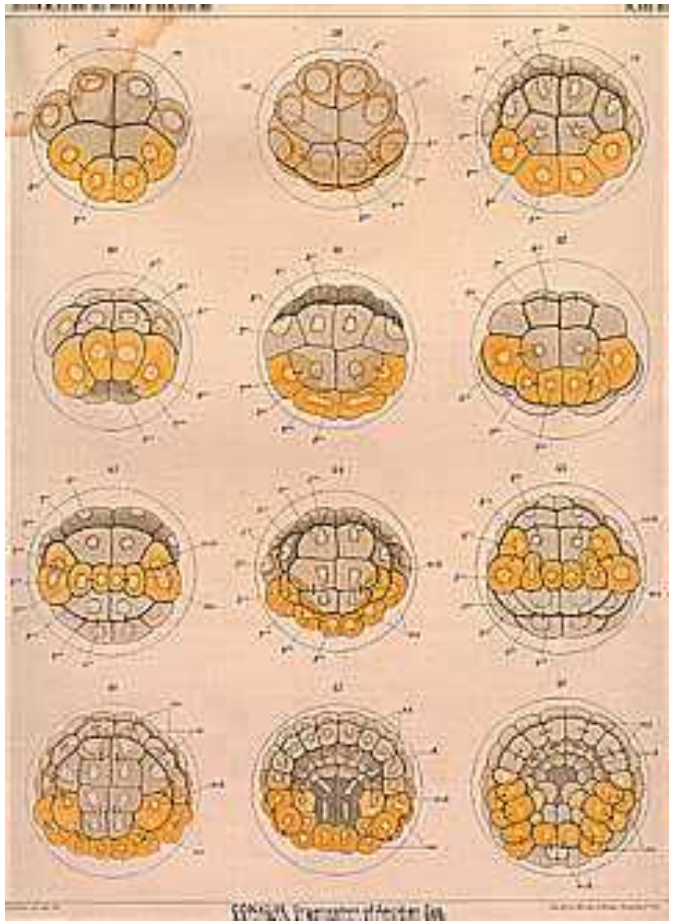
Ascidian Development (Conklin 1905)



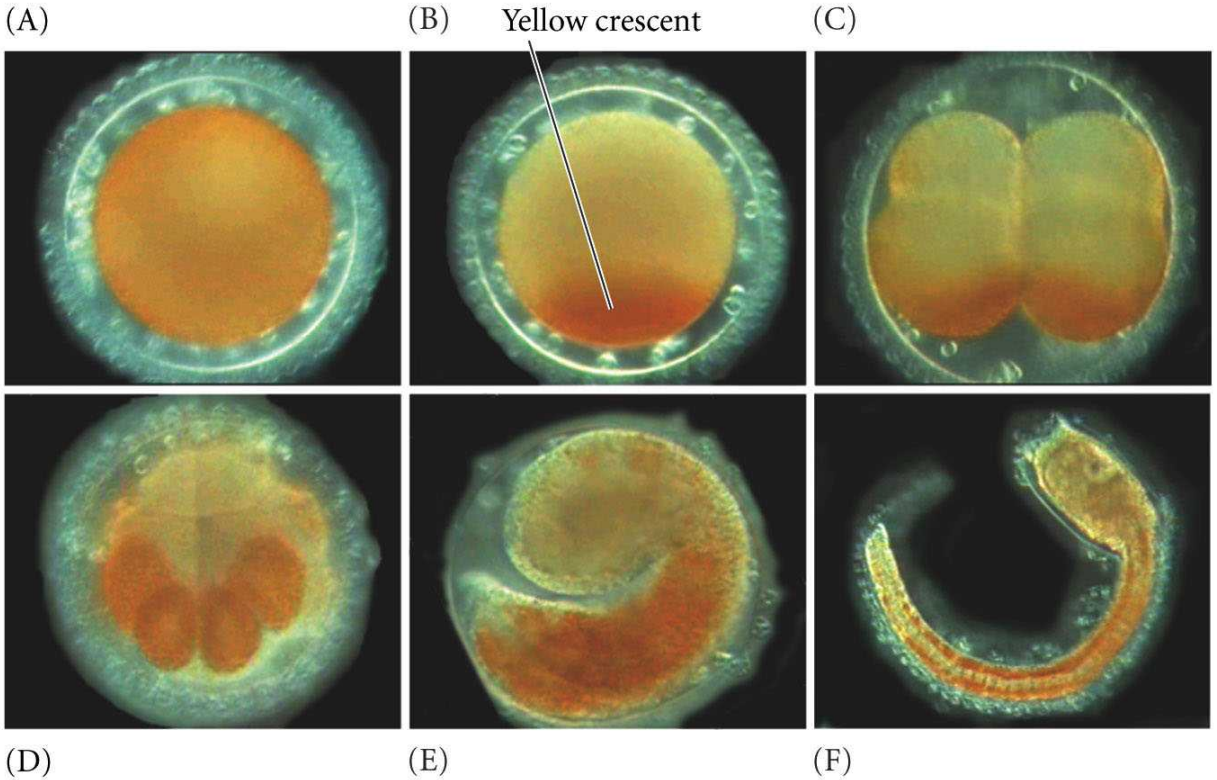


Ascidian Development (Conklin 1905)

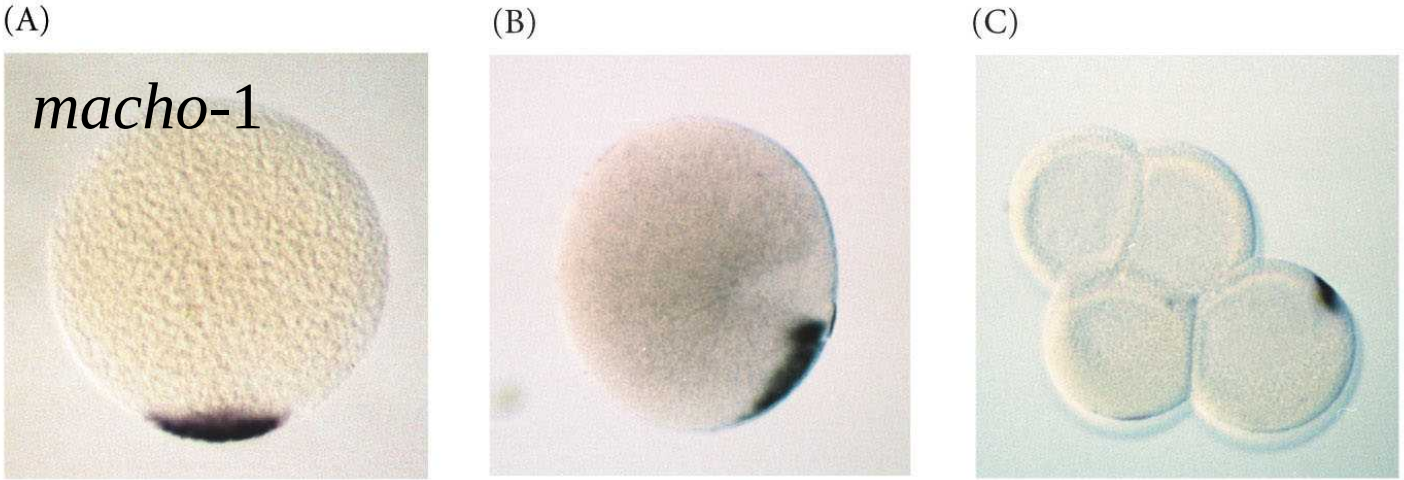




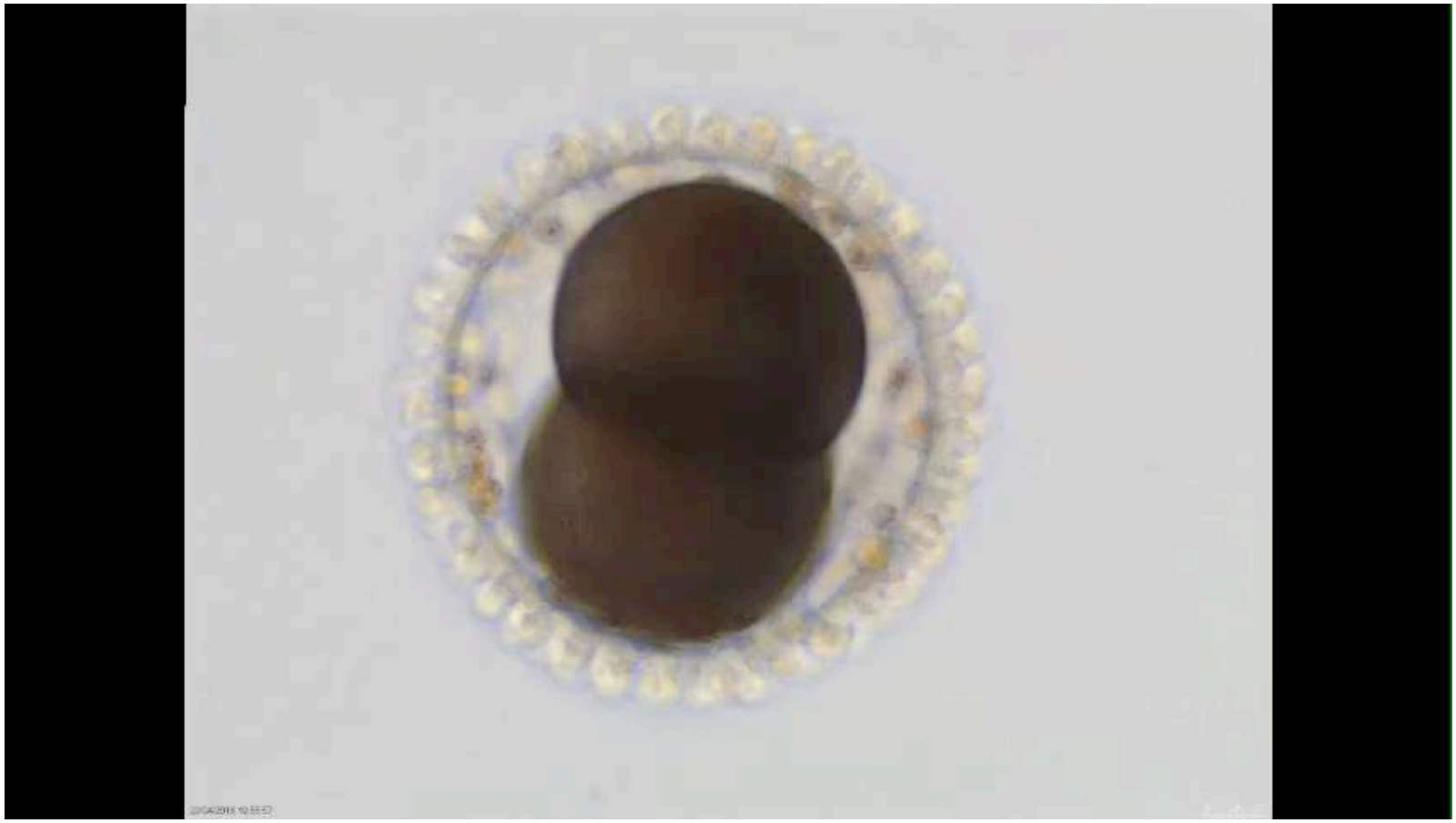
Cytoplasmic segregation in the egg of *Styela partita*



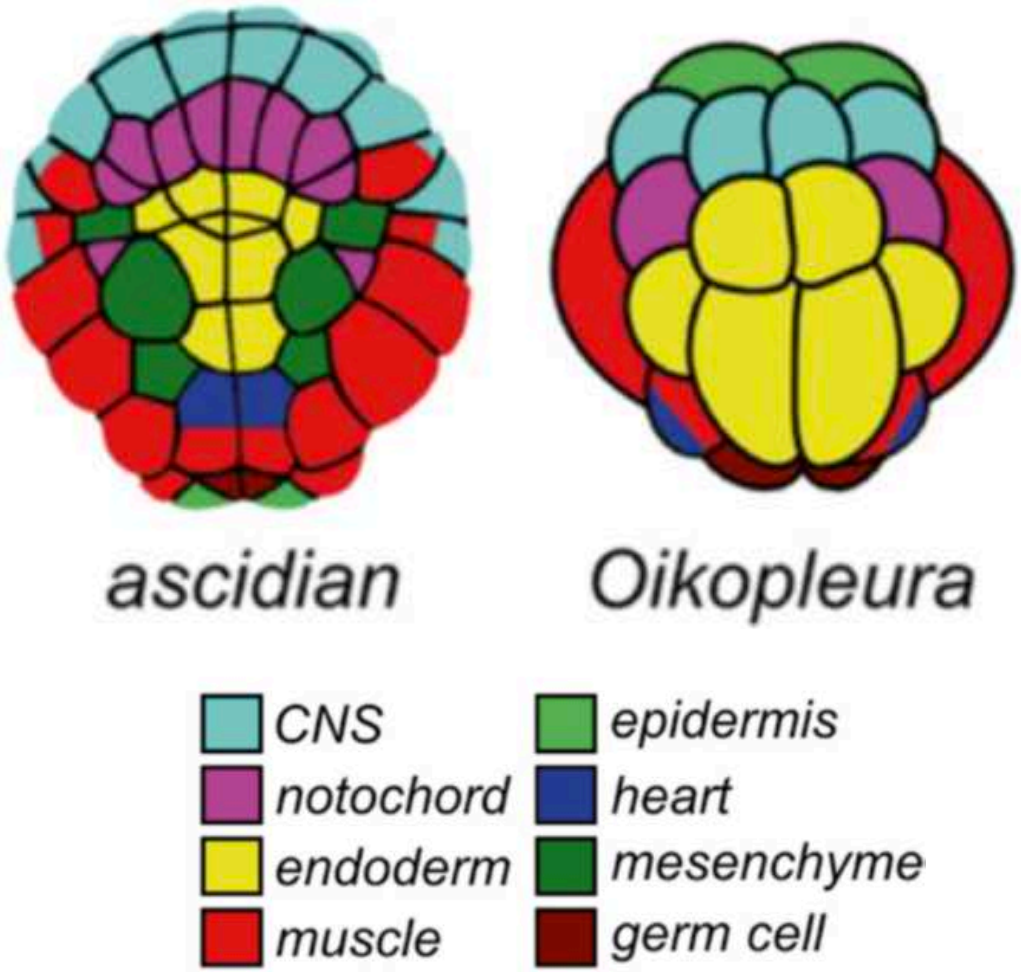
Autonomous specification



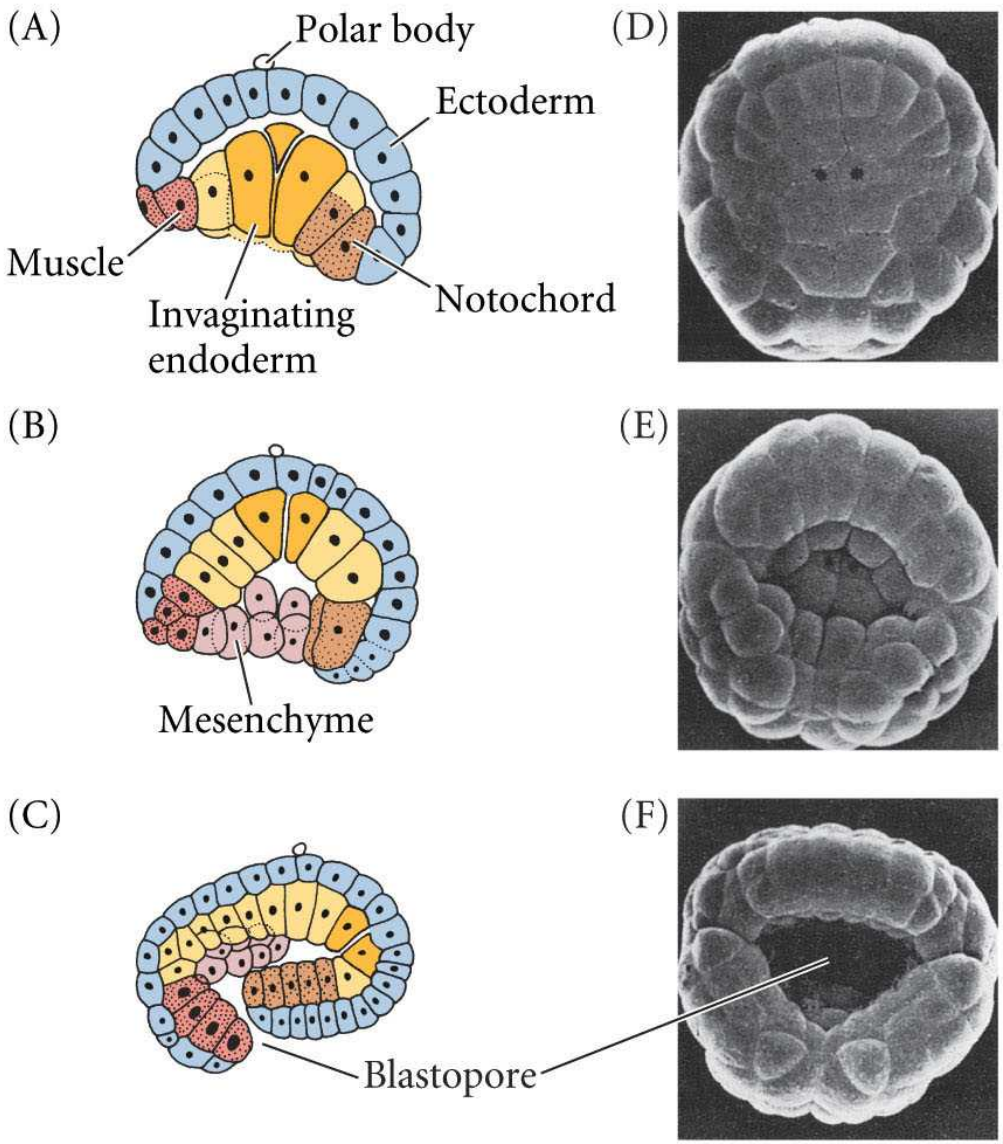
Desenvolvimento Styela



Tunicates: reduction in cell numbers during development



Gastrulation in the tunicate



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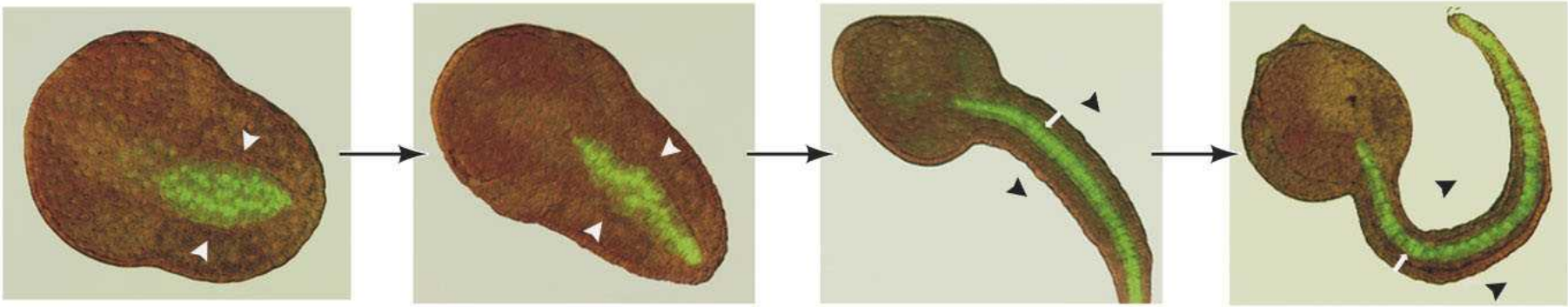
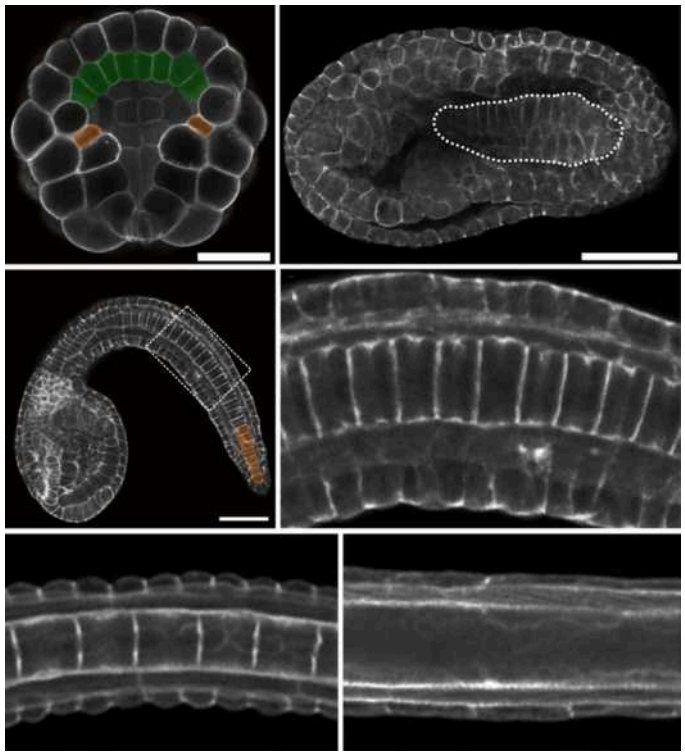
Notocorda se forma por movimentos de convergencia e extensão





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