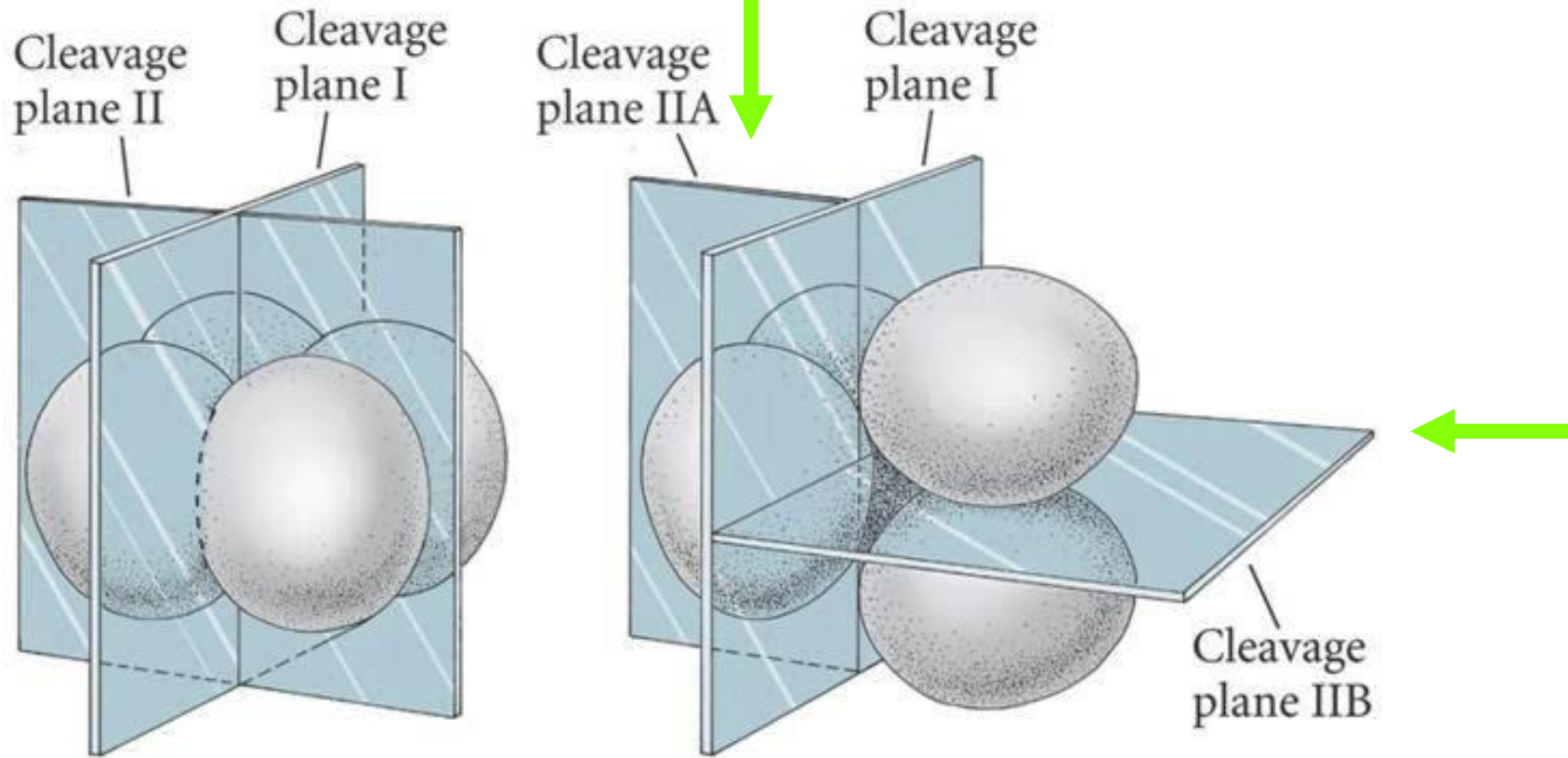


# Segmentación o clivaje

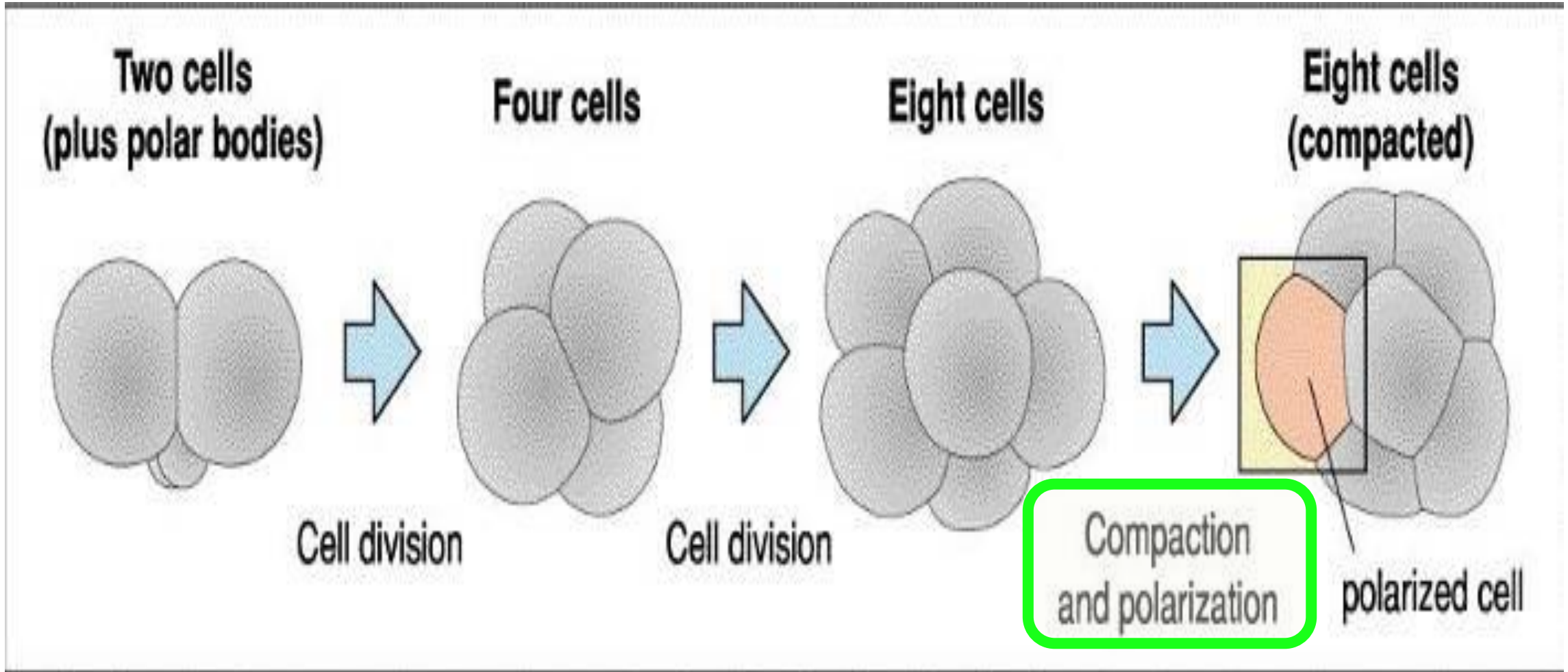




(A) ECHINODERM AND AMPHIBIAN

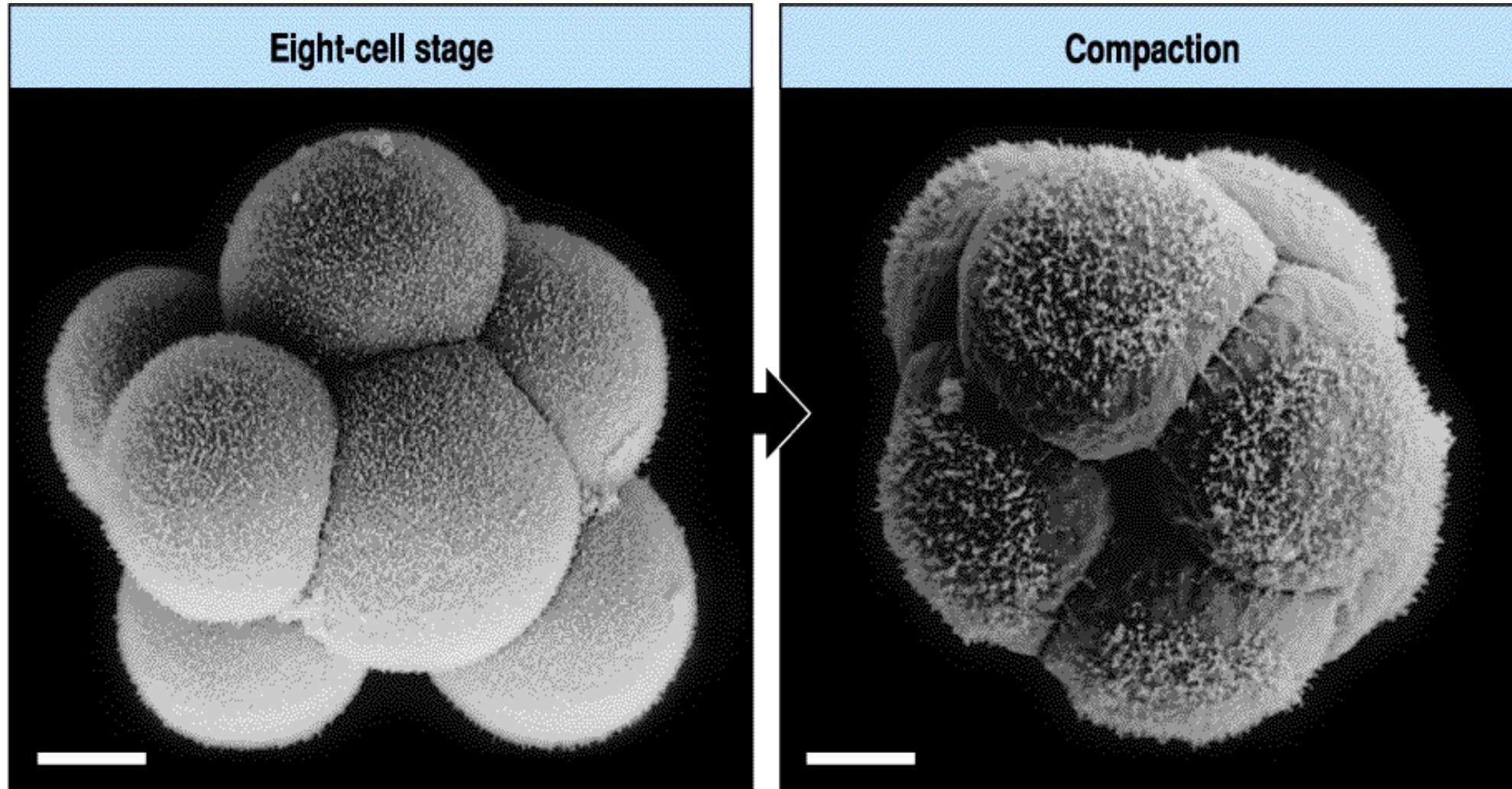
(B) MAMMAL





Clivaje radial rotacional de mamíferos

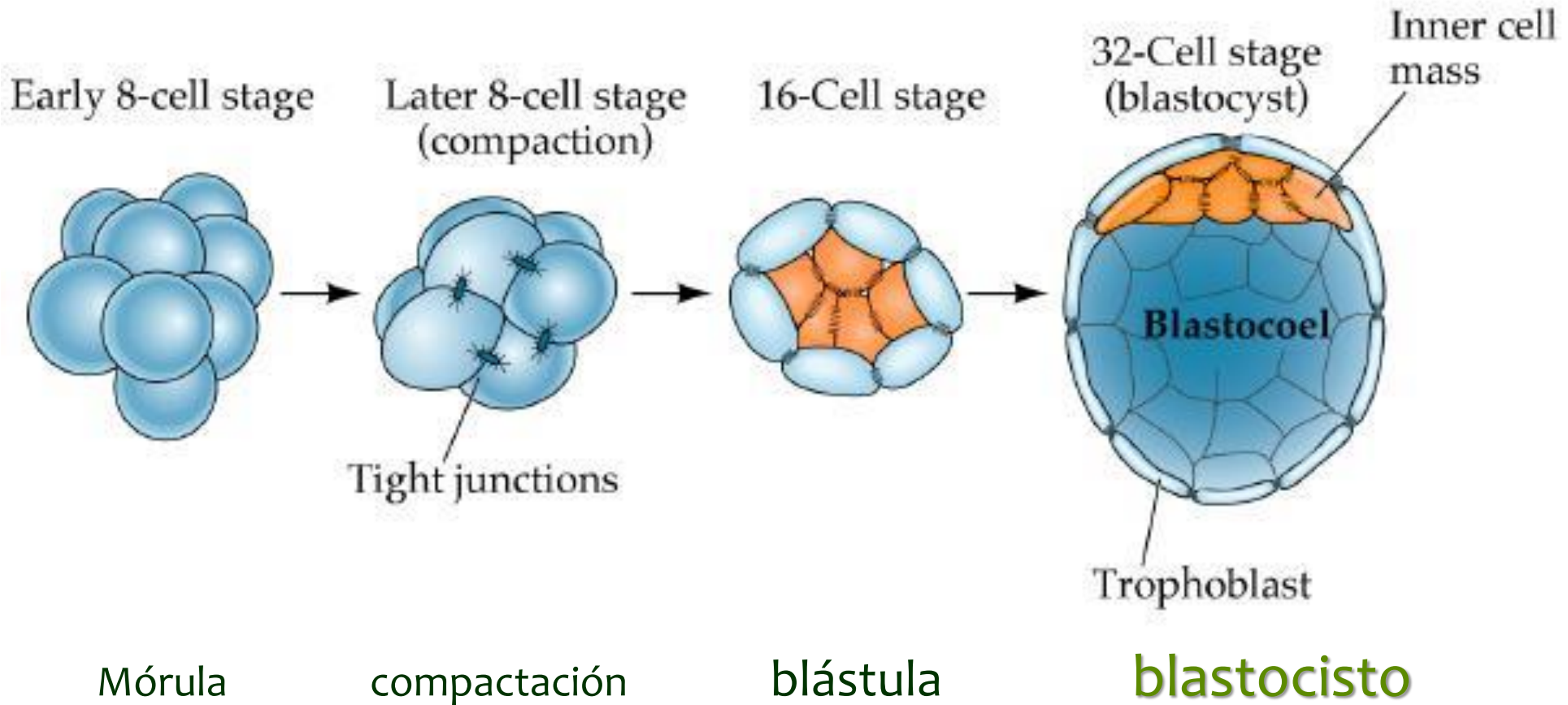


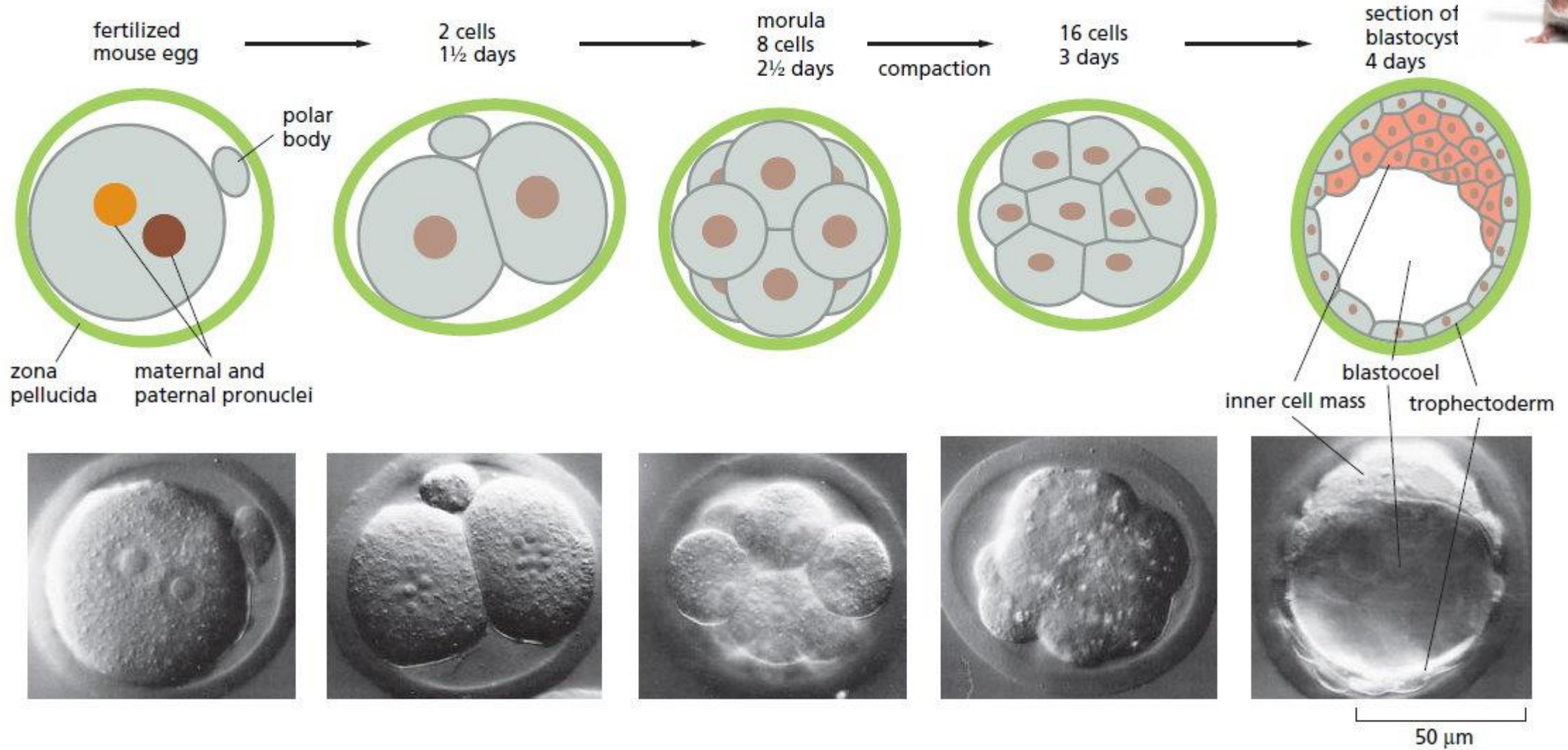


Hay compactación de las células en estado de 8 células

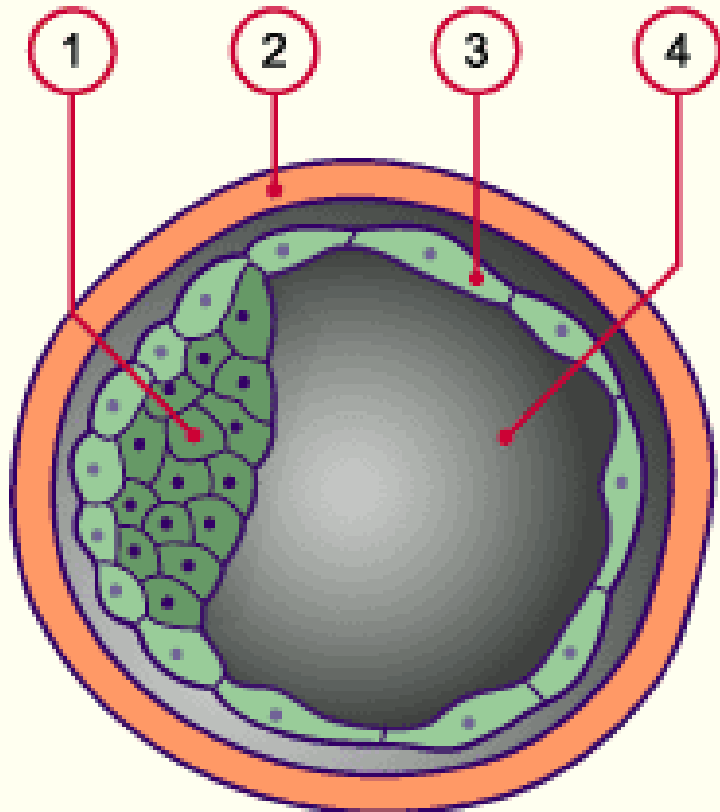


En mamíferos clivaje radial rotacional holoblástico, blástula: blastocisto





# Blastocisto



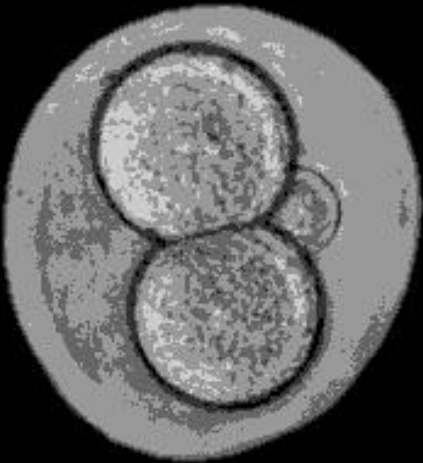
1. Botón germinal o masa interna de células
2. Membrana de fertilización o zona pelúcida
3. Trofoblasto
4. Blastocelo

El blastocelo es INFRAGERMINAL

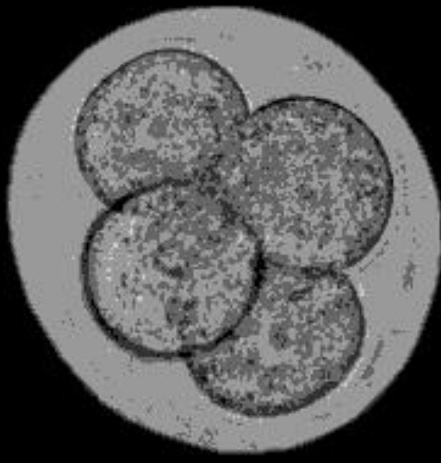




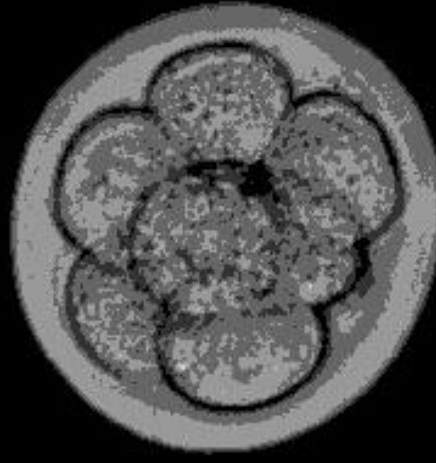
Two-cell



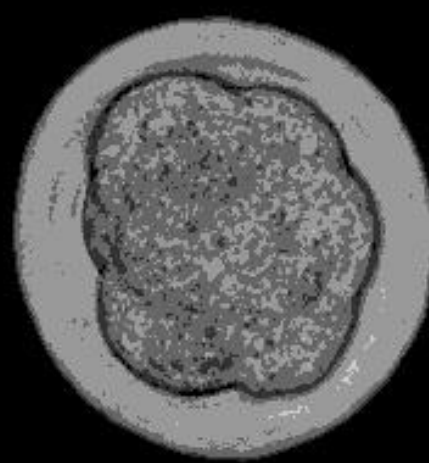
Four-cell



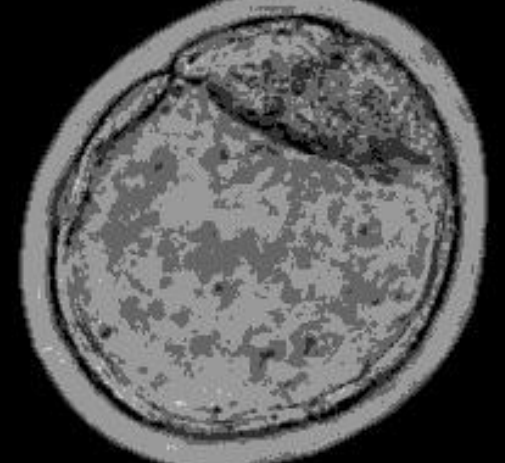
Eight-cell



Compacted morula



Blastocyst



Rotación del  
segundo huso  
mitótico



Mórula 8 células



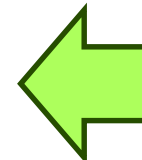
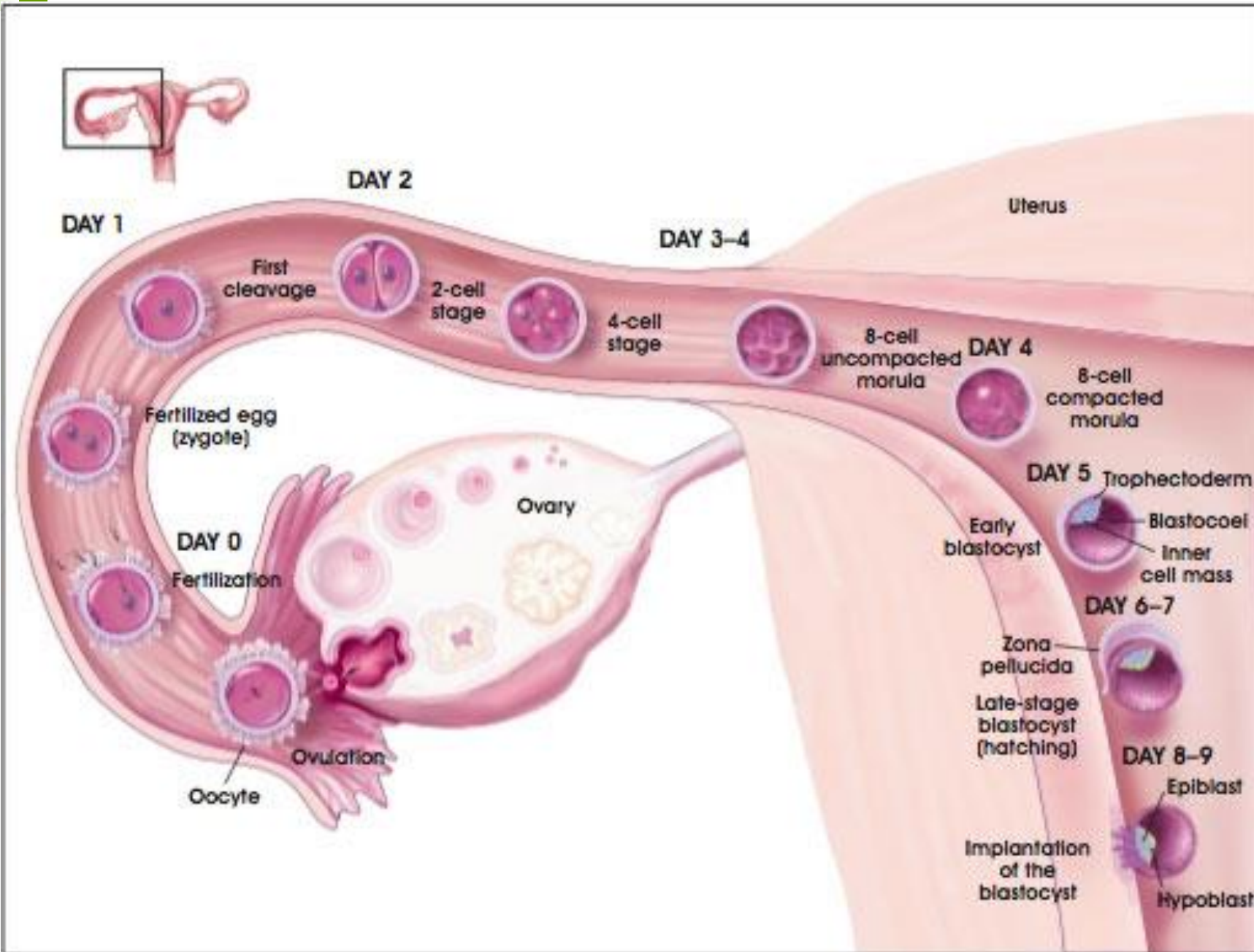
mórula compactada



blastocisto

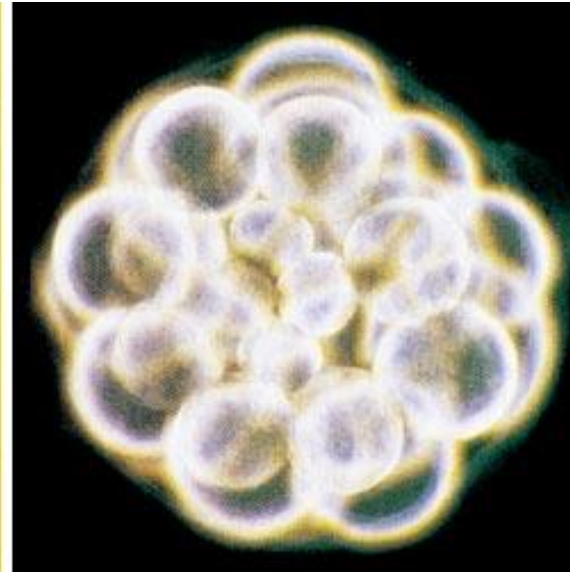
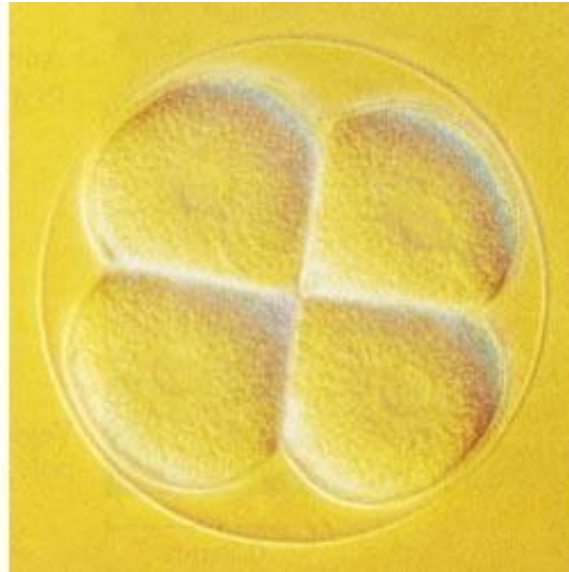




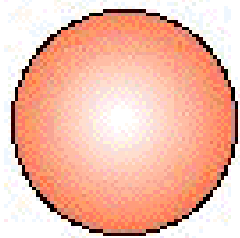


Blastocisto

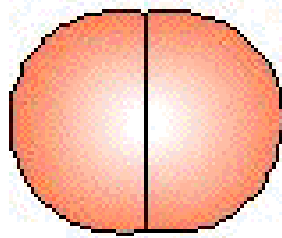




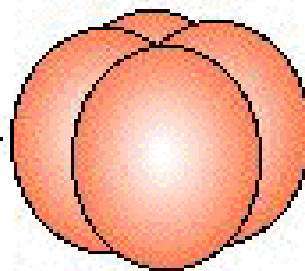
## Clivaje holoblástico espiral



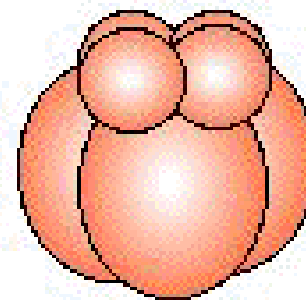
zygote



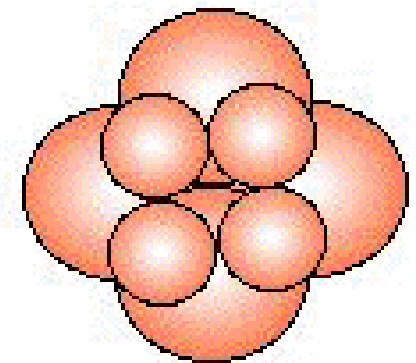
2 cells



4 cells

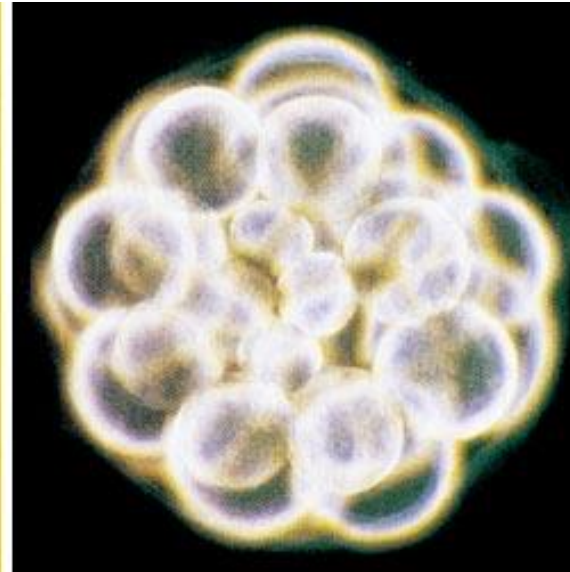
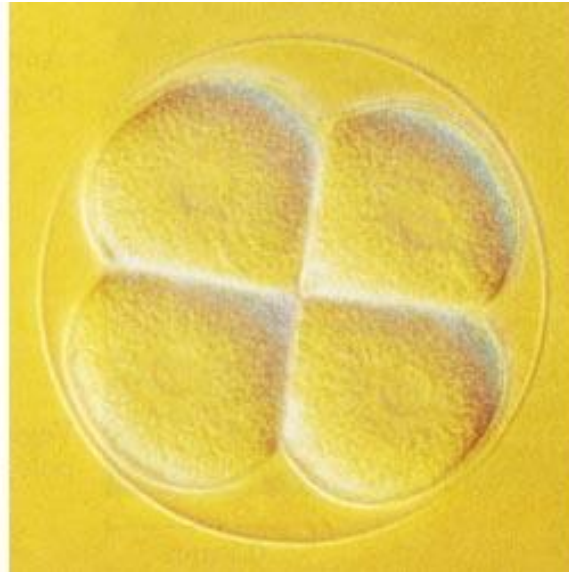
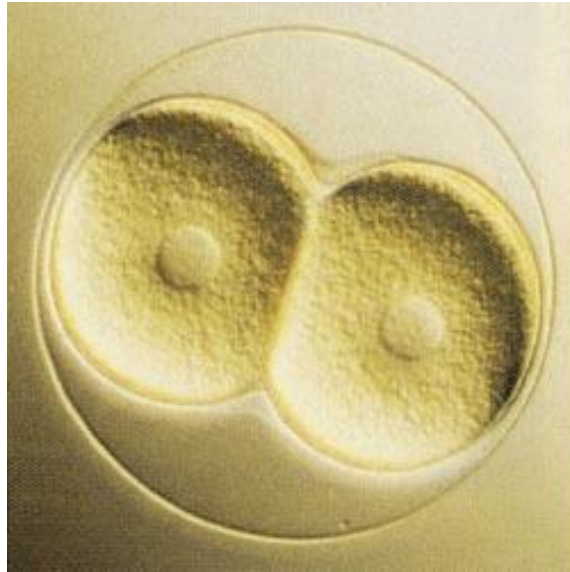


8 cells



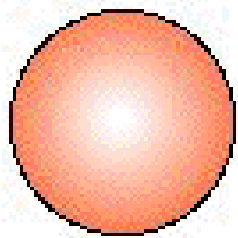
8 cells



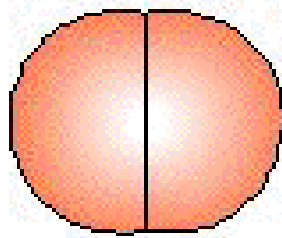


estereoblástula

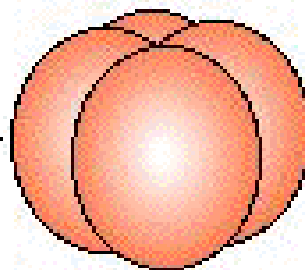
### Clivaje holoblástico espiral



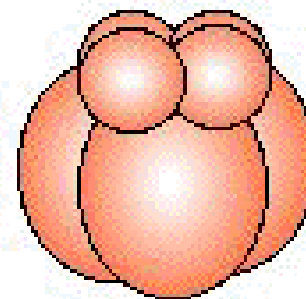
zygote



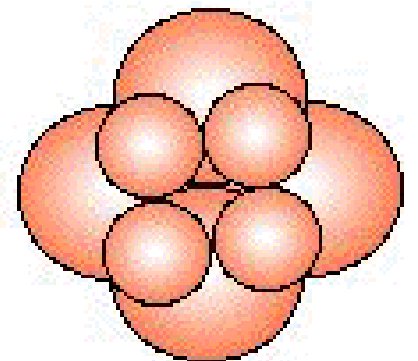
2 cells



4 cells



8 cells




8 cells

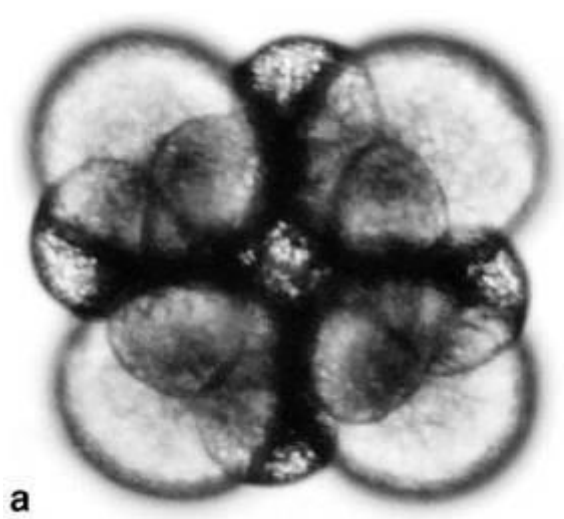


**Protostomes**  
(mollusks, annelids,  
arthropods)

**Eight-cell stage**

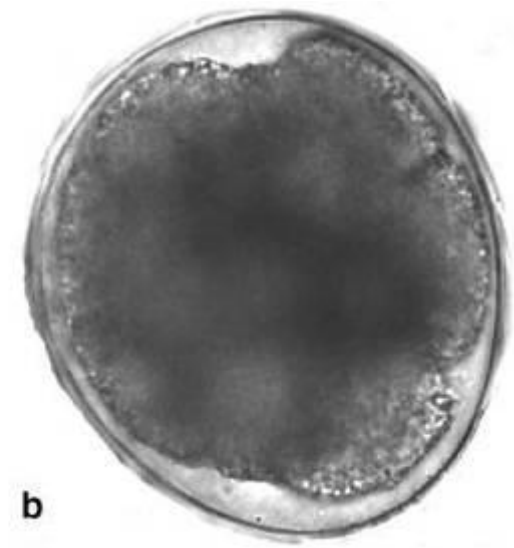


**Spiral and determinate**



a

Mórula



b

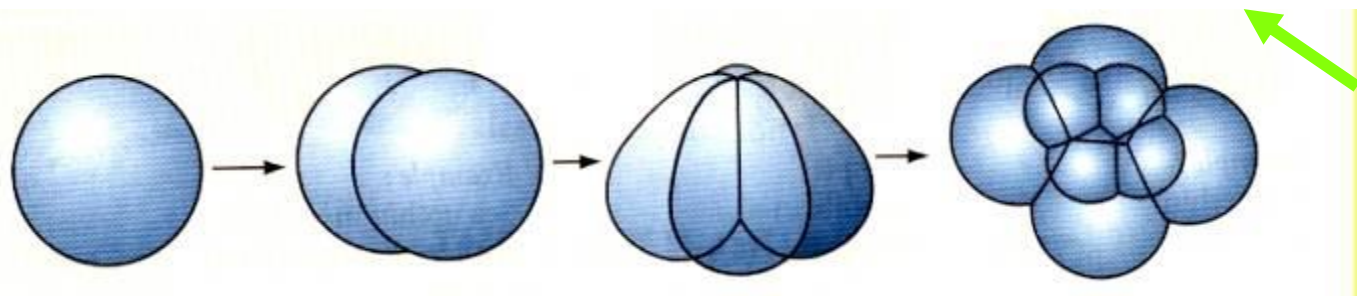
blástula



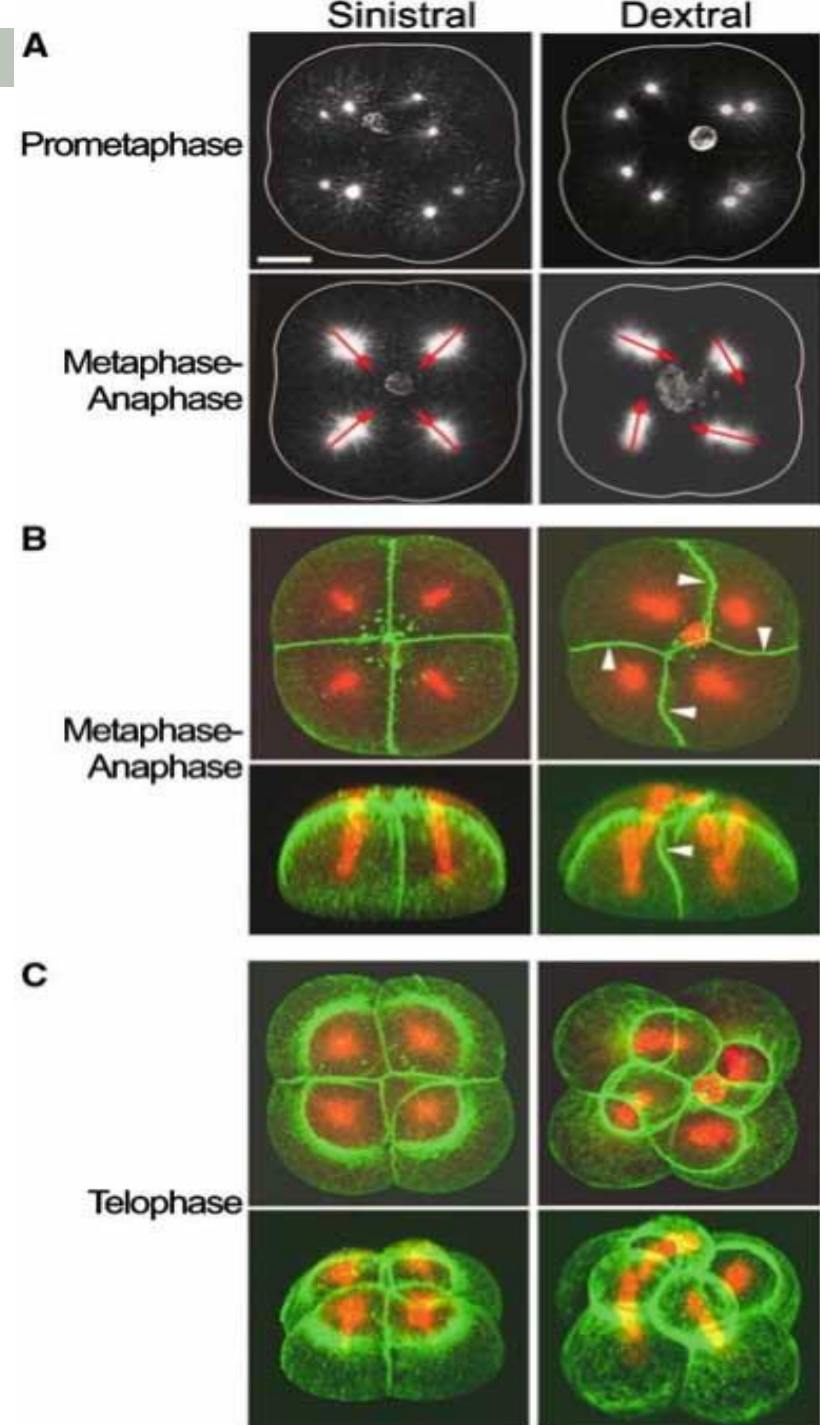
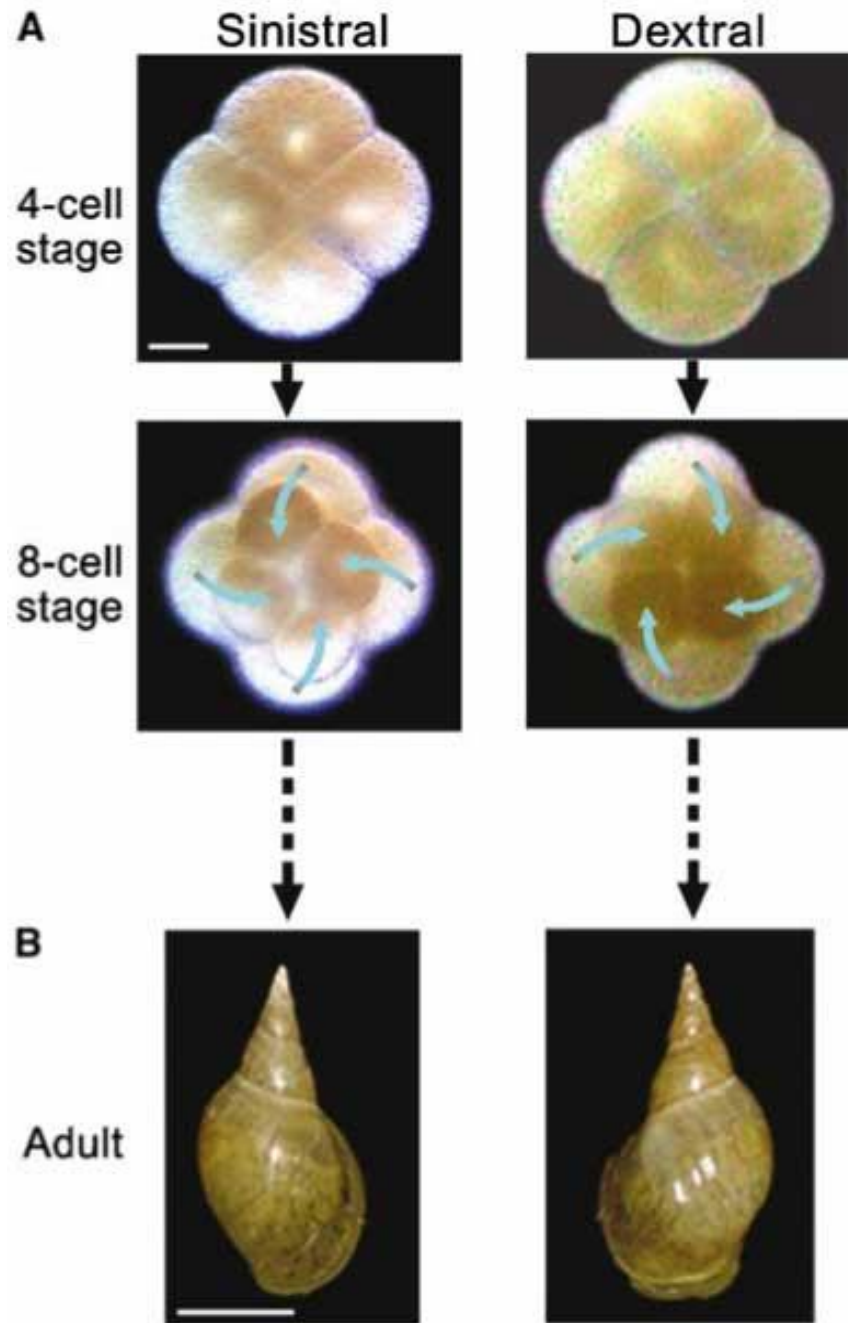
estereoblástula

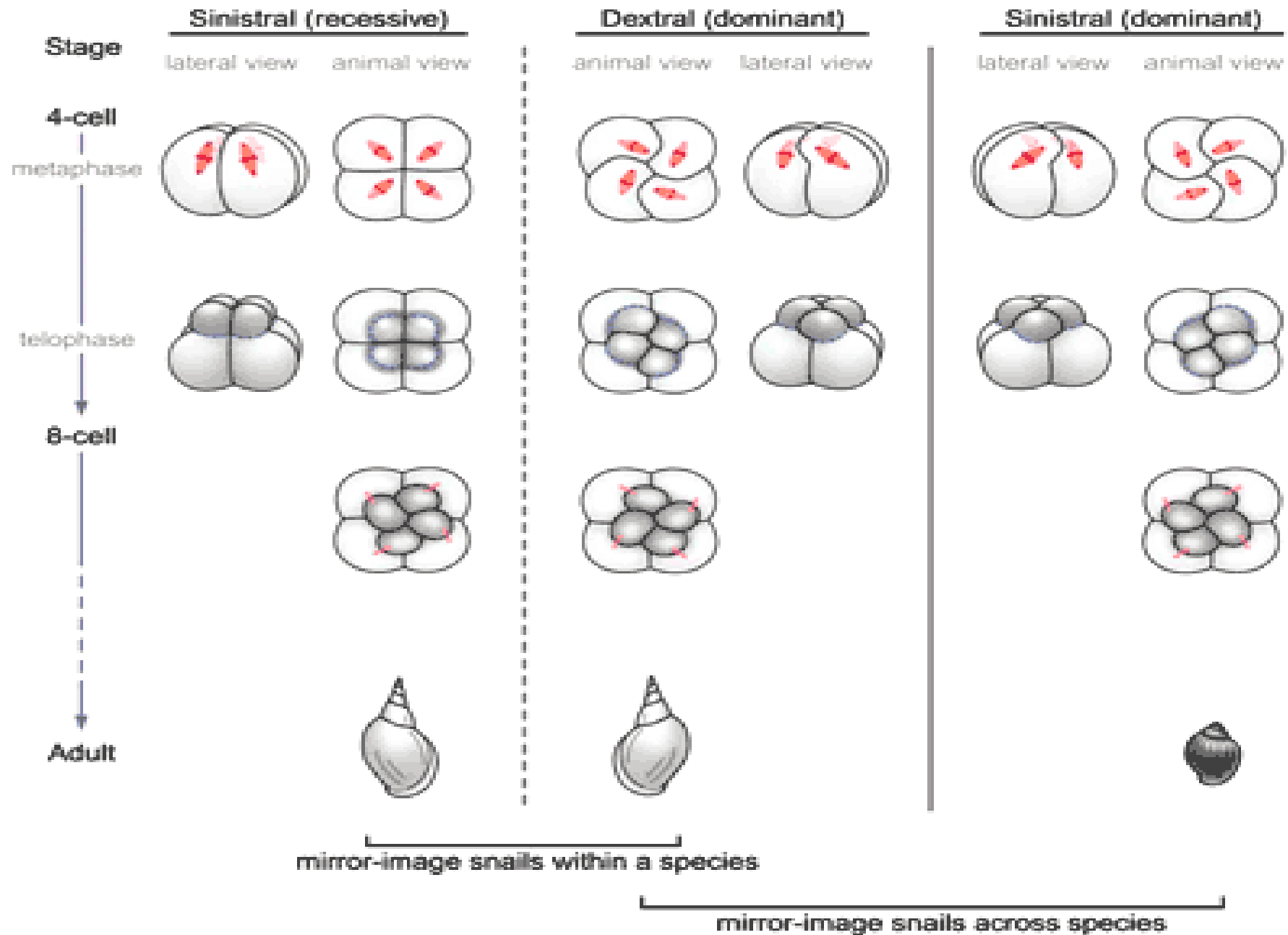
### Segmentación en platelmintos

2. Spiral cleavage  
Annelids, molluscs,  
flatworms

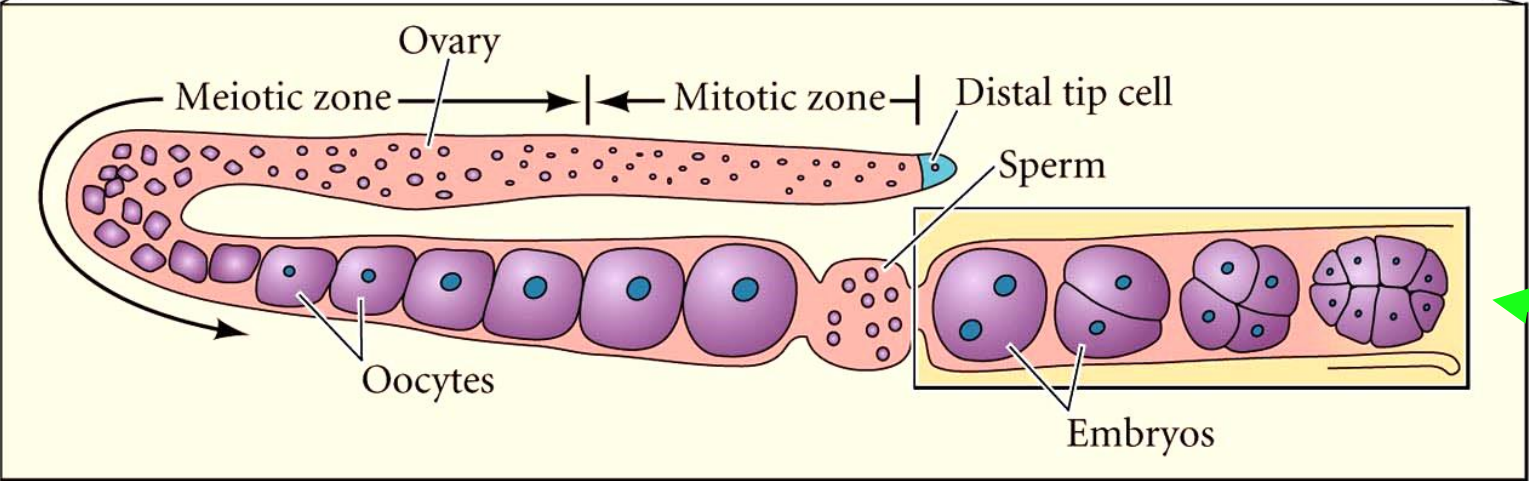
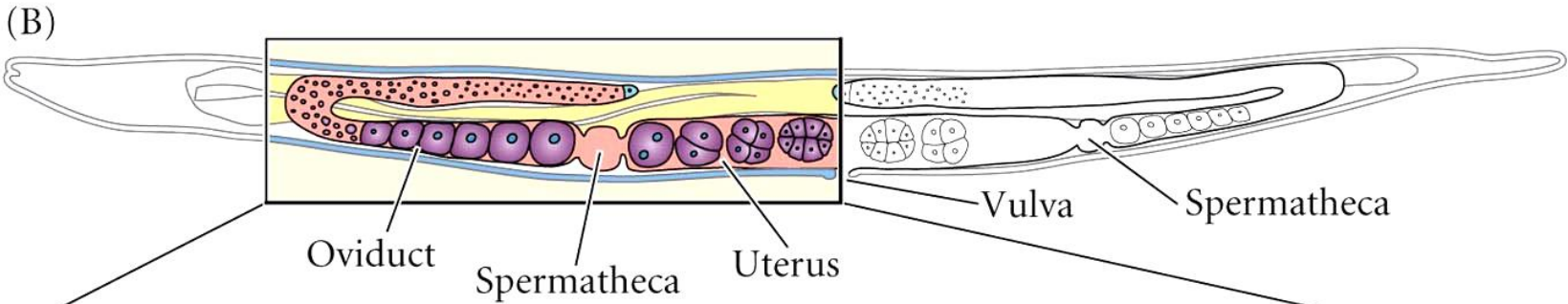
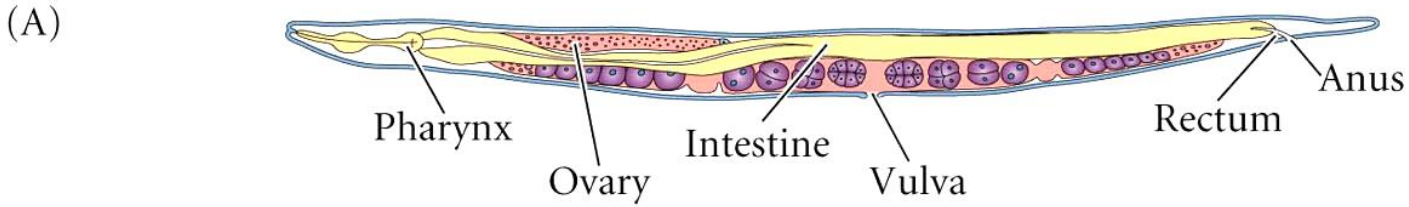
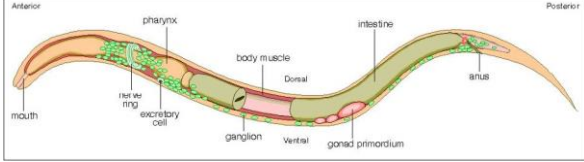


# Clivaje espiral





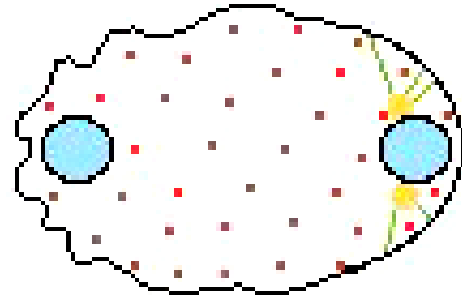
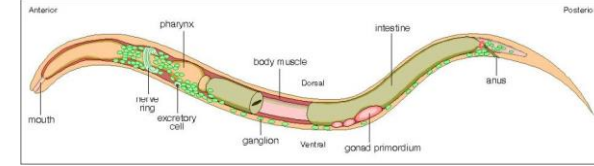
# Clivaje espiral rotacional



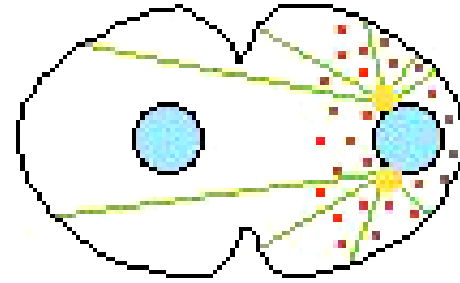
estereoblástula



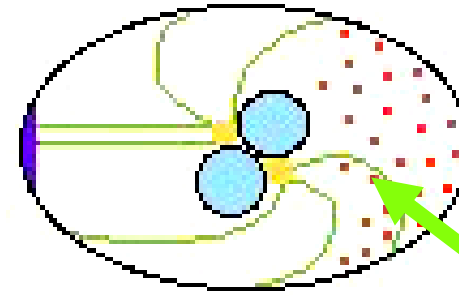
# Clivaje espiral rotacional



a

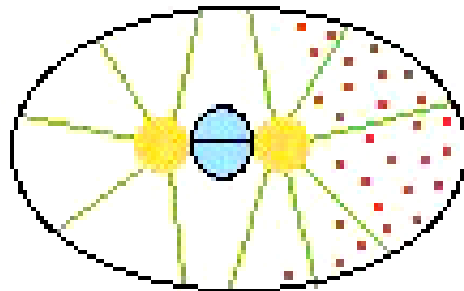


b

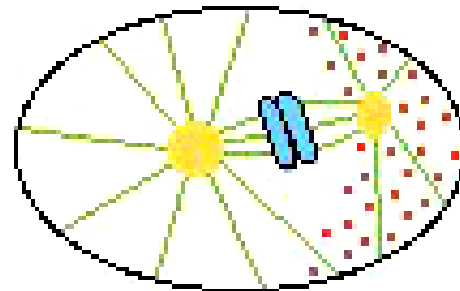


c

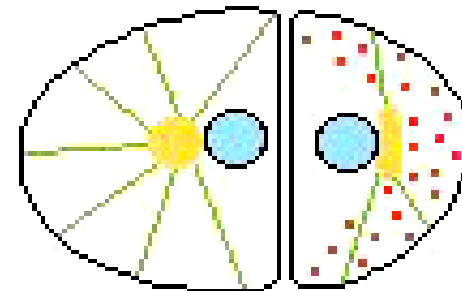
Acercamiento y fusión de pronúcleos



d

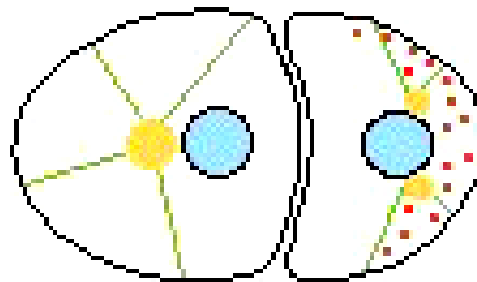


e

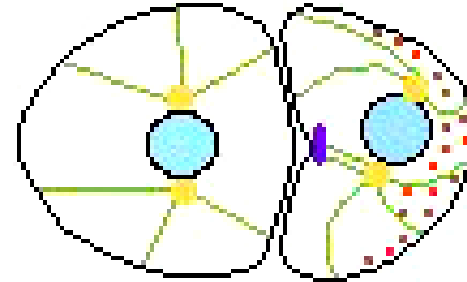


f

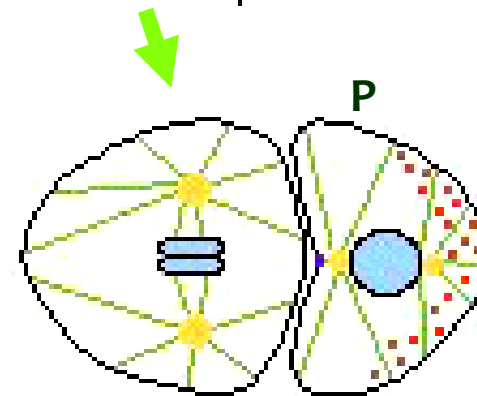
Primera división mitótica desigual



g



h



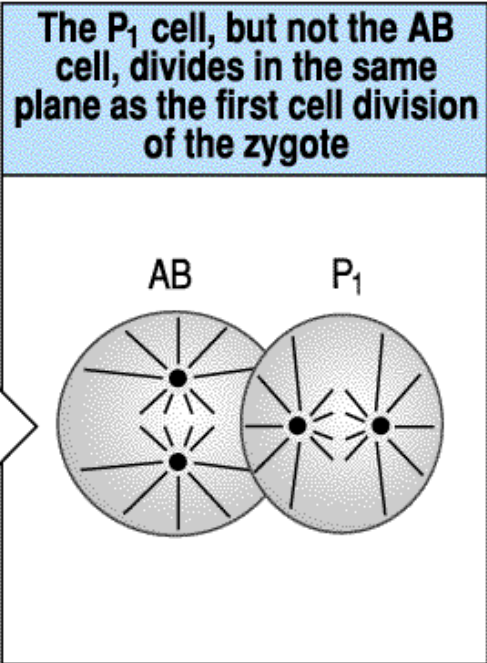
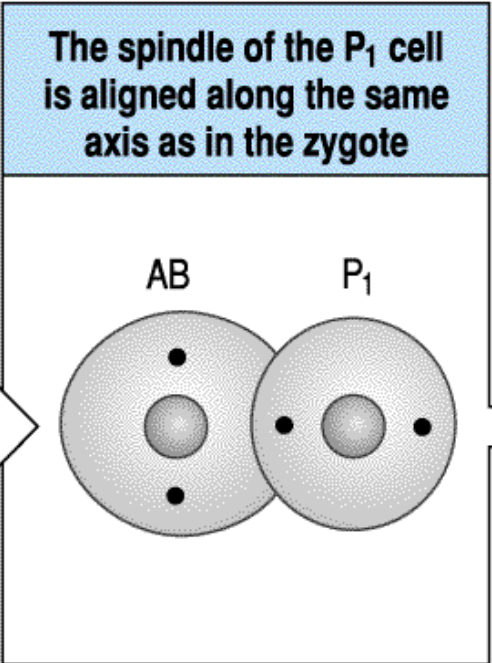
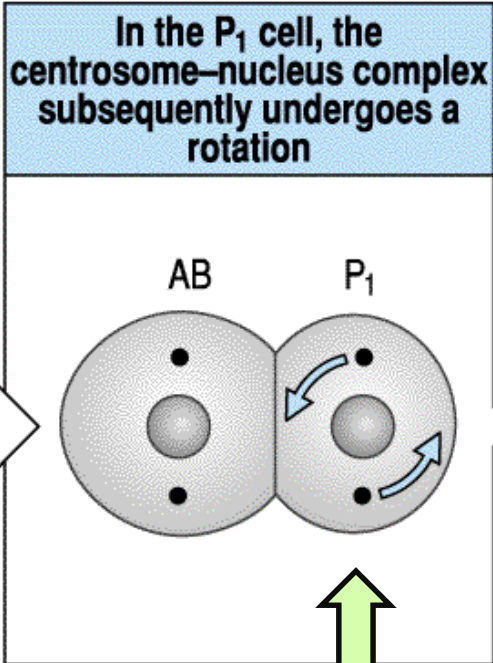
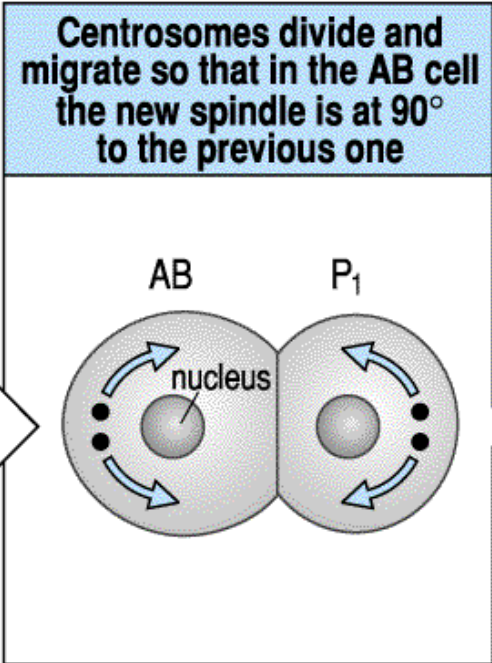
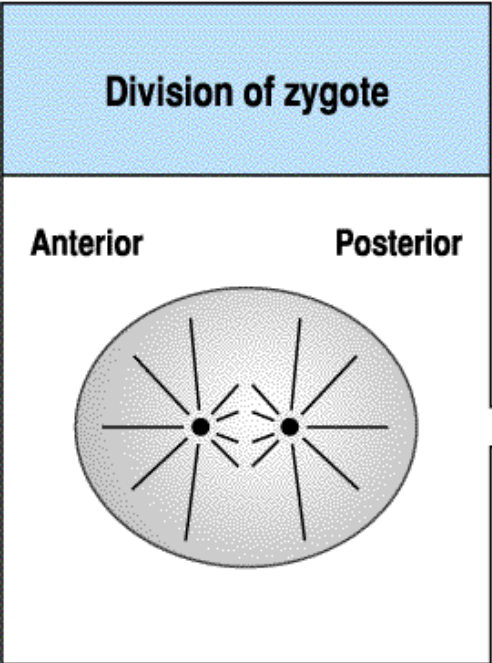
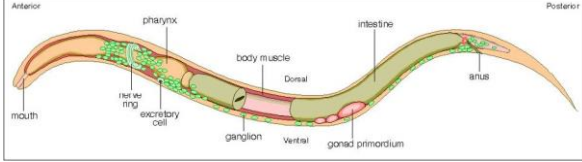
i

Huso mitótico de la célula más grande para la segunda mitosis en orientación vetical

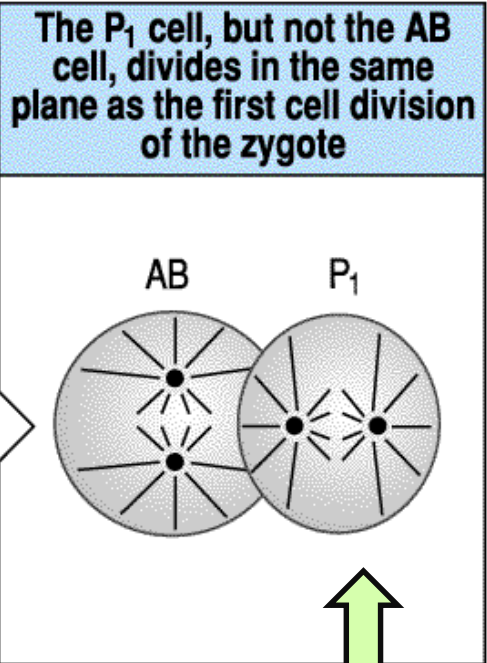
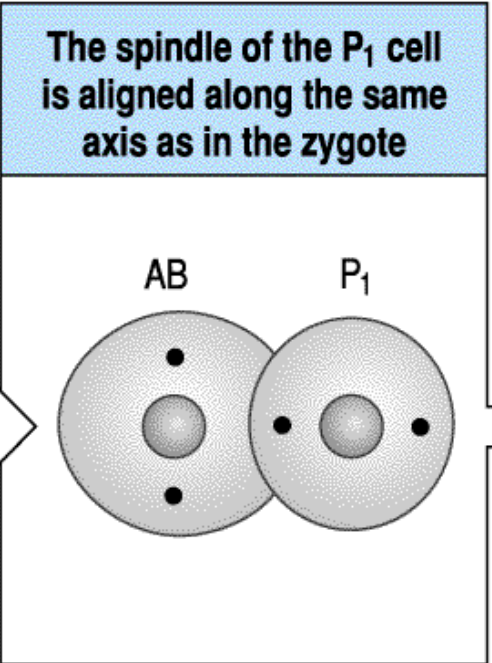
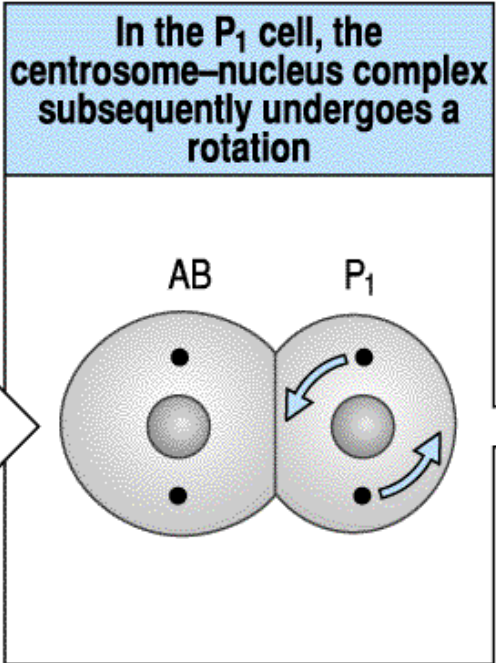
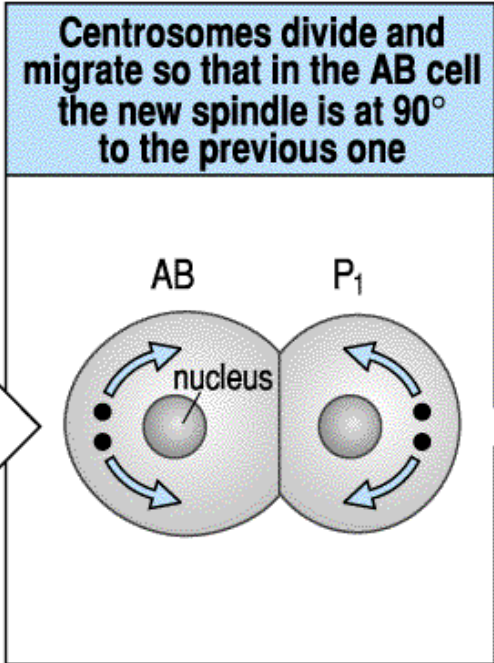
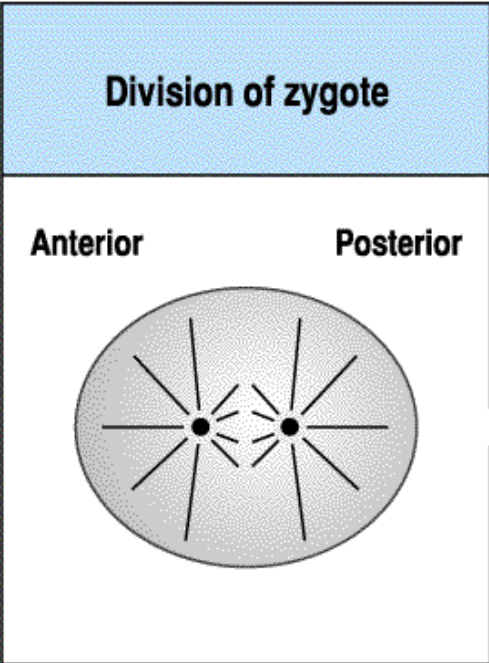
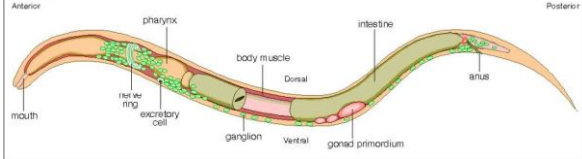


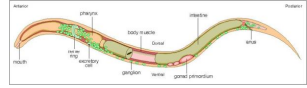


# Clivaje espiral rotacional

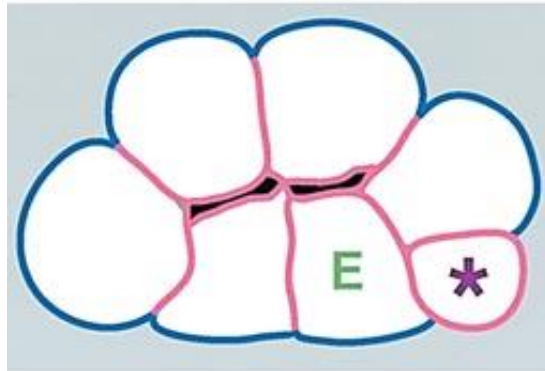
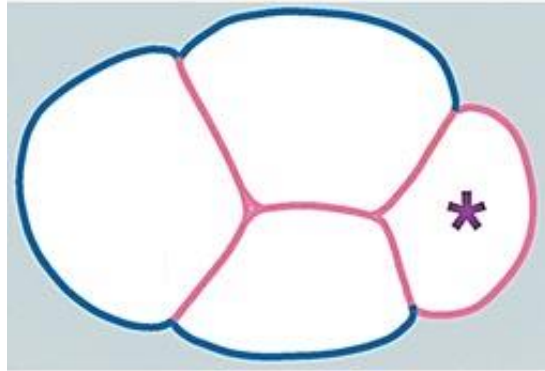
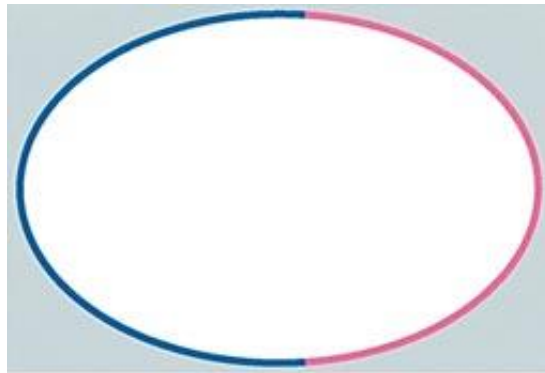
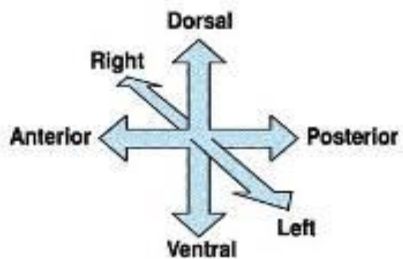
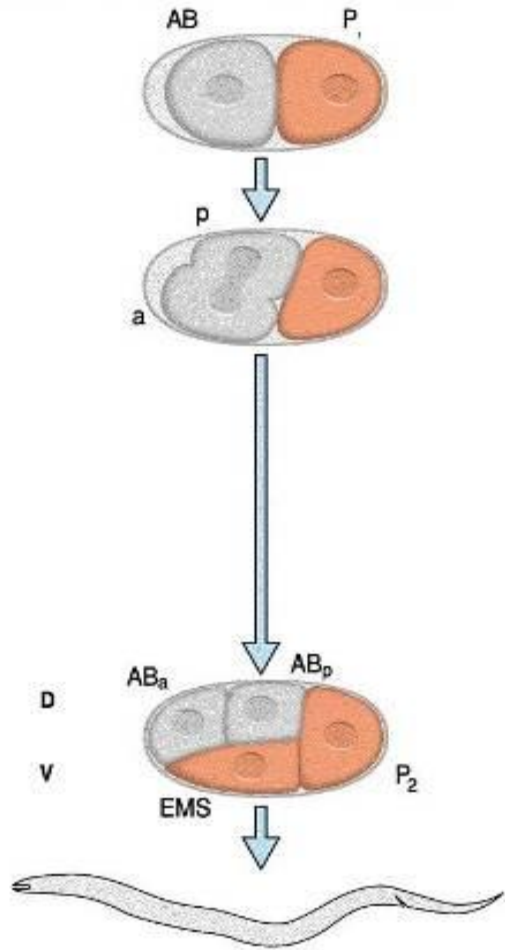


# Clivaje espiral rotacional



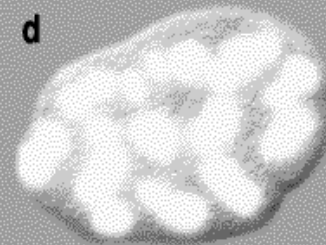
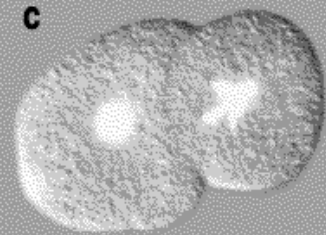
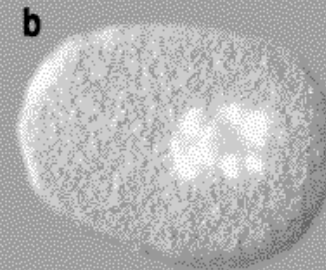
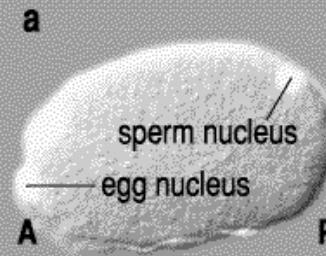


## Normal development

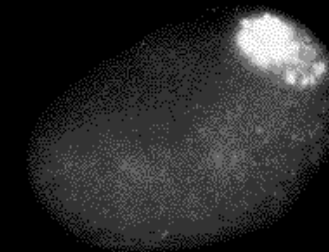
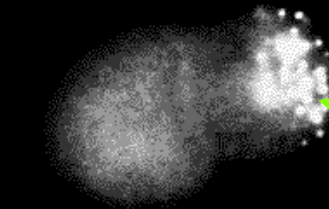
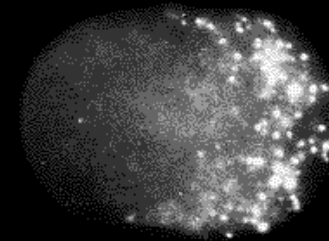
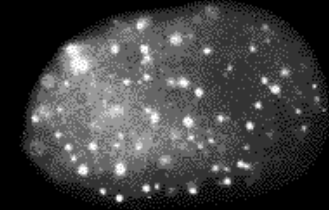


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 From *Gastrulation: From Cells to Embryo*  
 © 2004 Cold Spring Harbor Laboratory Press  
 Chapter 4, Figure 3

## Chromosomes



## P granules

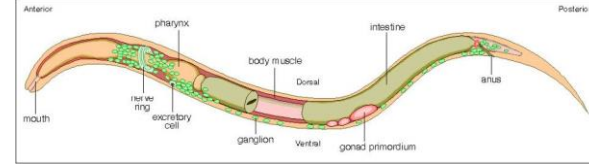


Célula P con los gránulos

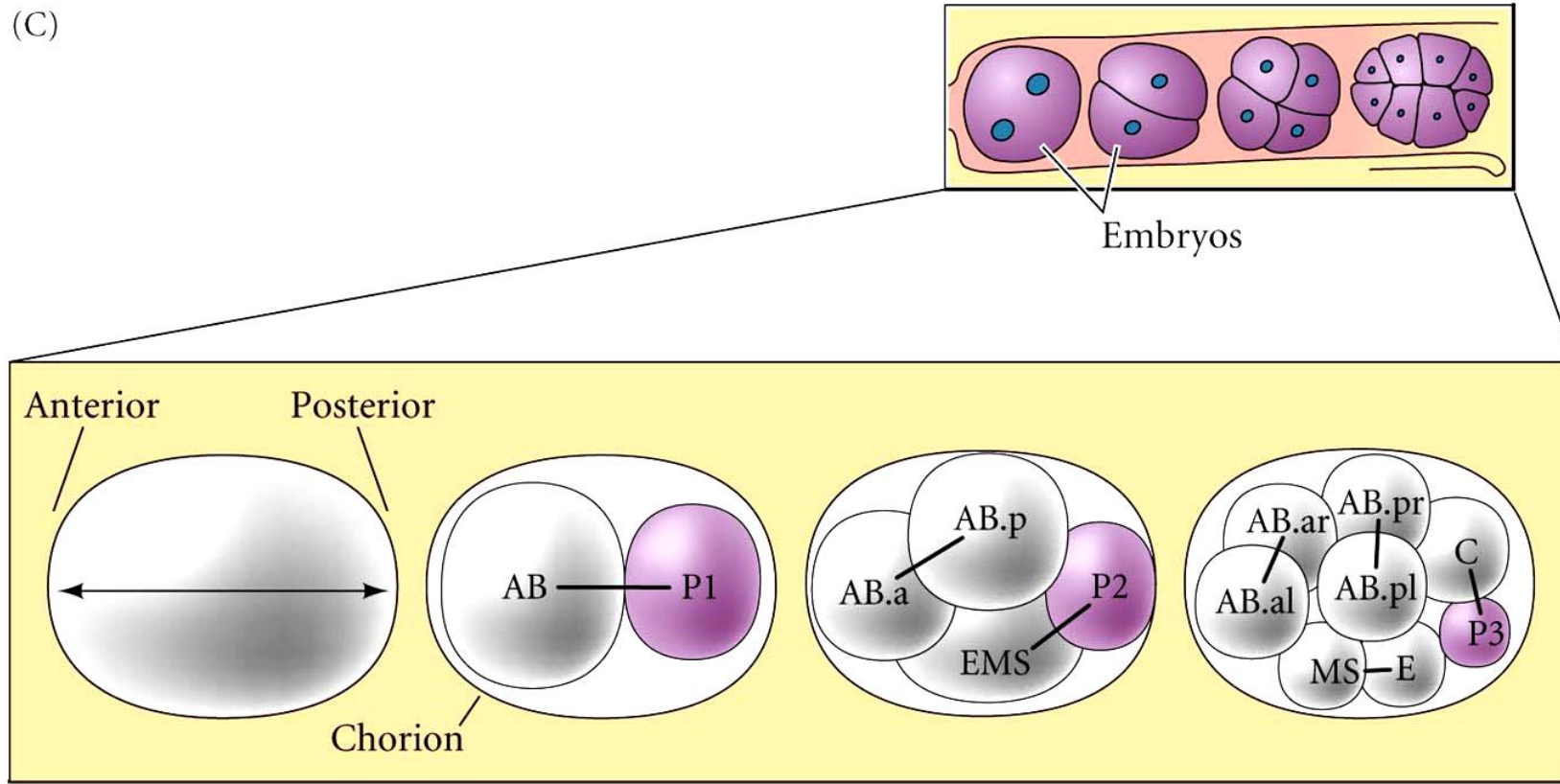
Célula P con los gránulos



# Clivaje espiral rotacional



(C)

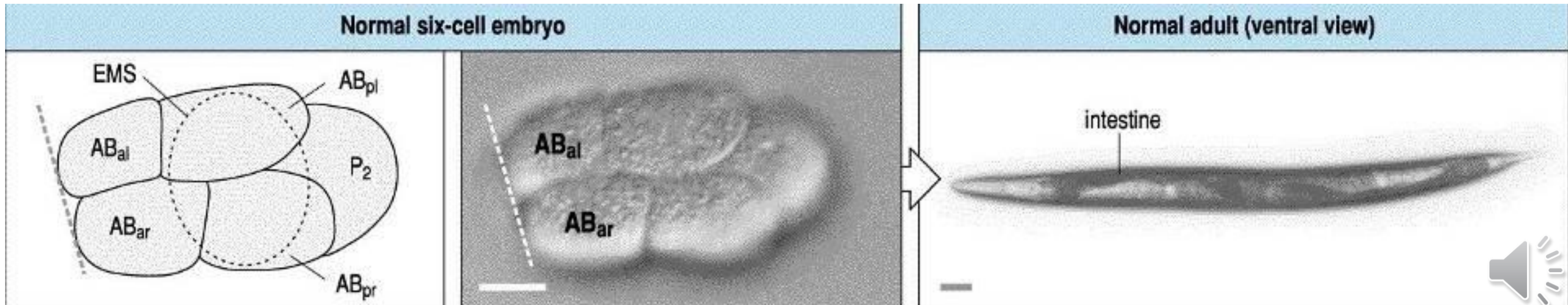
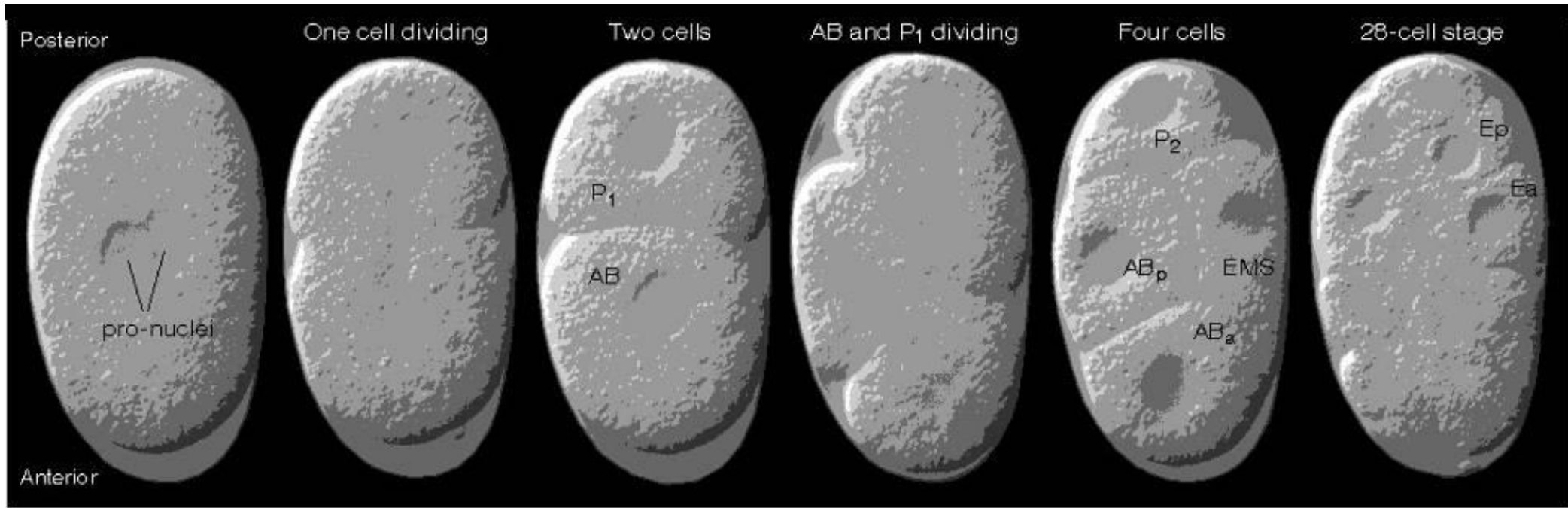


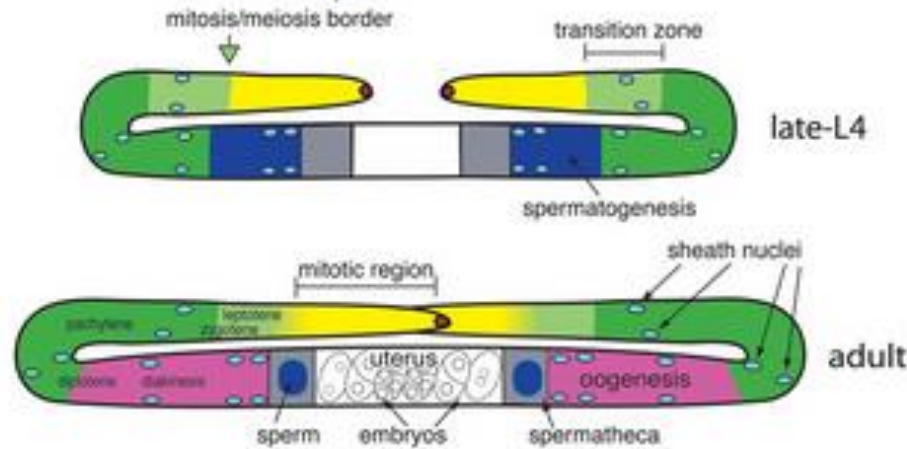
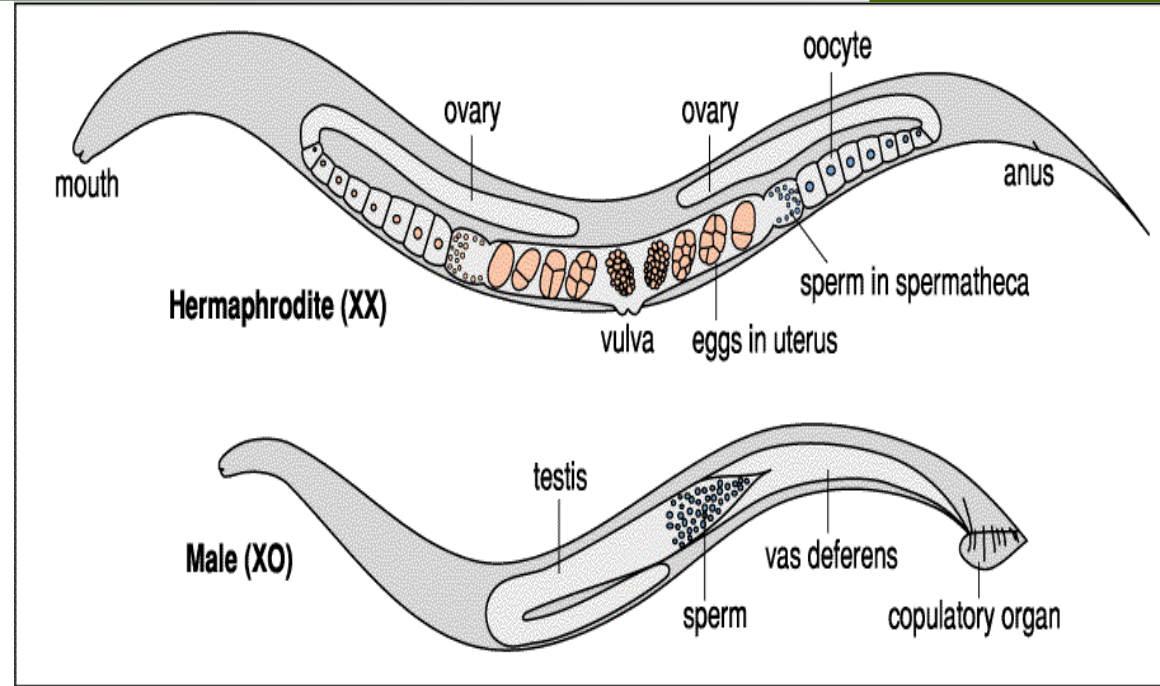
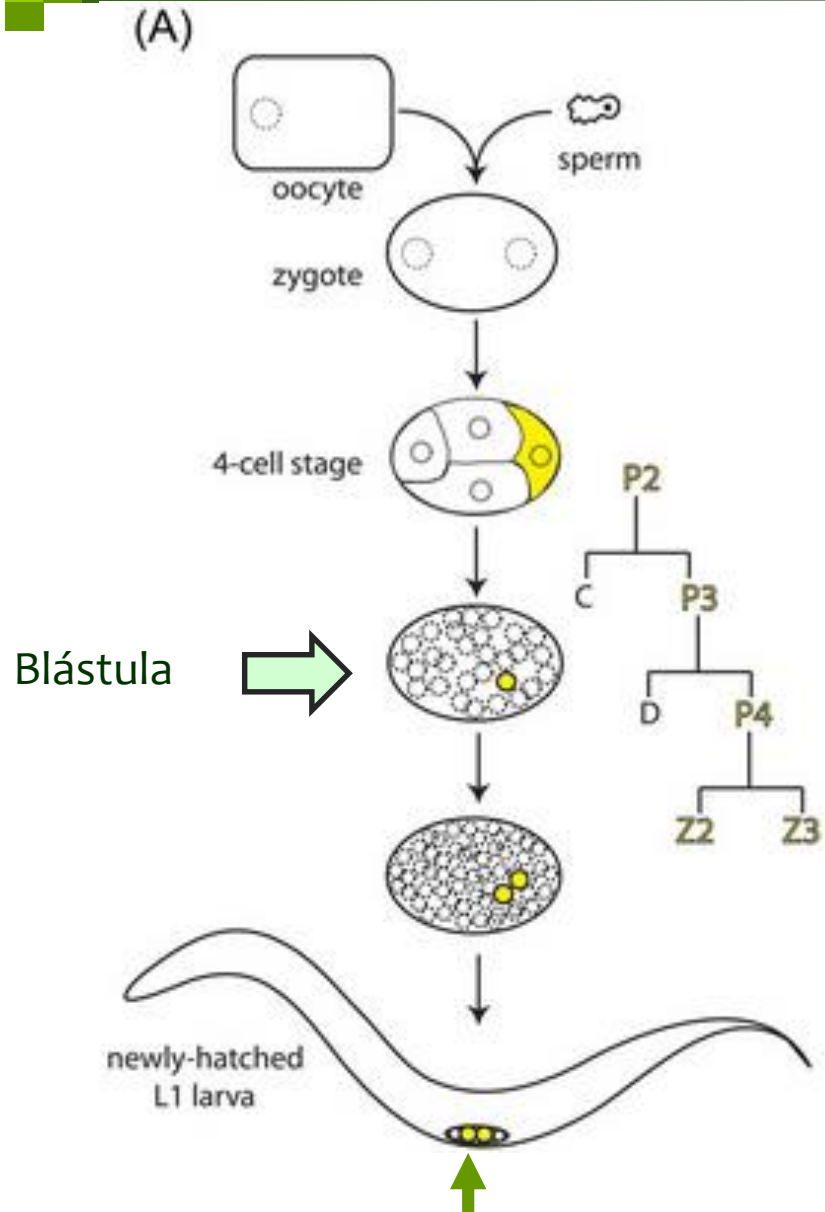
2 células

mórula

blástula

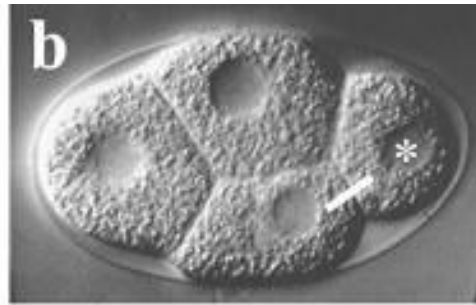
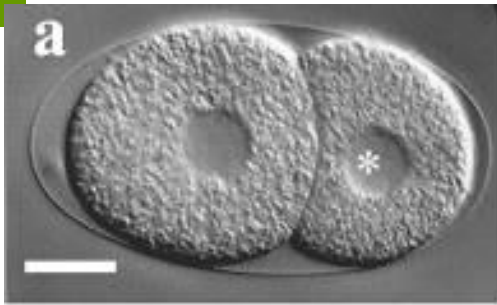




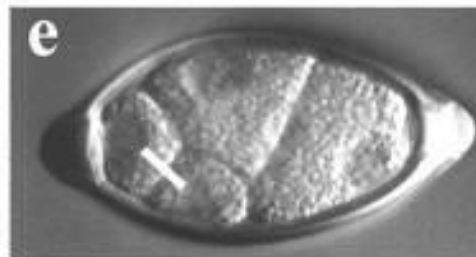


Las células P se convierten en las células germinales en el individuo recién nacido

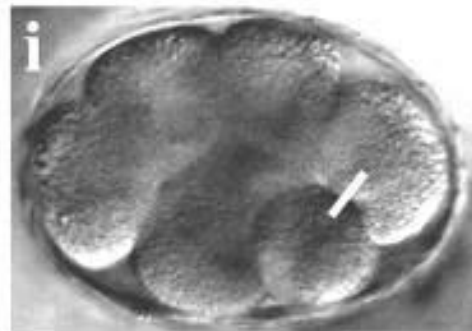
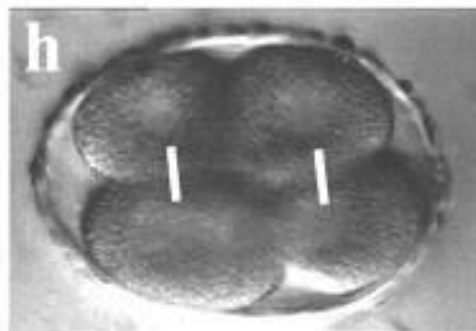
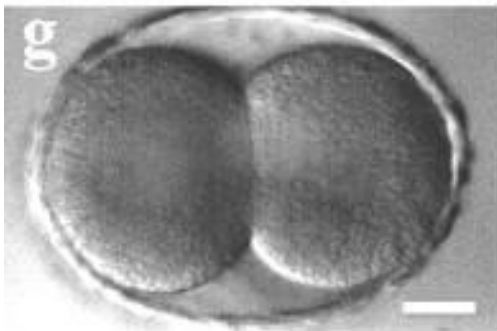




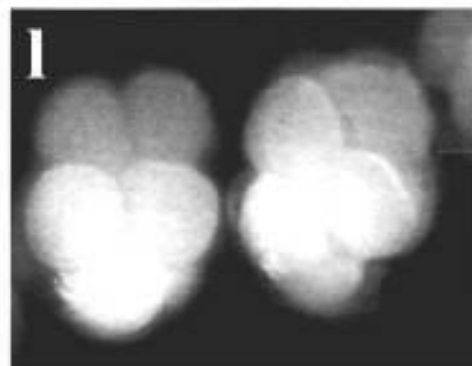
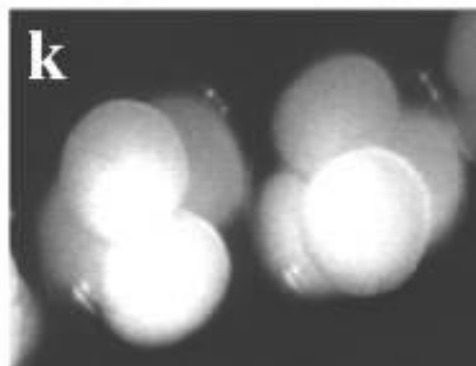
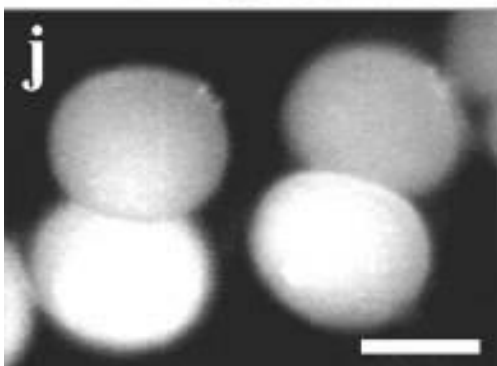
*C. elegans*



*Trichiurius muris*



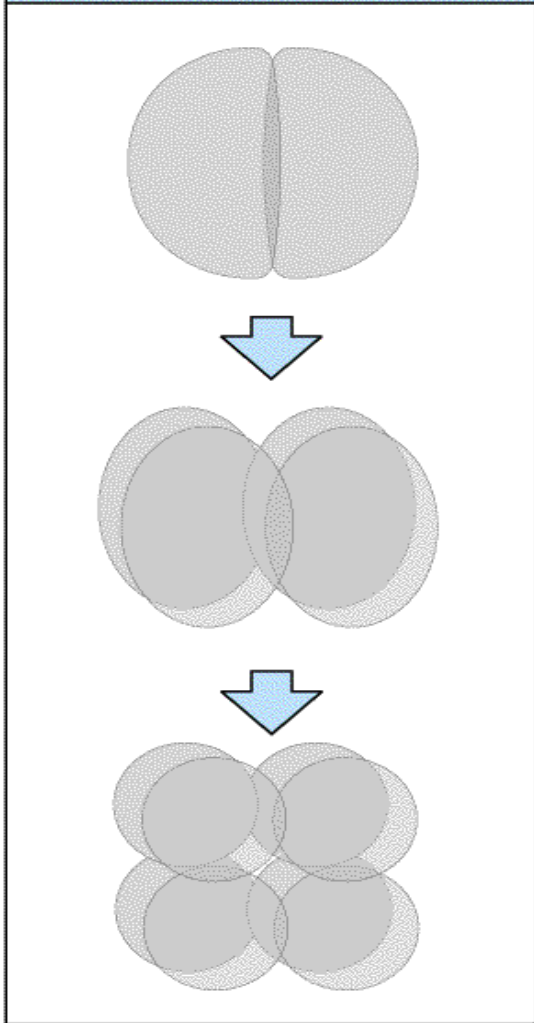
*Prionchulus* sp.



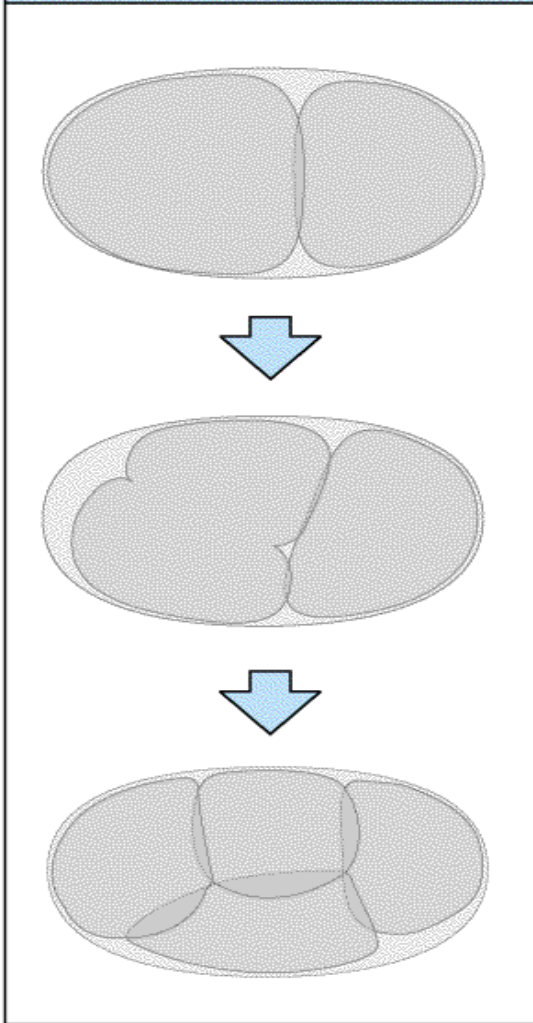
*Enòplus brevis*



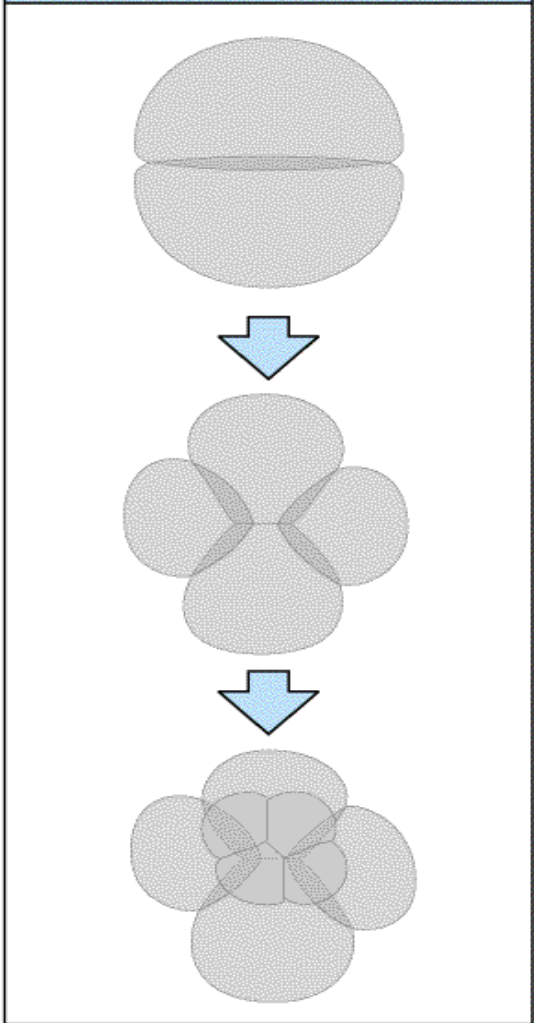
**Radial cleavage—sea urchin**



**Unequal cleavage—nematode**



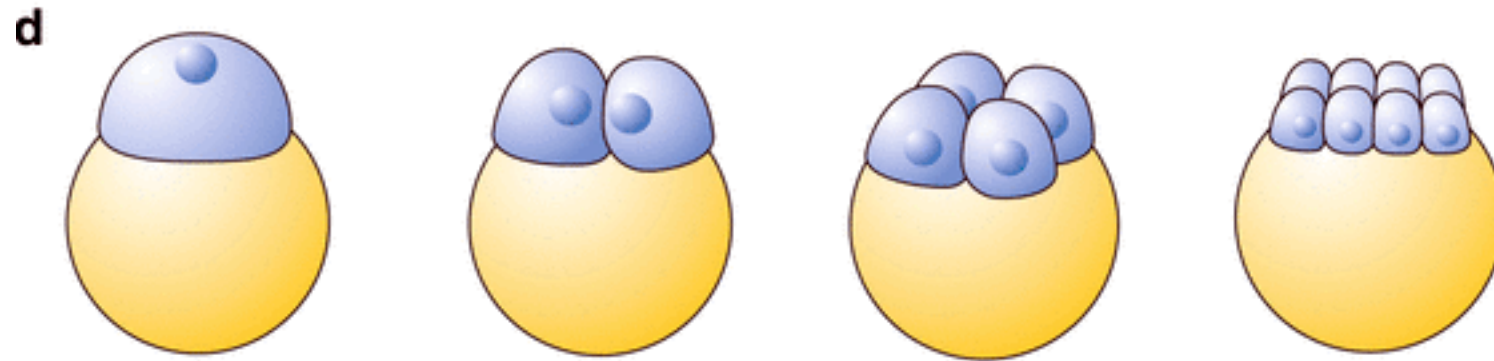
**Spiral cleavage—annelids and molluscs**



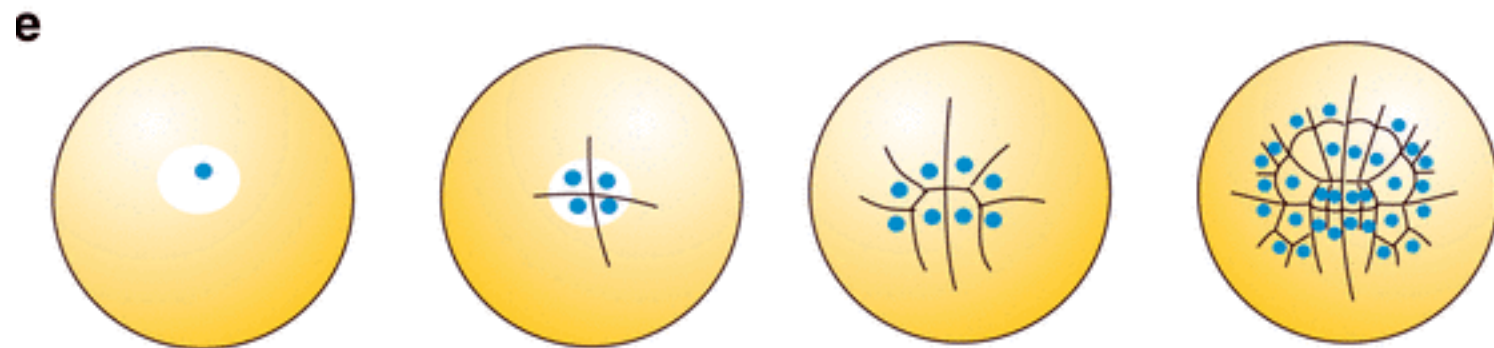
De manera comparativa el clivaje radial, el clivaje espiral rotacional desigual y el clivaje espiral característico de cada grupo.



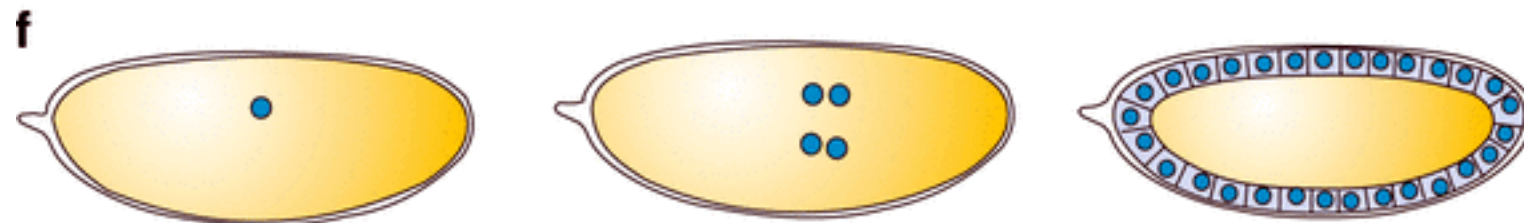




Partial (meroblastic), moderately discoidal: Examples: Fishes, *Danio*, *Oryzias*



Partial (meroblastic) discoidal; View from above. Examples: Reptiles, birds



Superficial. Example: most insects, *Drosophila*

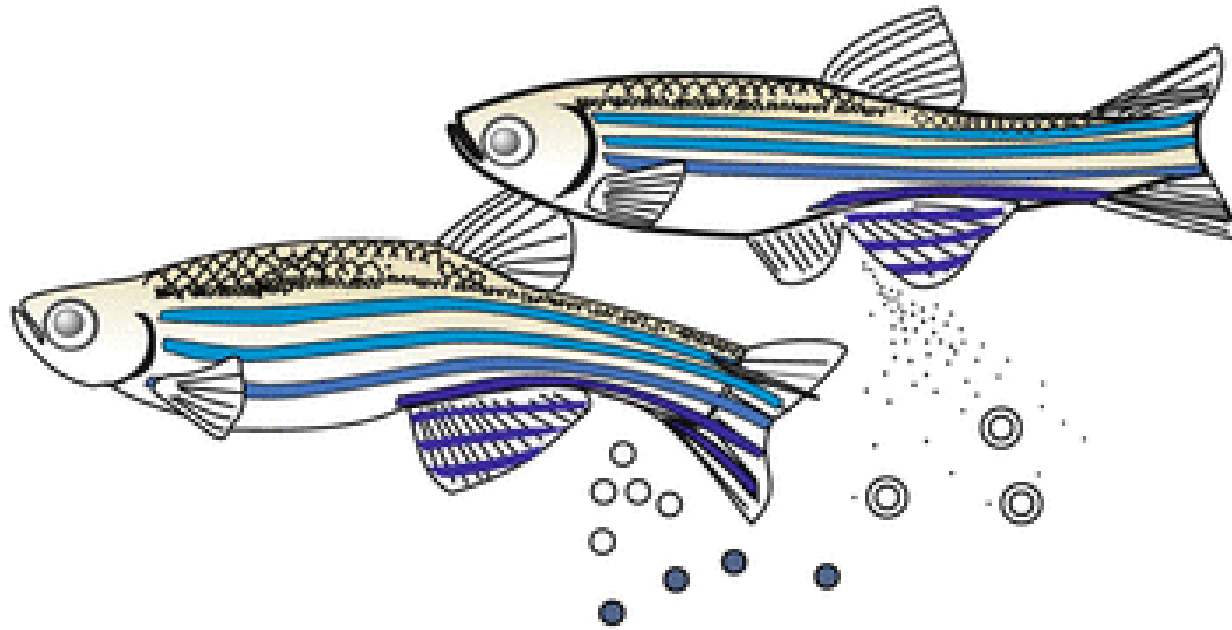
Meroblástico discoidal en peces

Meroblástico discoidal en reptiles, elasmobranquios y cefalópodos

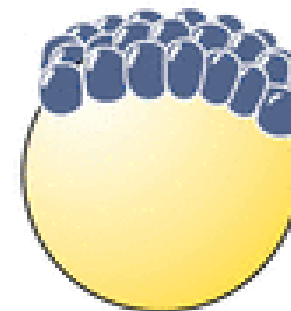
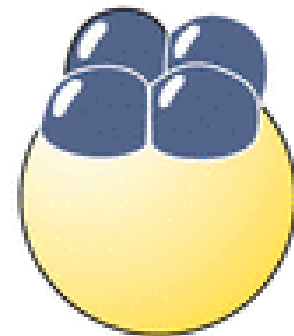
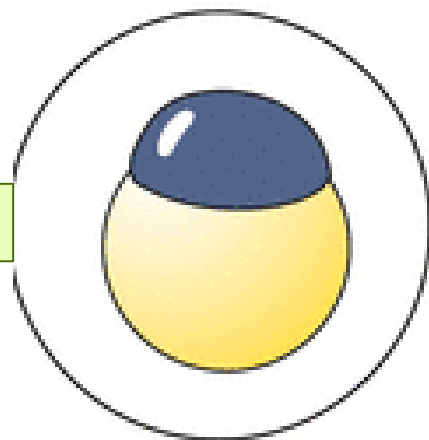
Meroblástico superficial en insectos



*Danio rerio*



cigoto



Cleavage

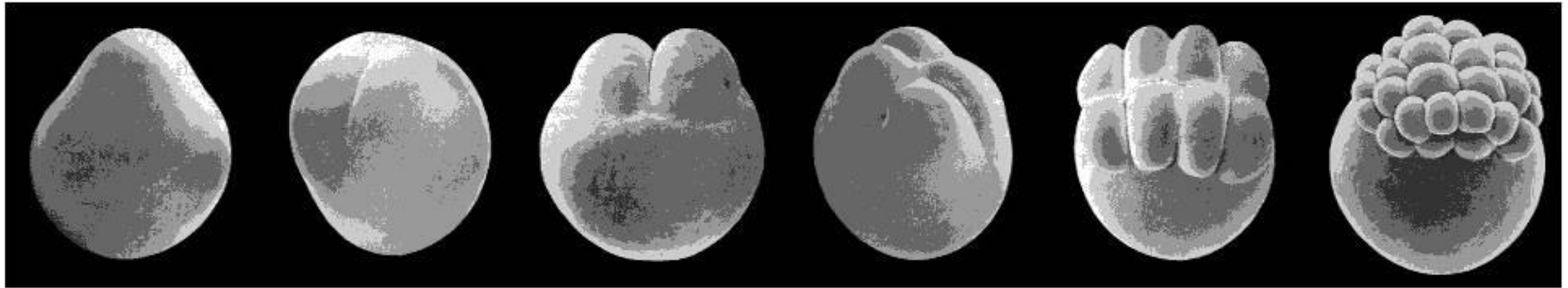


2 células

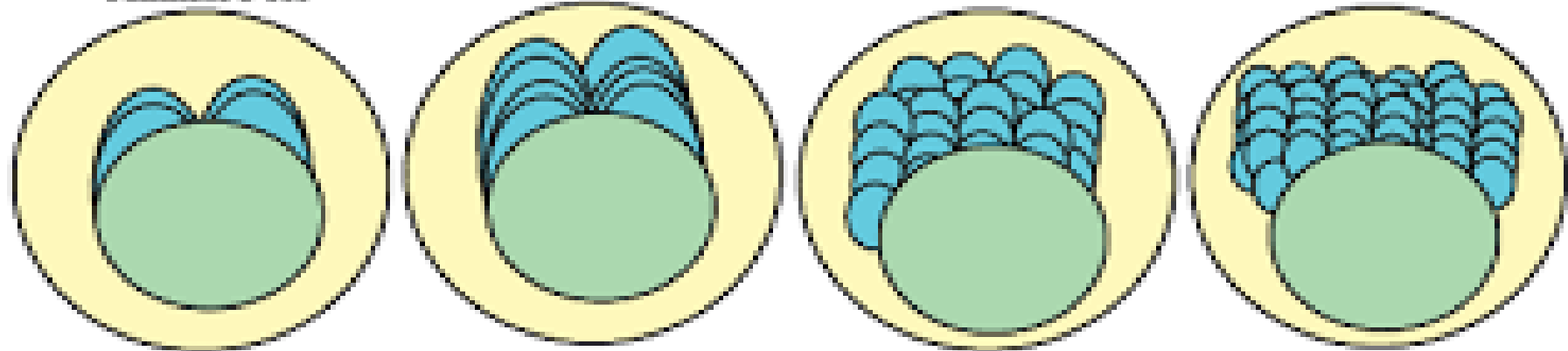
4 células

8 células

64 células



Animal Pole



Ventral Pole

4 Cells

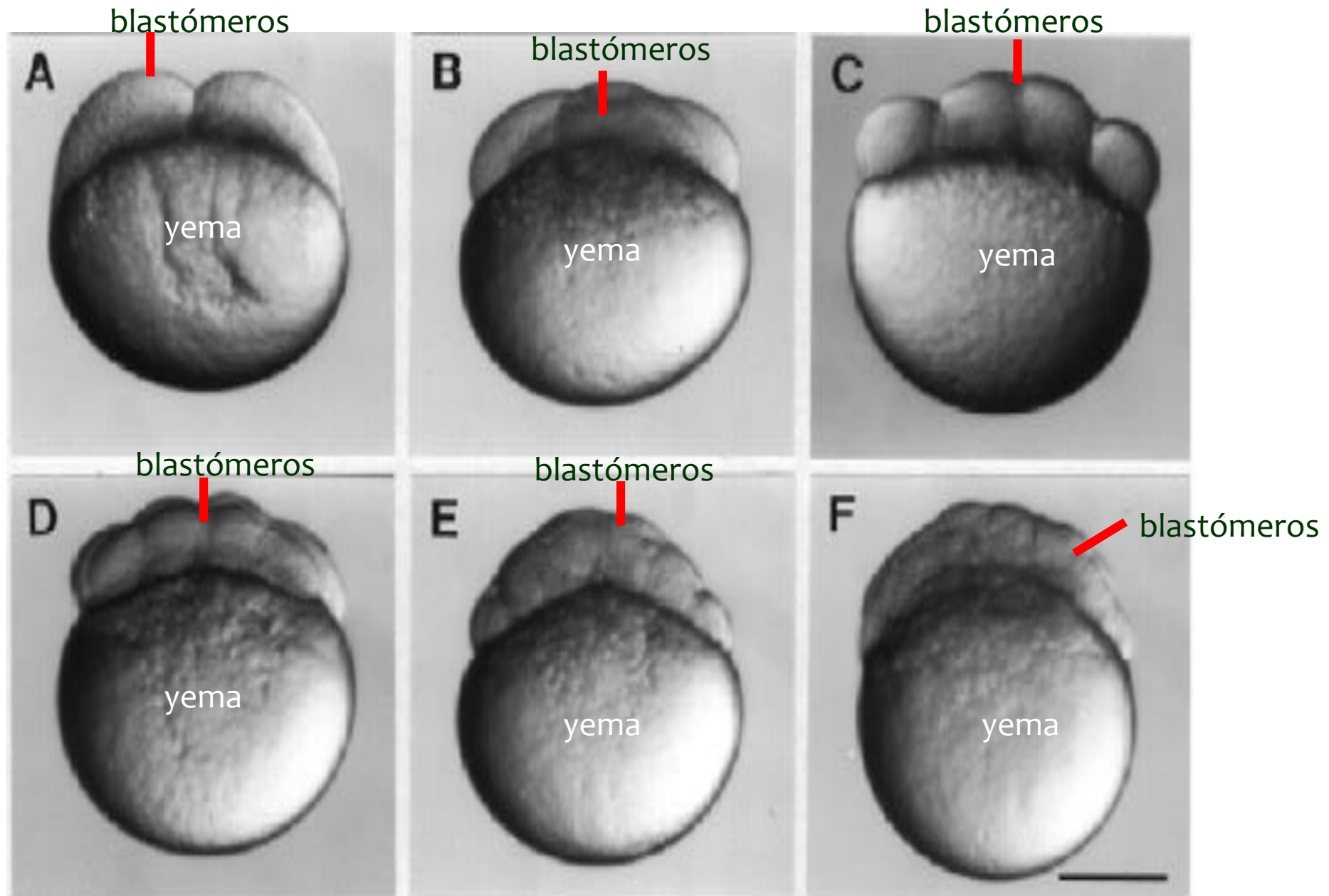
8 Cells

32 Cells

64 Cells

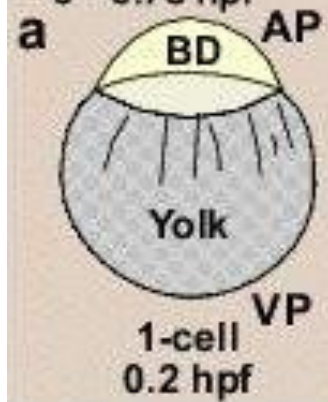
-  Embryonic Fluid
-  Fertilised Egg (Yolk)
-  Blastodisc



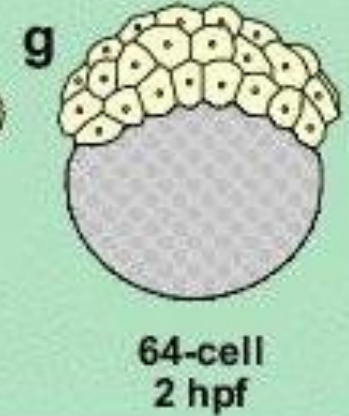
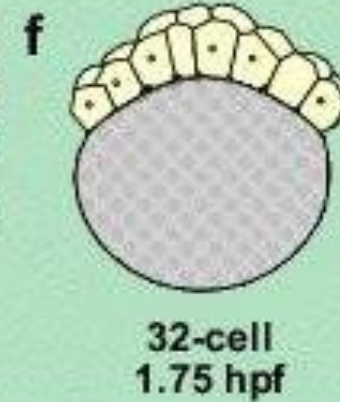
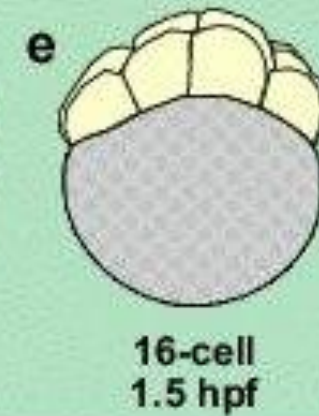
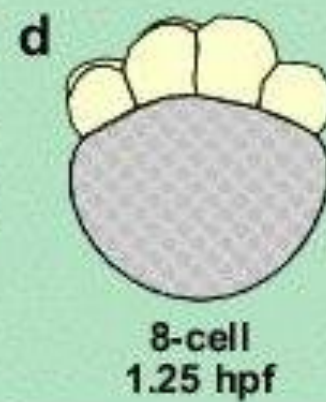
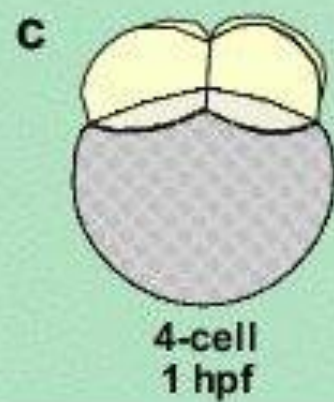
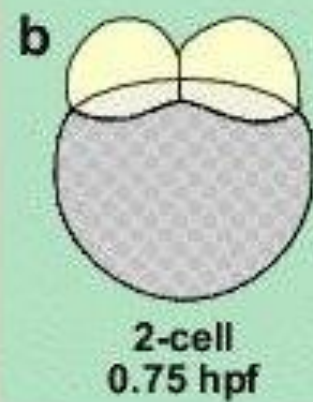




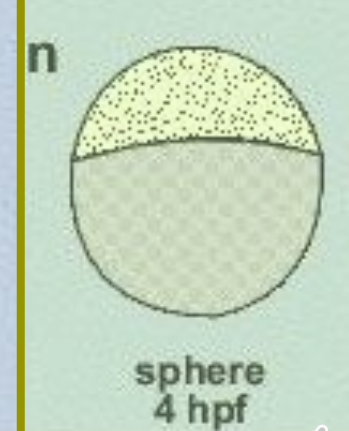
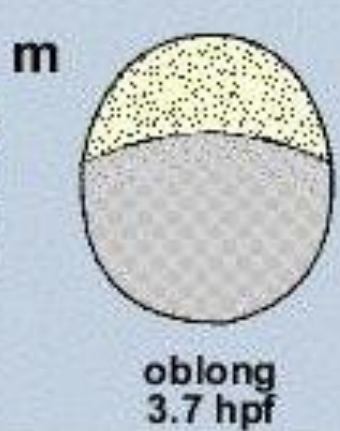
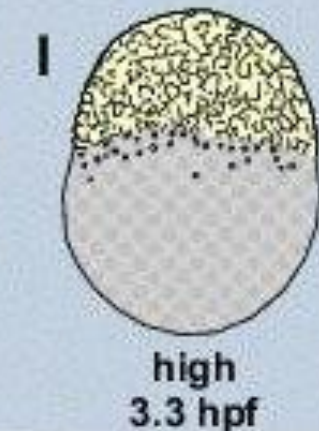
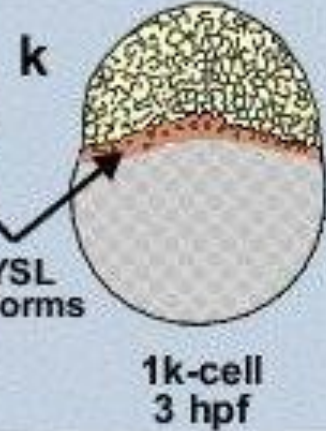
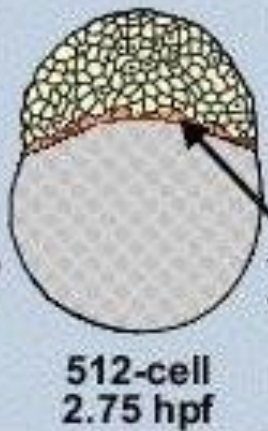
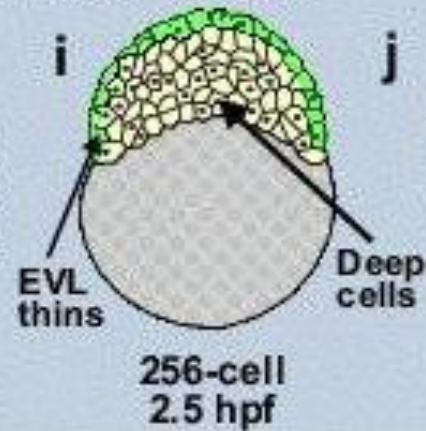
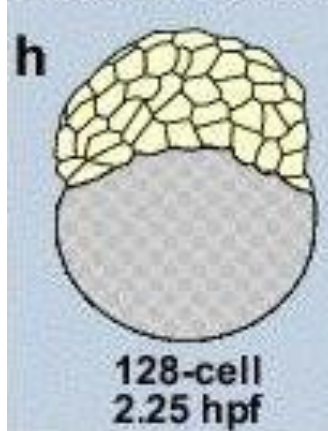
**Zygote Period**  
- 0 - 0.75 hpf



**Cleavage Period - 0.75 - 2.25 hpf**



**Blastula Period - 2.25 - 5.25 hpf**



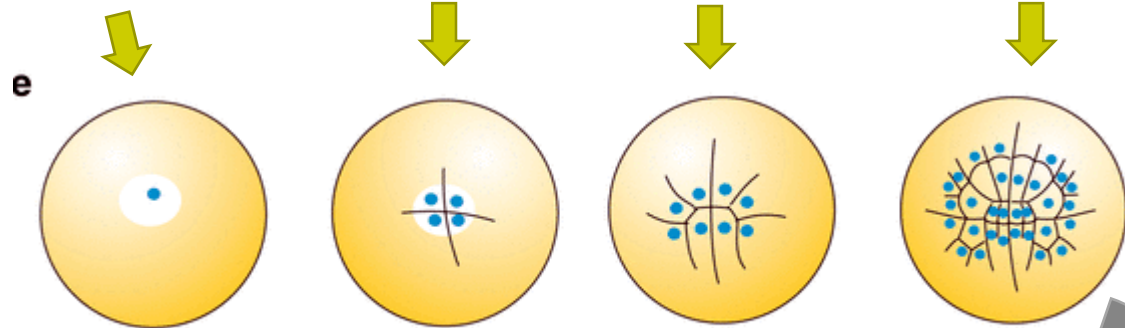


Citoplasma activo con núcleo del cigoto

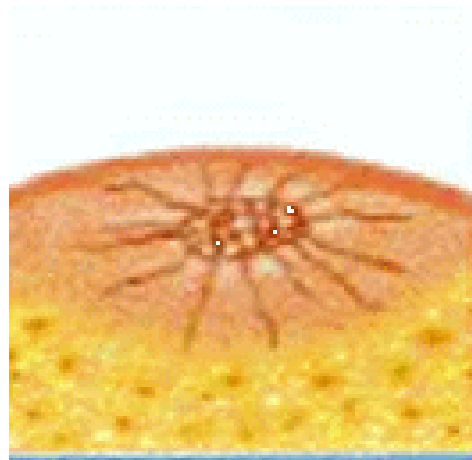
Primera y segunda divisiones mitóticas

Estado de 8 células

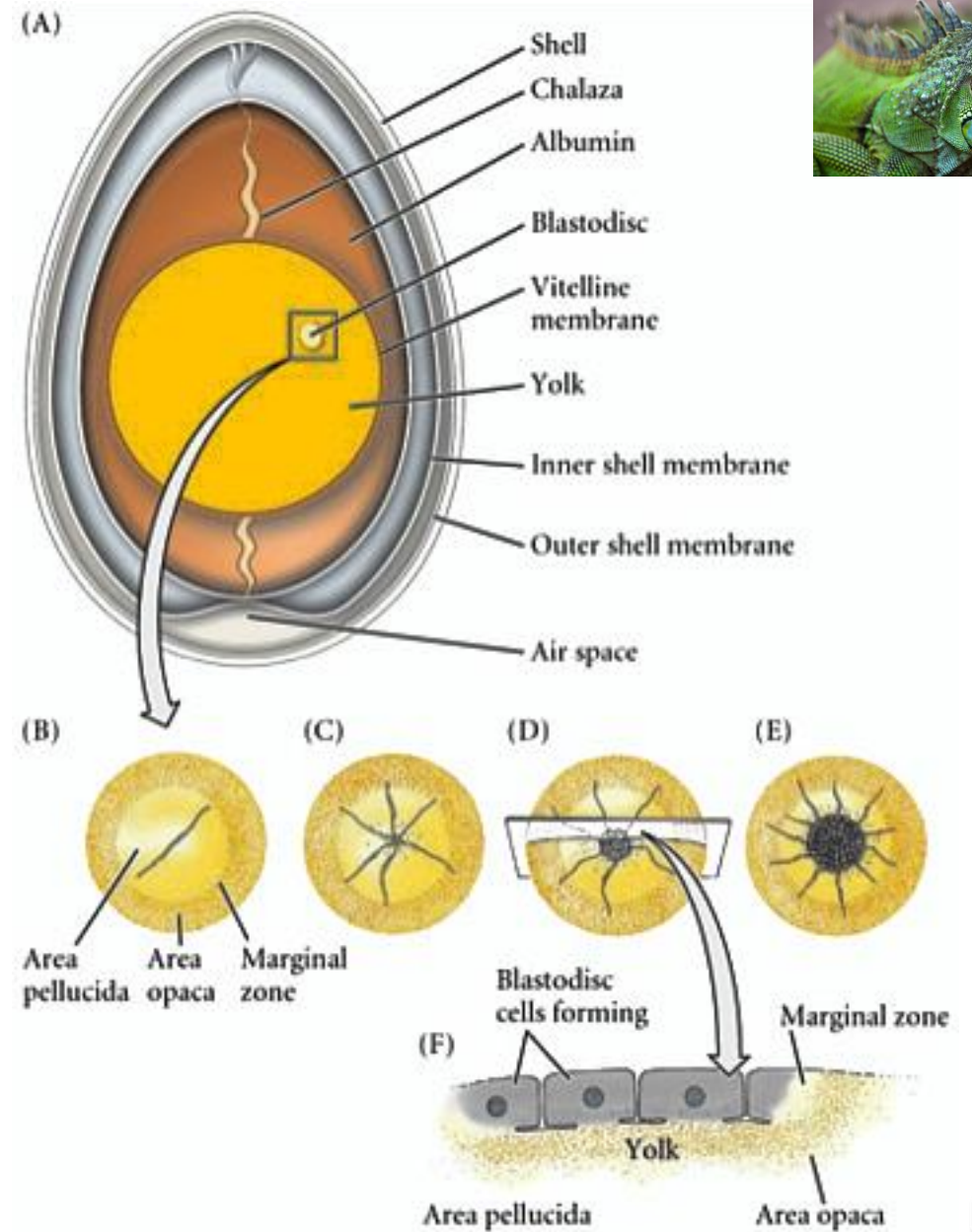
Mórula



Partial (meroblastic) discoidal; View from above. Examples: Reptiles, birds



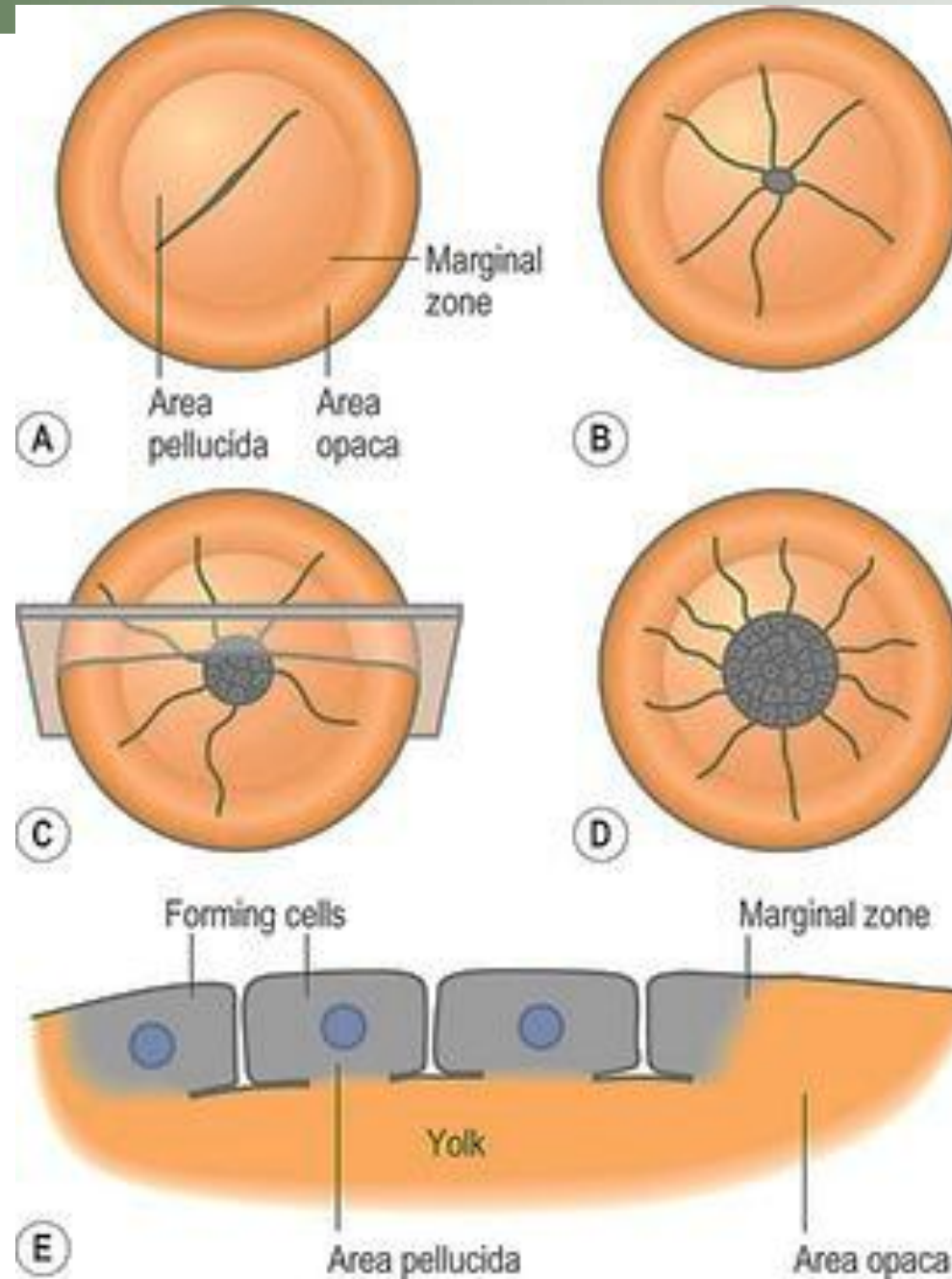
Mórula



DEVELOPMENTAL BIOLOGY 10e, Figure 9.2

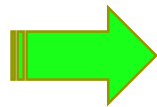


Disco germinativo  
Primera división mitótica

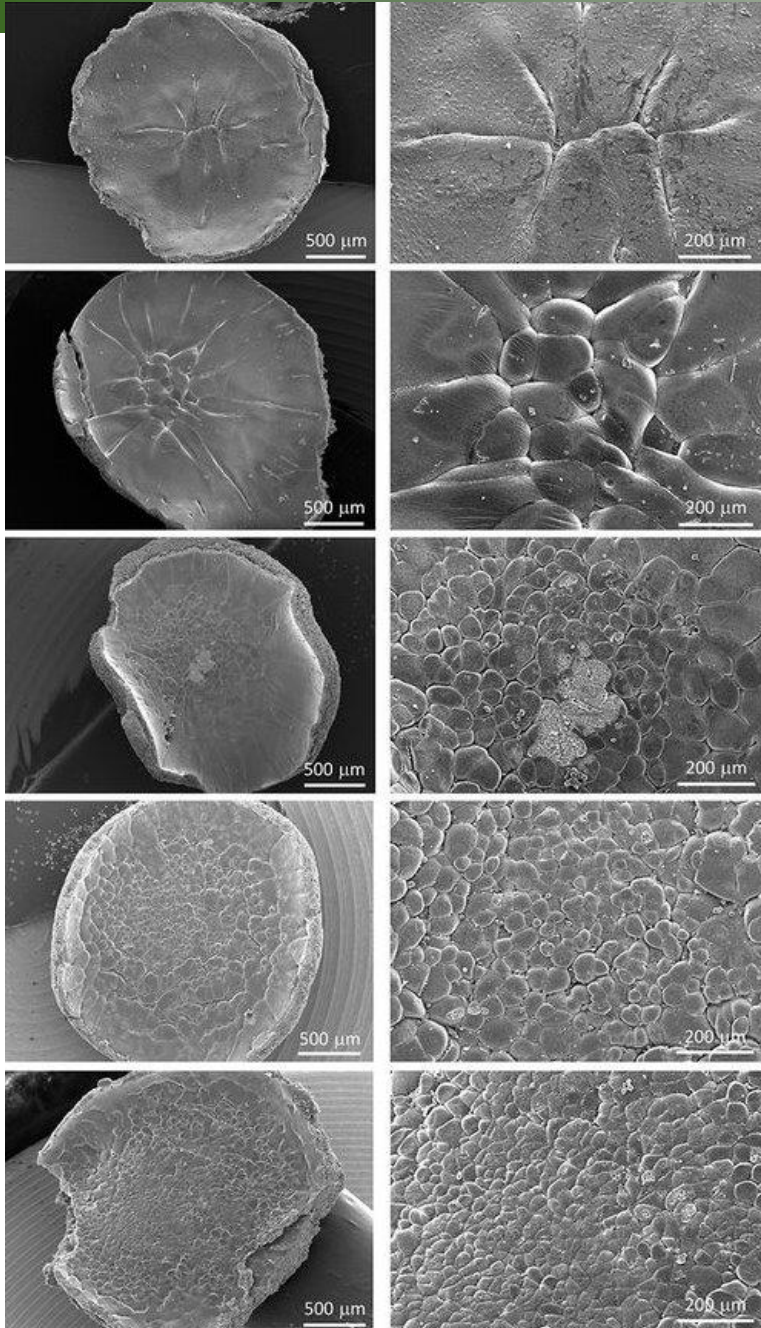


Disco germinativo  
Segunda y tercera  
divisiones mitóticas

Mórula plana



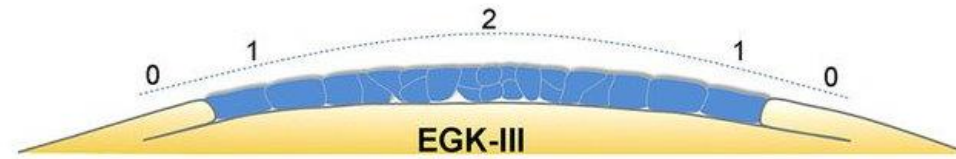
# Clivaje meroblástico



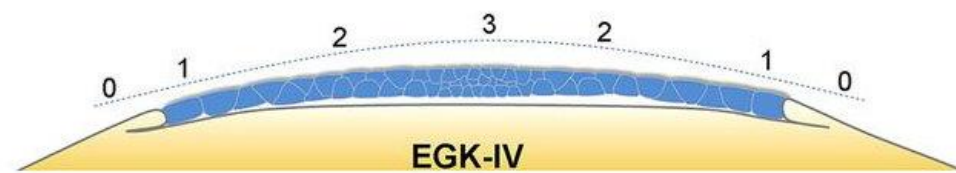
EGK-I



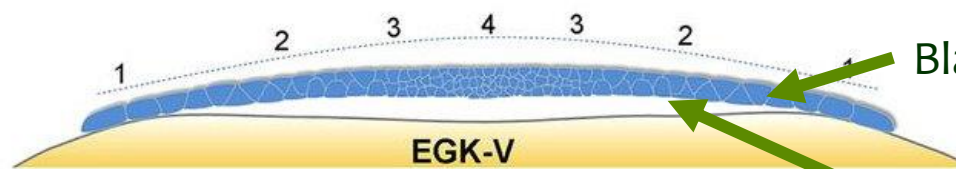
EGK-II



EGK-III



EGK-IV



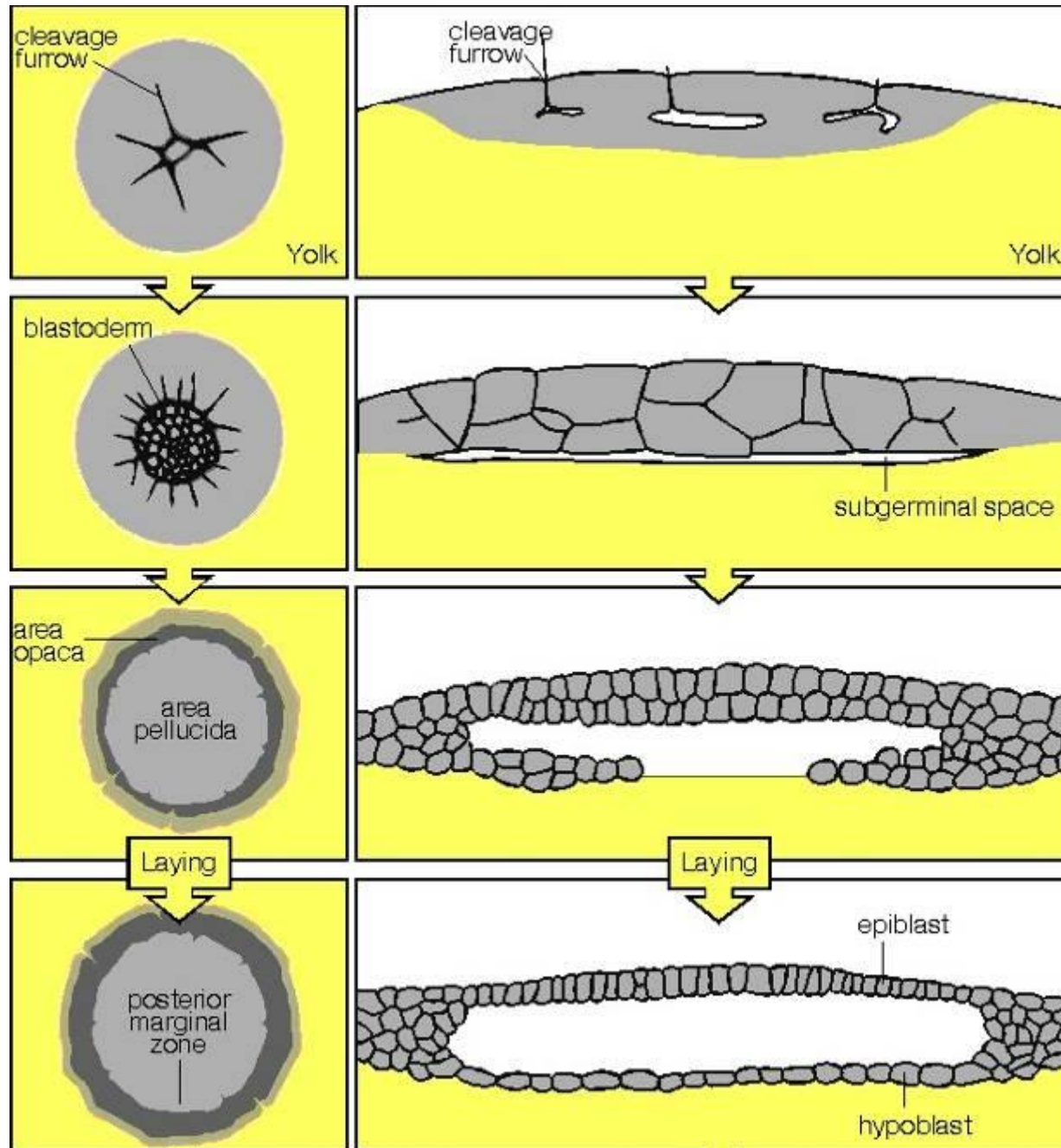
EGK-V

Blastodermo

Cavidad subgerminal







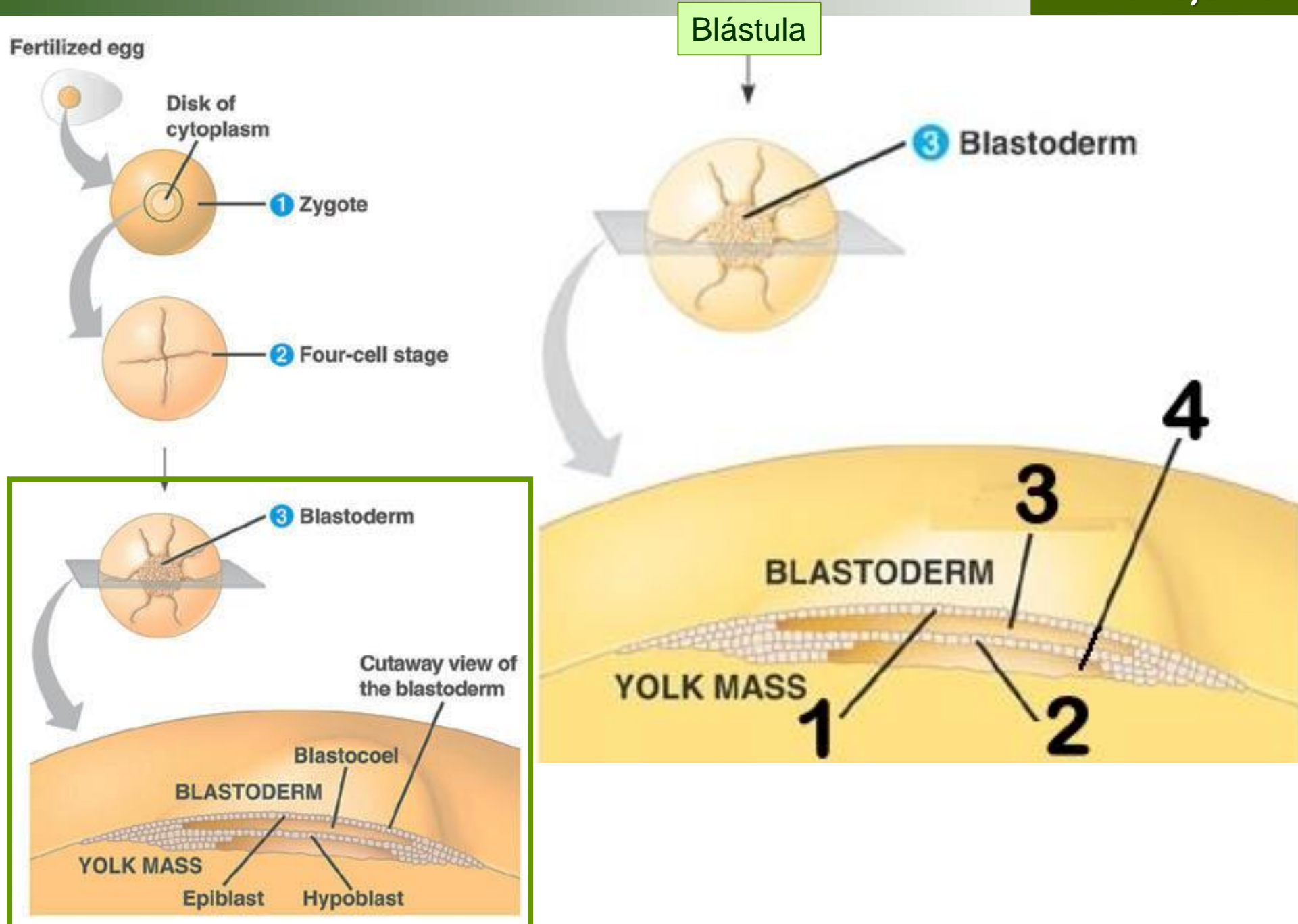
Inicio del clivaje

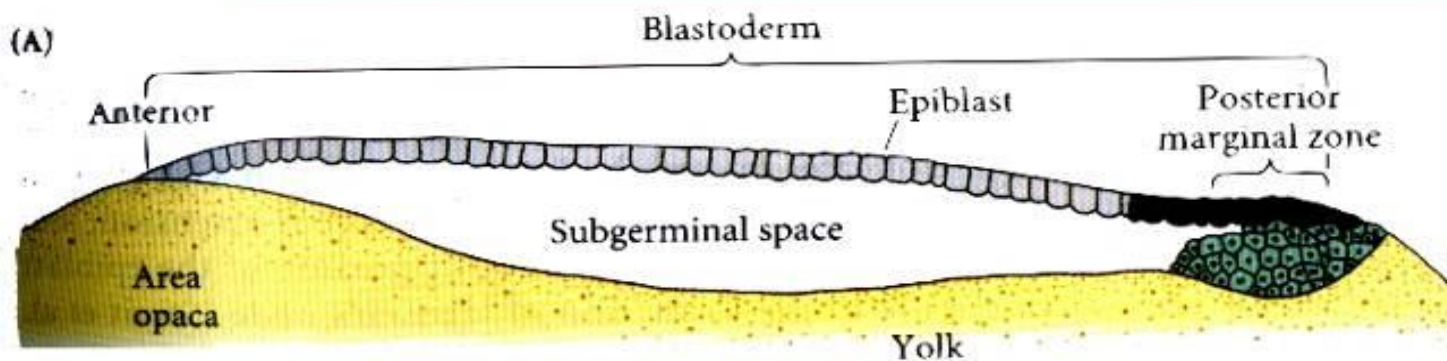
Formación de la  
cavidad  
subgerminal

Formación del  
blastocelo

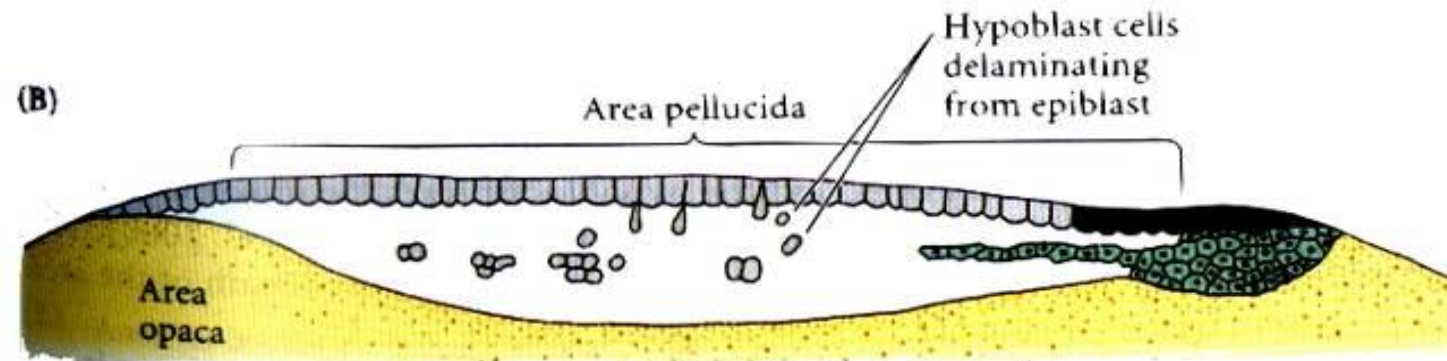
Formación de el  
área clara y el  
ara opaca



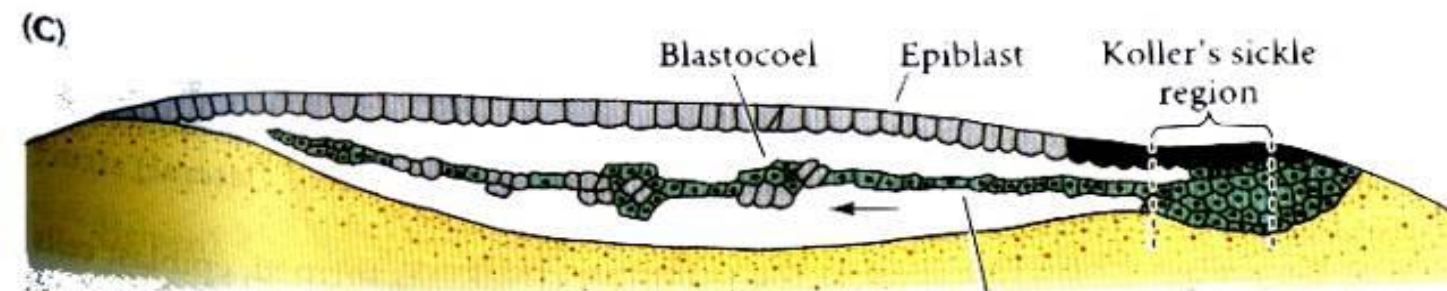




La zona marginal posterior equivale a la zona donde los blastómeros empezaron la licuefacción de la yema



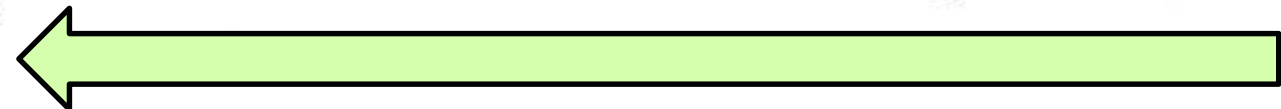
Y determina desde dónde se organiza el hipoblasto, será la región posterior del embrión



El epiblasto el dorso, hipoblasto región ventral

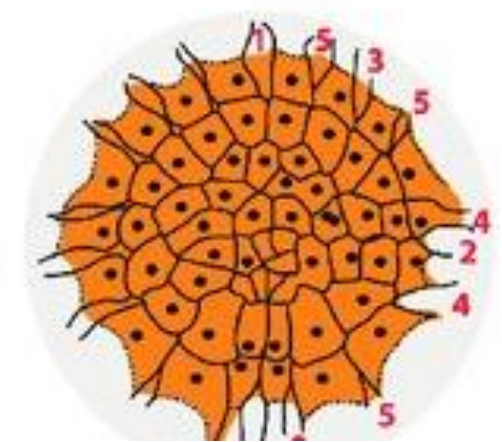
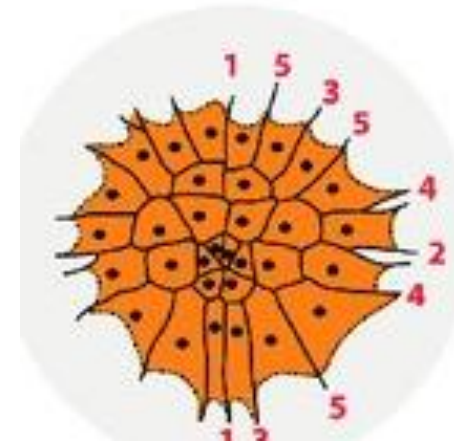
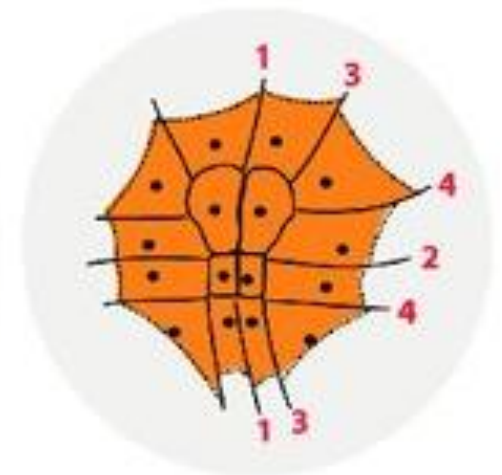
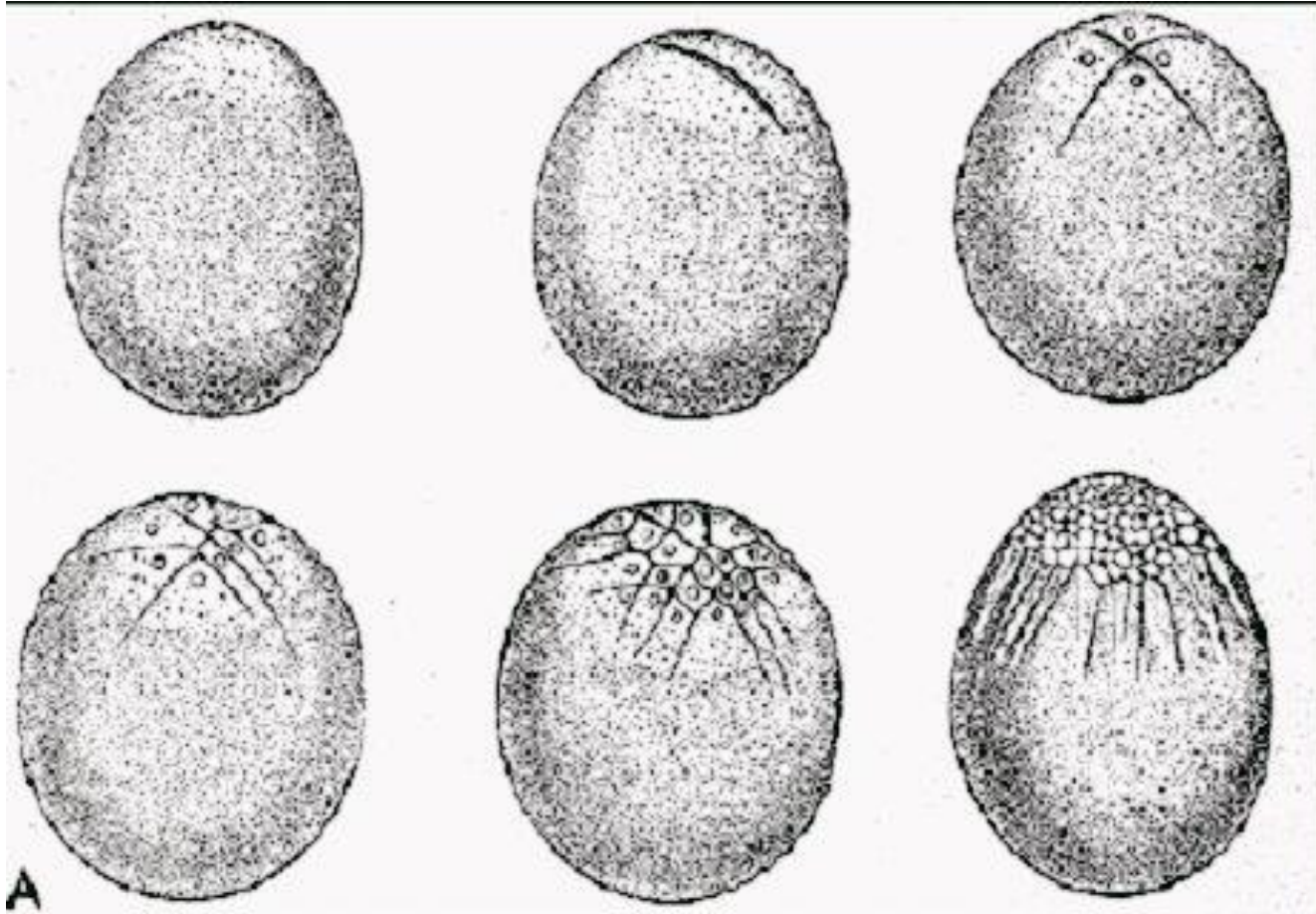


cefálica

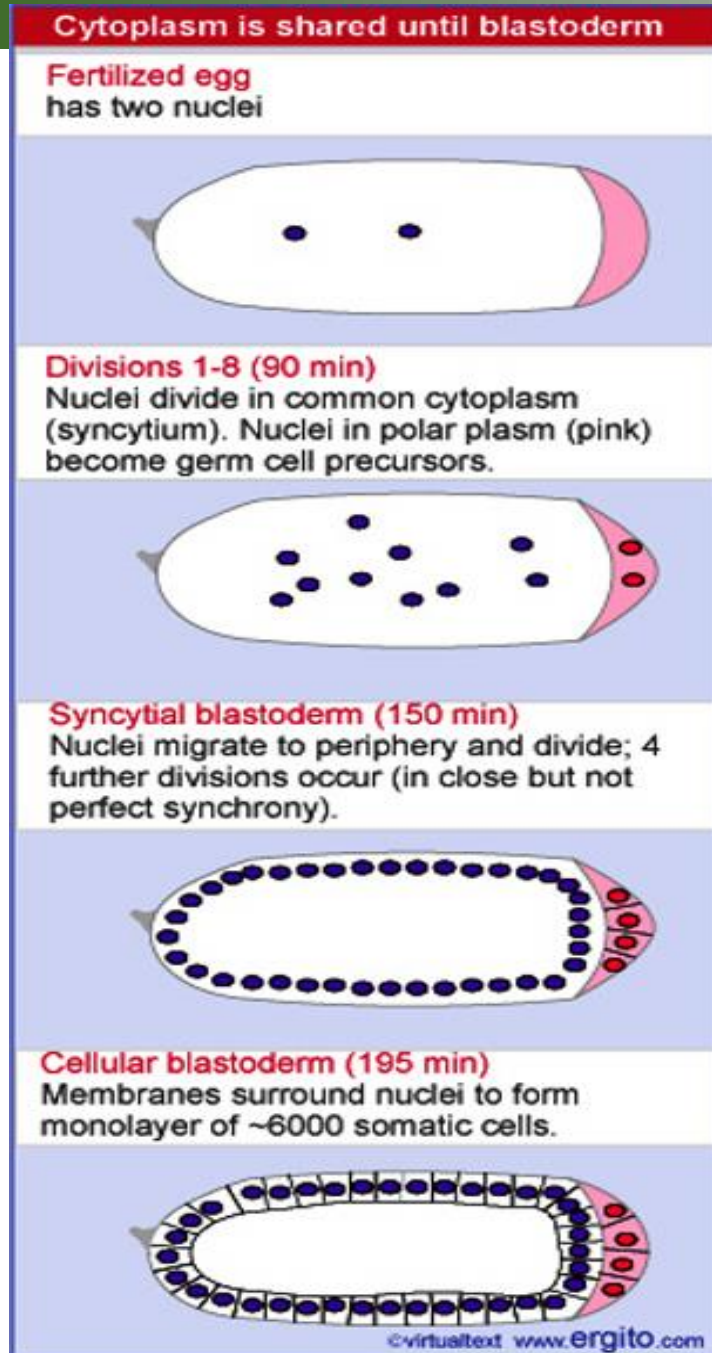
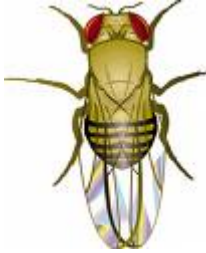


caudal





# Clivaje meroblástico superficial



Pronúcleos acercándose



Divisiones mitóticas sin citoquinesis



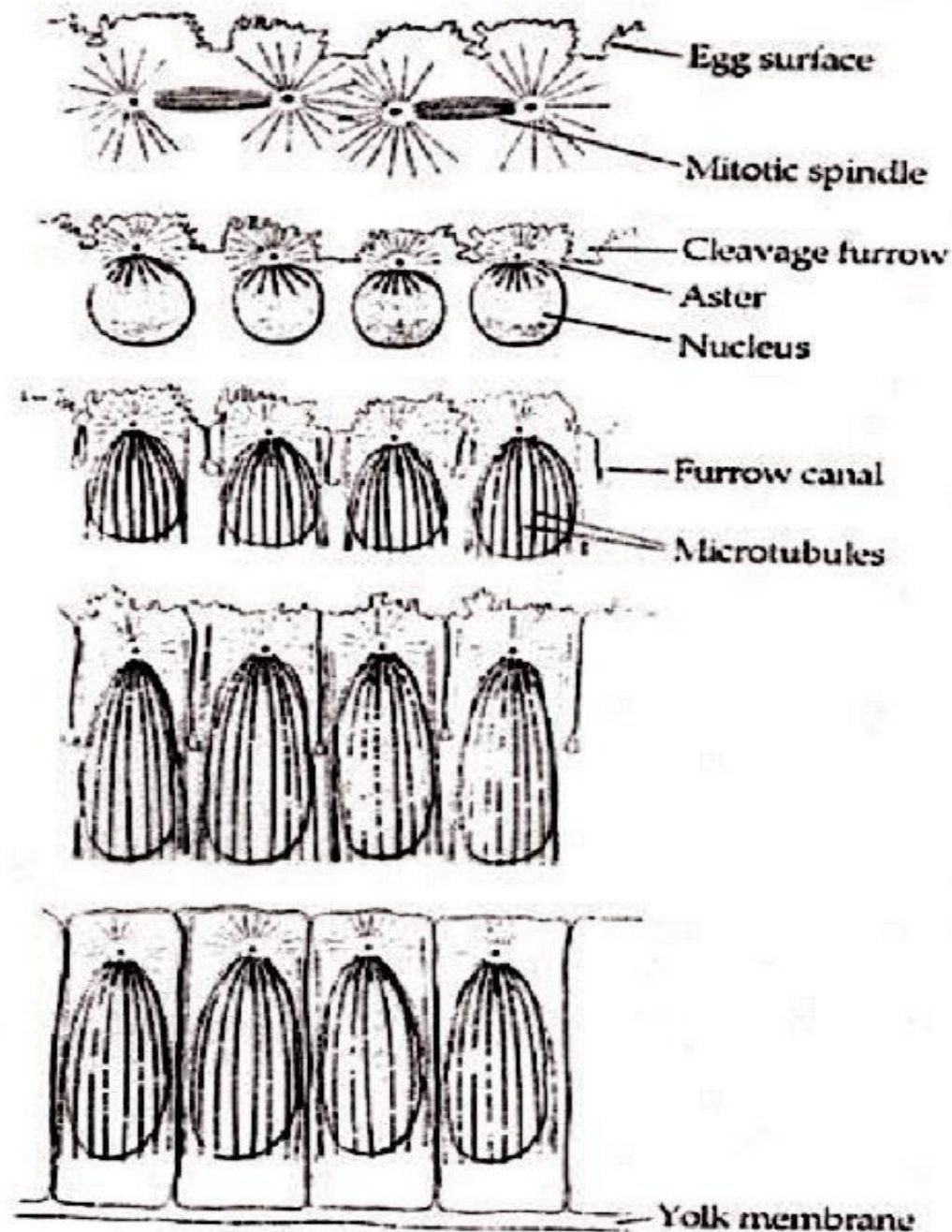
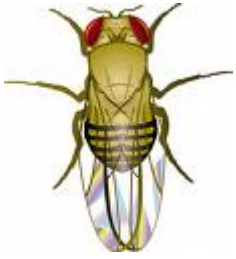
Migración de núcleos a la superficie



Citoquinesis y formación de células superficiales



# Clivaje meroblástico superficial



Divisiones mitóticas sin citoquinesis



Se inicia la formación del surco de clivaje



Los microtúbulos organizan los núcleos mientras se completan los surcos de segmentación

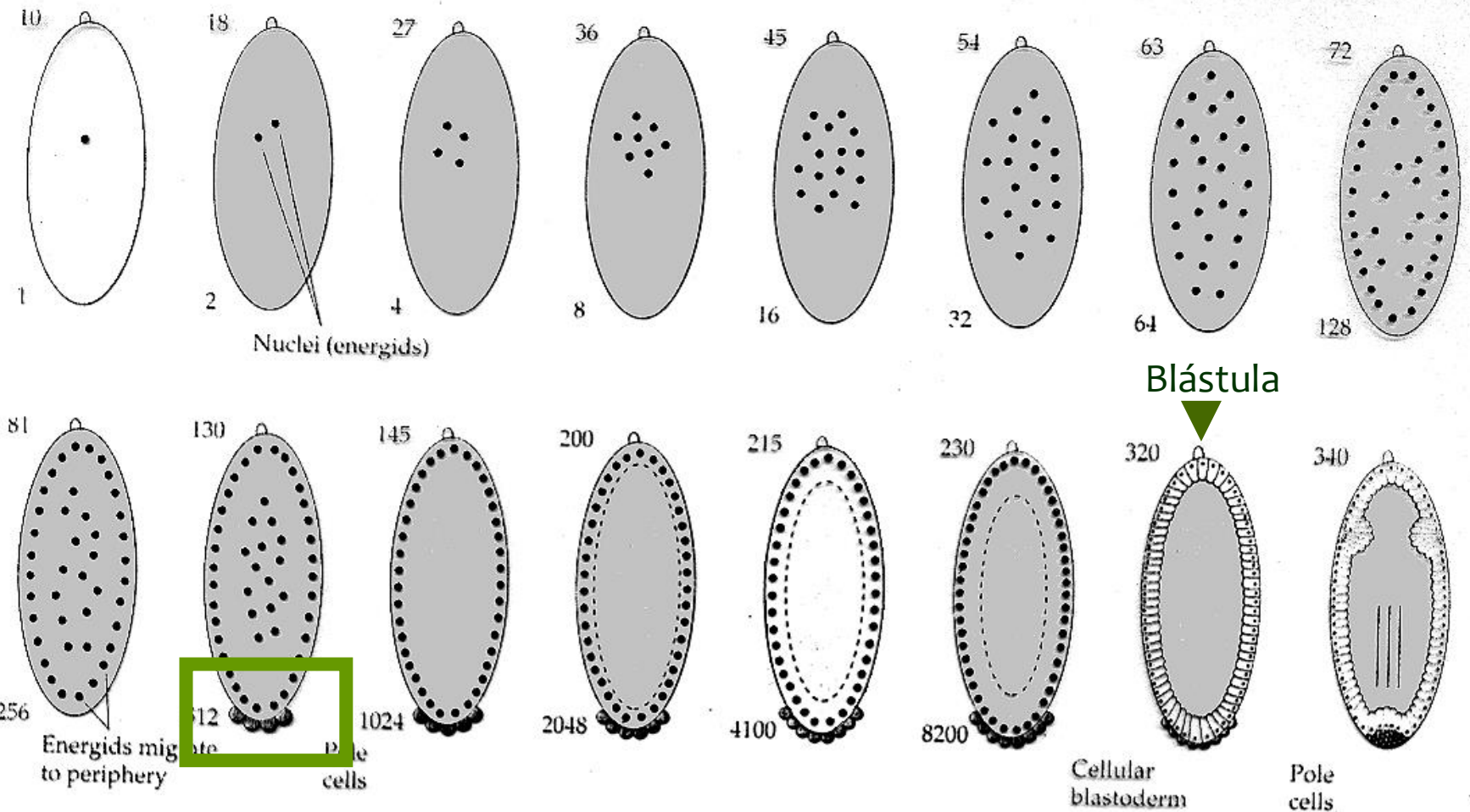
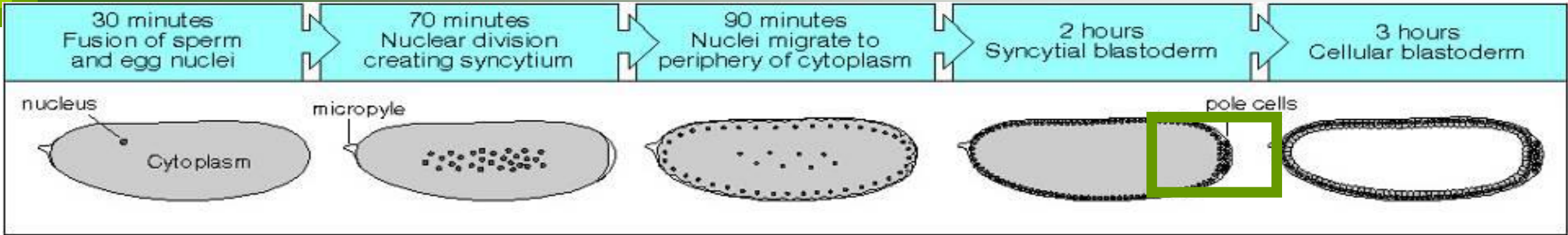


Elongación de las células



Se completa el surco y se forman las membranas basales que separan las células de la yema





Clivaje meroblástico superficial



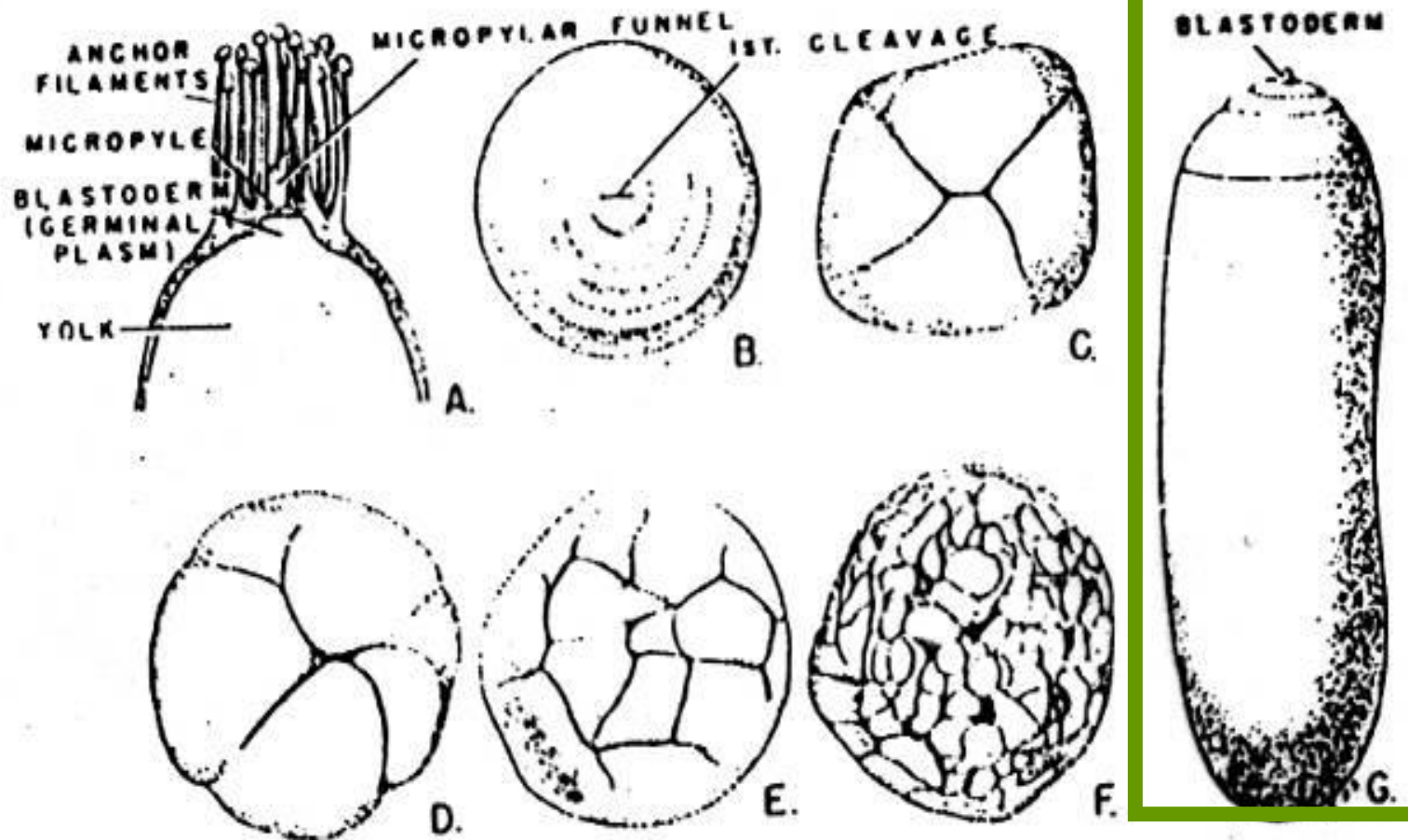


FIG. 162. Egg and cleavage in the marine lamprey, *Polistotrema (Bdellostoma) stouti*. (After Dean, 1899.) (A) Animal pole end of the egg. (B) Surface view of blastodermic hillock, showing first cleavage furrow. (C) Same, second cleavage. (D) Third cleavages. (E, F) Later cleavages, strongly irregular. (G) Egg with shell removed.





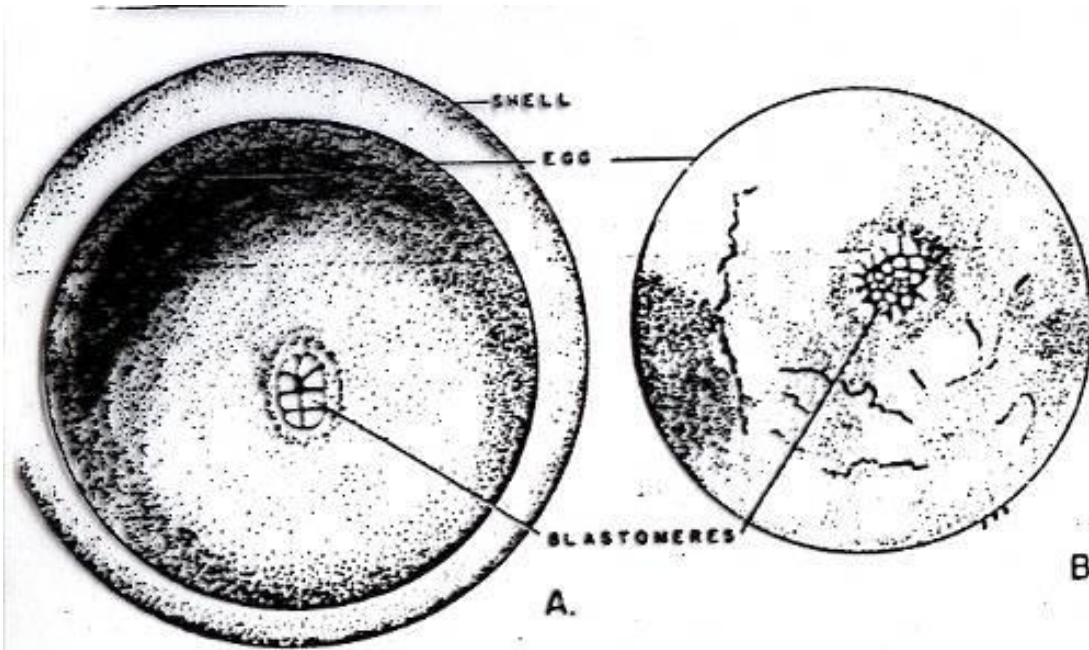


FIG. 160. Cleaving eggs of *Platypus* and *Echidna*. (After Flynn and Hill, '39.) (A) Egg, shell, and early cleavage in *Ornithorhynchus*. (B) Early cleavage in *Echidna*. See p. 161D.

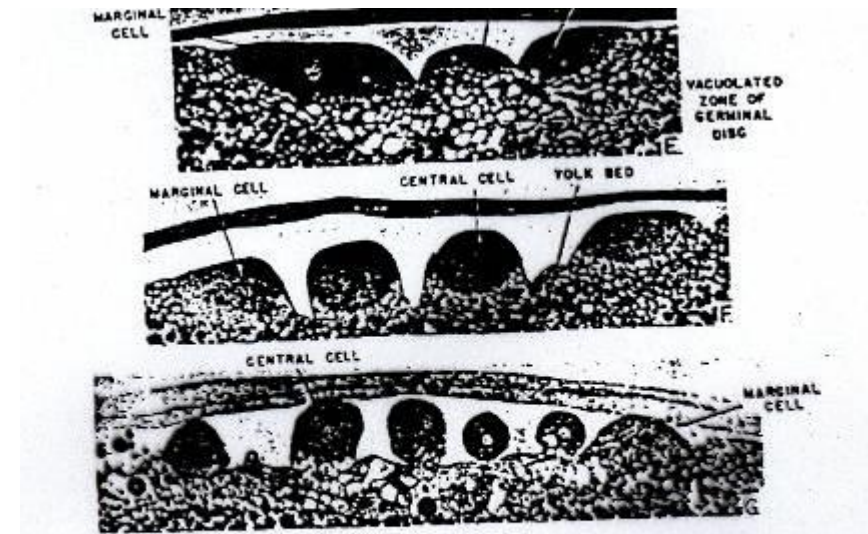


FIG. 161. Early cleavage in *Echidna*. (Courtesy, Flynn and Hill, '39.) (A) Four-cell stage. (B) Eight-cell stage. (C) About 16-cell stage. Two meridional and four vertical cleavages have occurred. (D) About 32-cell stage. Observe marginal and central cells. (E) Section through blastodisc of 4 to 8-cell stage. (F) Section through blastoderm of 16-cell stage. See (C). (G) Section through blastoderm of 32-cell stage, showing



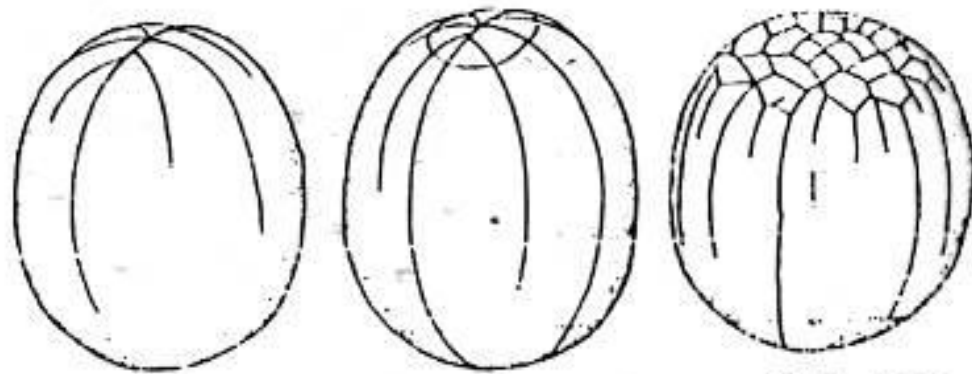
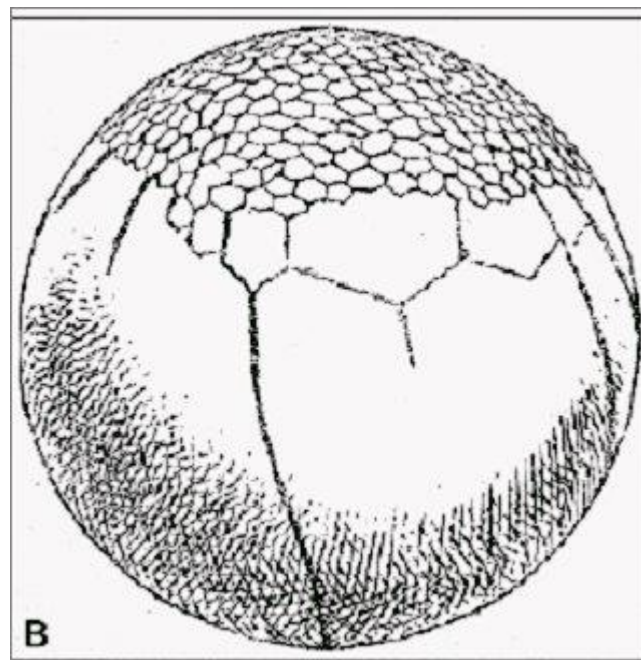
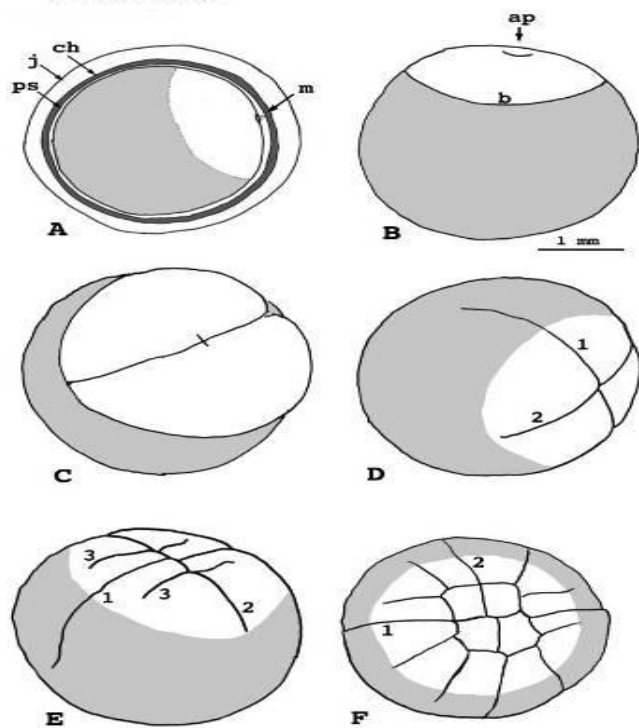


Figure 93. Cleavage in the gonoid fish *Amia*. (After Whitman and Eylesheimer, from Korschelt, 1936.)



*Amia calva*



*Lepisosteus oseus*



