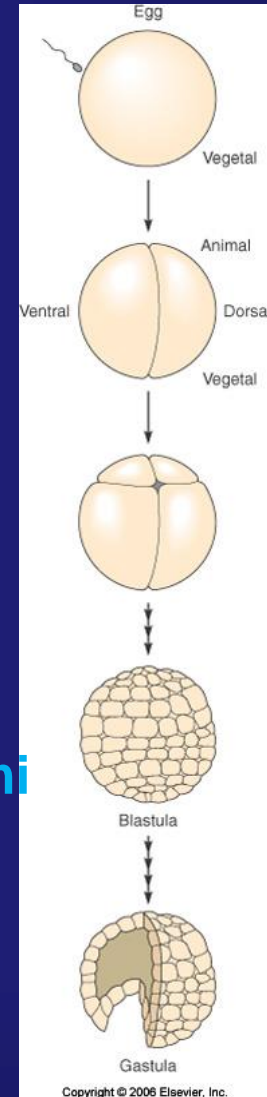
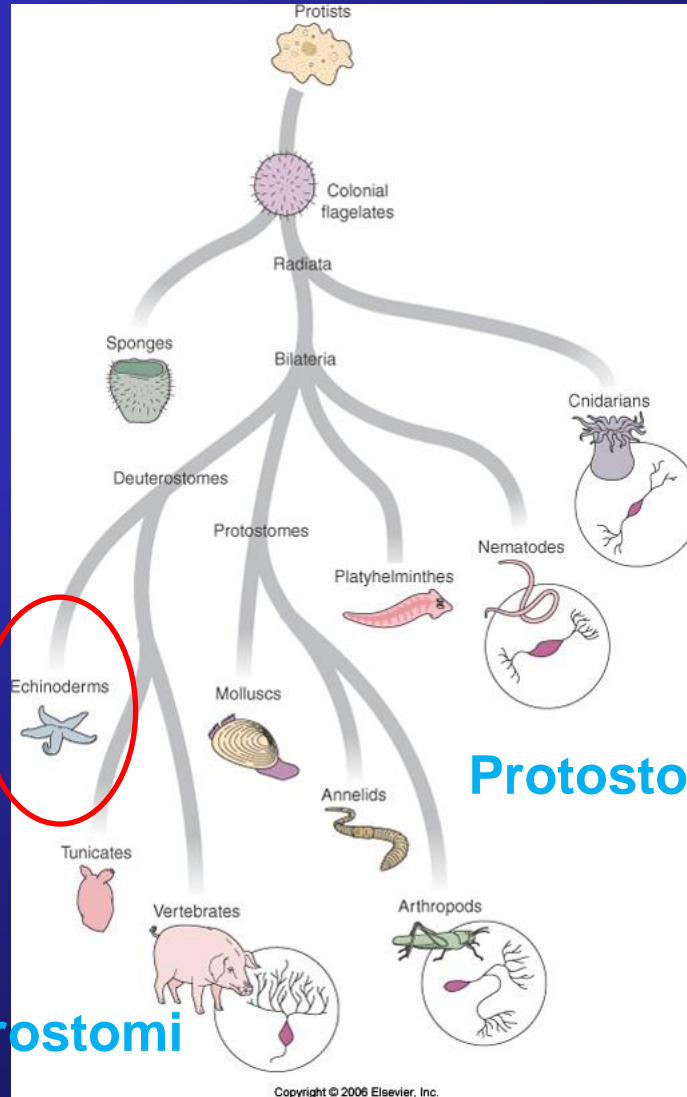
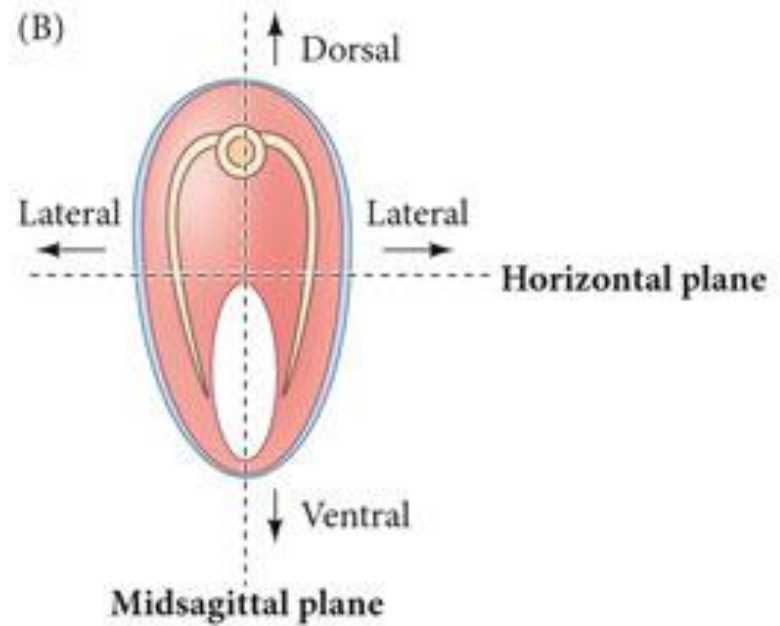
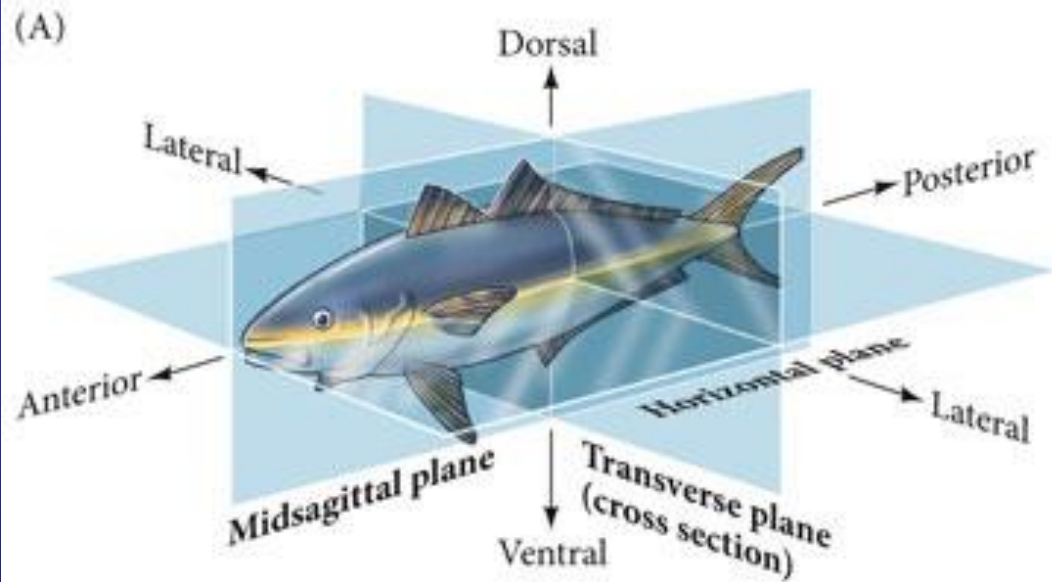
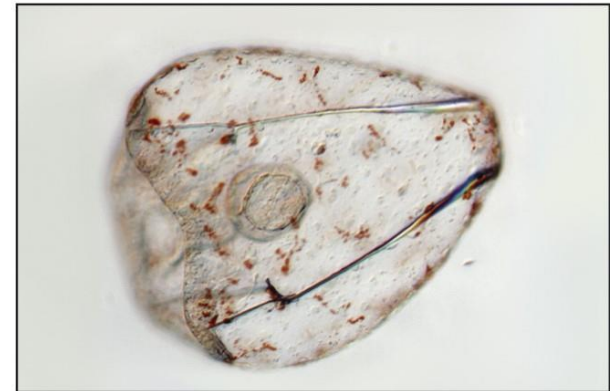
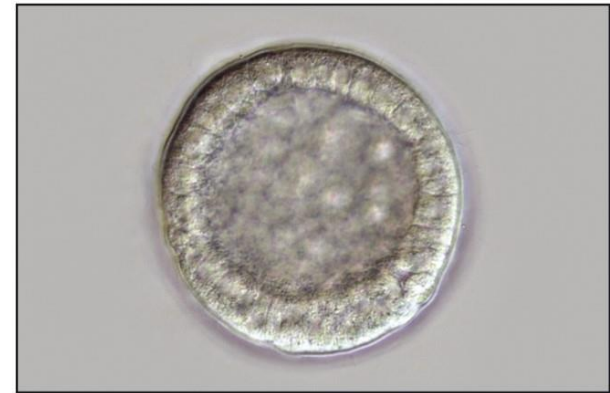
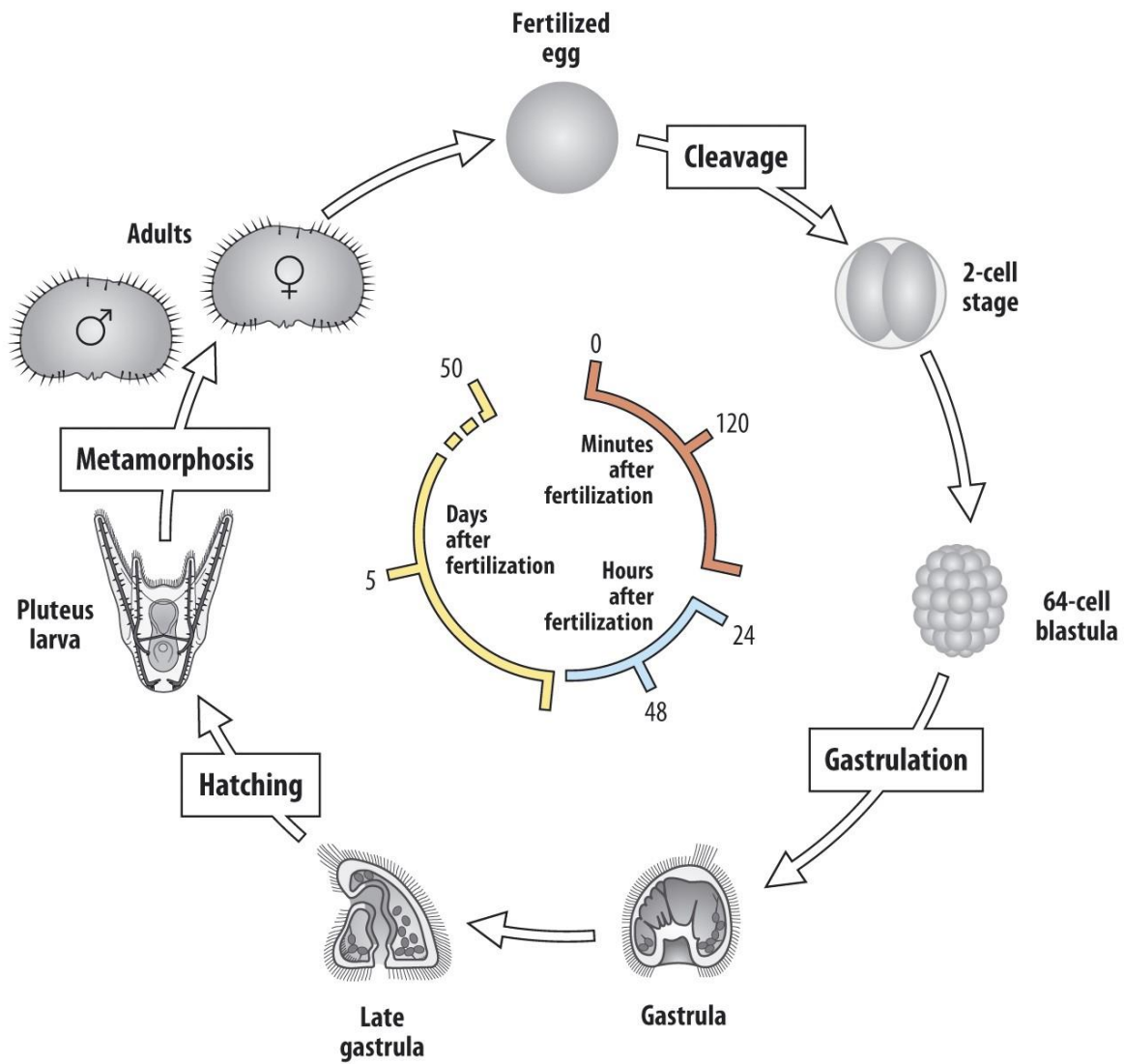


SVILUPPO PRECOCE DEL RICCIO DI MARE

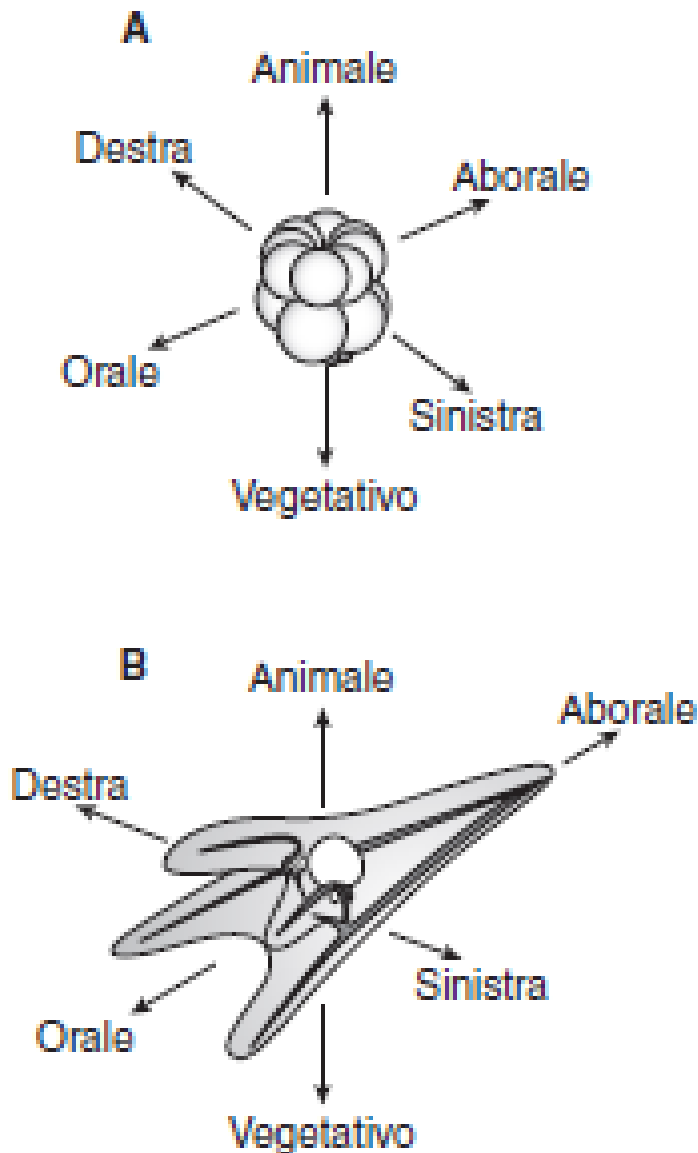


Protostomi: nel canale alimentare si forma prima la bocca
Deuterostomi: nel canale alimentare la bocca si forma per ultima





L'embrione di riccio di mare presenta degli assi di polarità'



Inoltre, presenta altre caratteristiche che lo rendono un valido organismo modello in biologia dello sviluppo:

sviluppo embrionale esterno

elevato numero di gameti e di embrioni che si possono far sviluppare in modo sincronizzato

tempi brevi di sviluppo (48 ore)

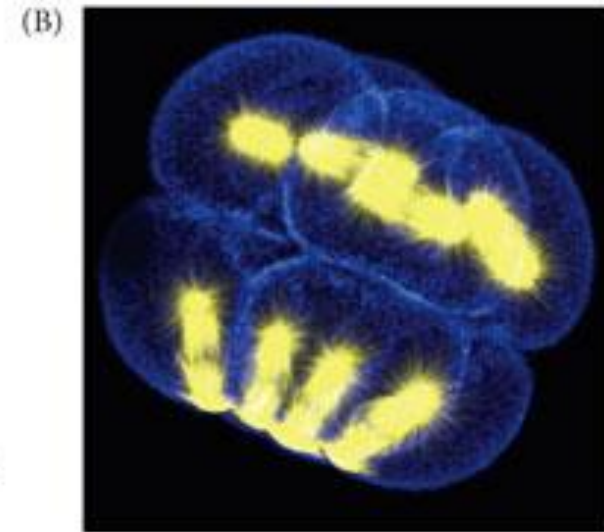
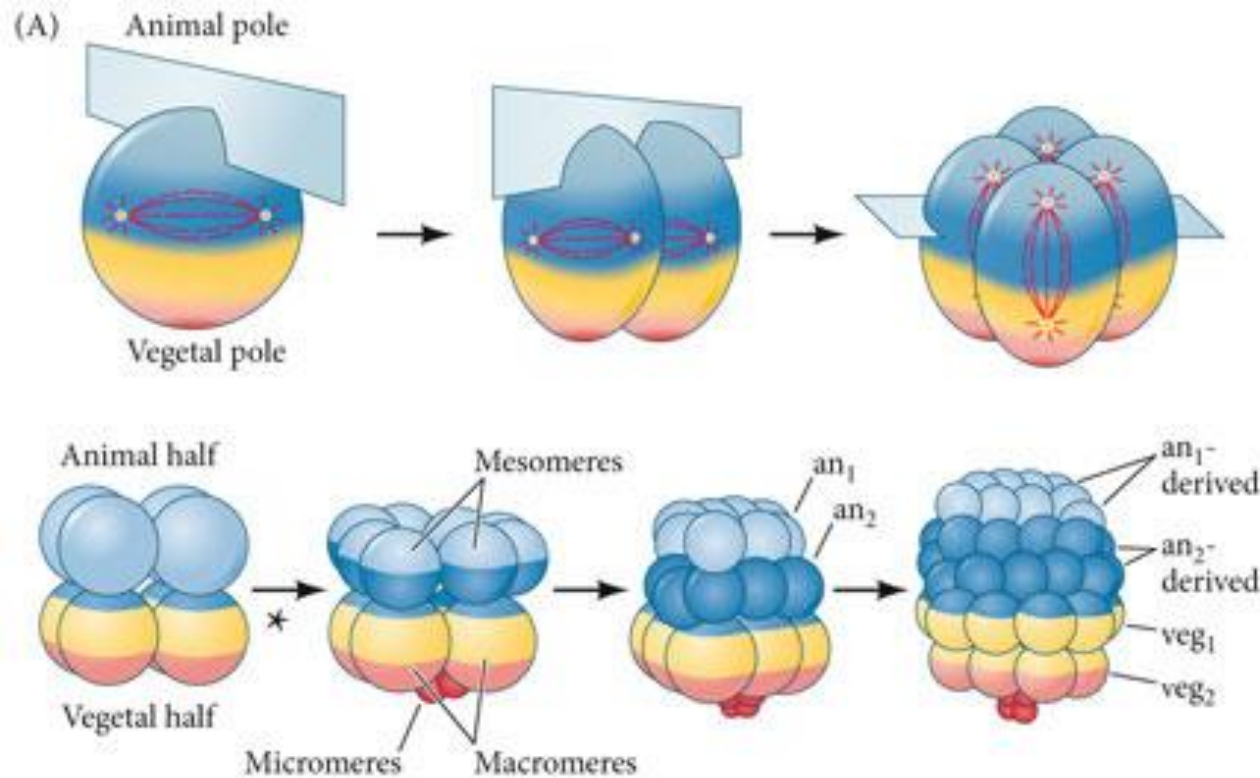
embrione trasparente

facile manipolazione

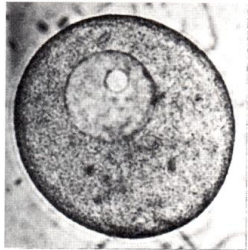
Figura 9

SEGMENTAZIONE

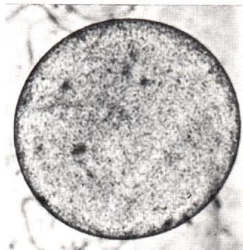
Uovo oligolecitico – Segmentazione oloblastica radiale subeguale



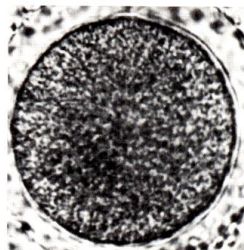
Notare la posizione e orientamento dei fusi mitotici!



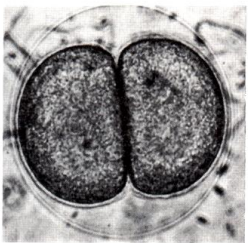
Ovocyte



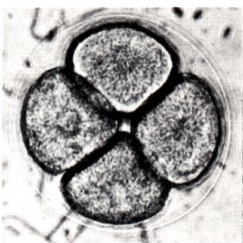
œuf mûr



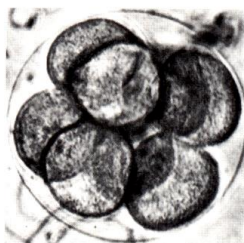
œuf fécondé



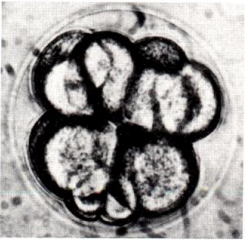
2 cellules



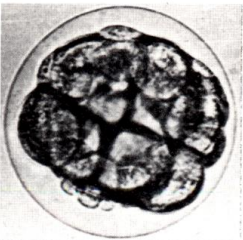
4 cellules



8 cellules



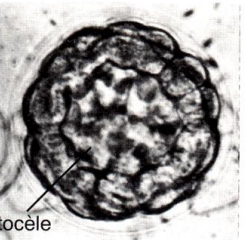
16 cellules



32 cellules

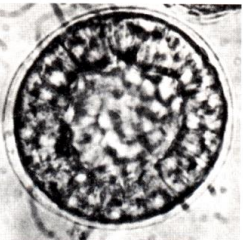


Morula



Blastocèle

Jeune blastula



Blastula



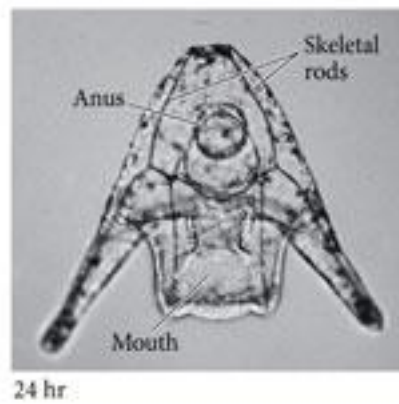
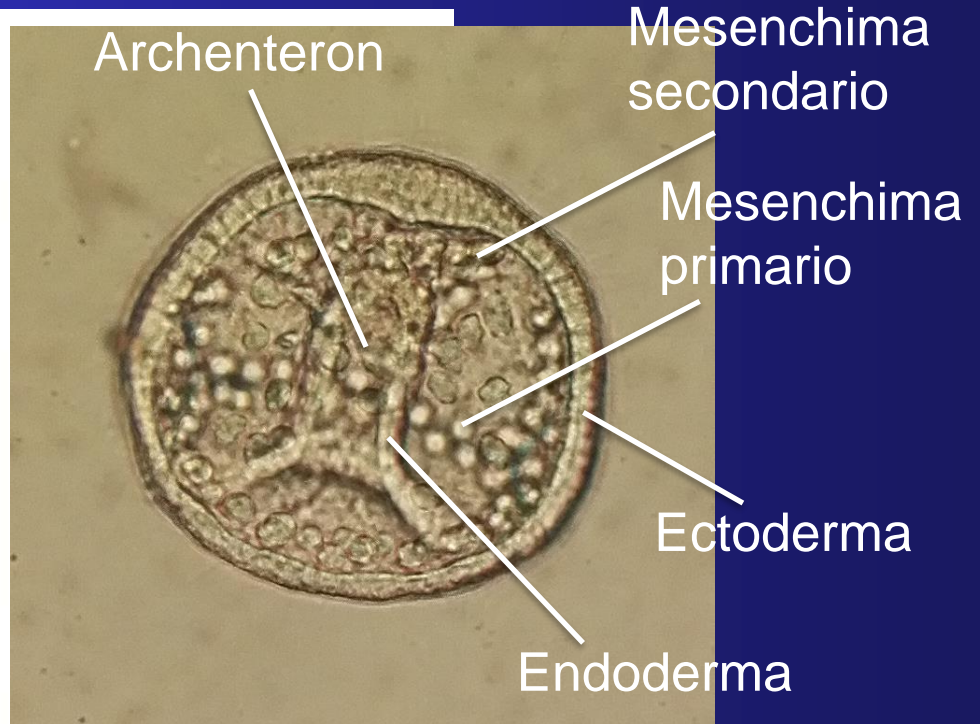
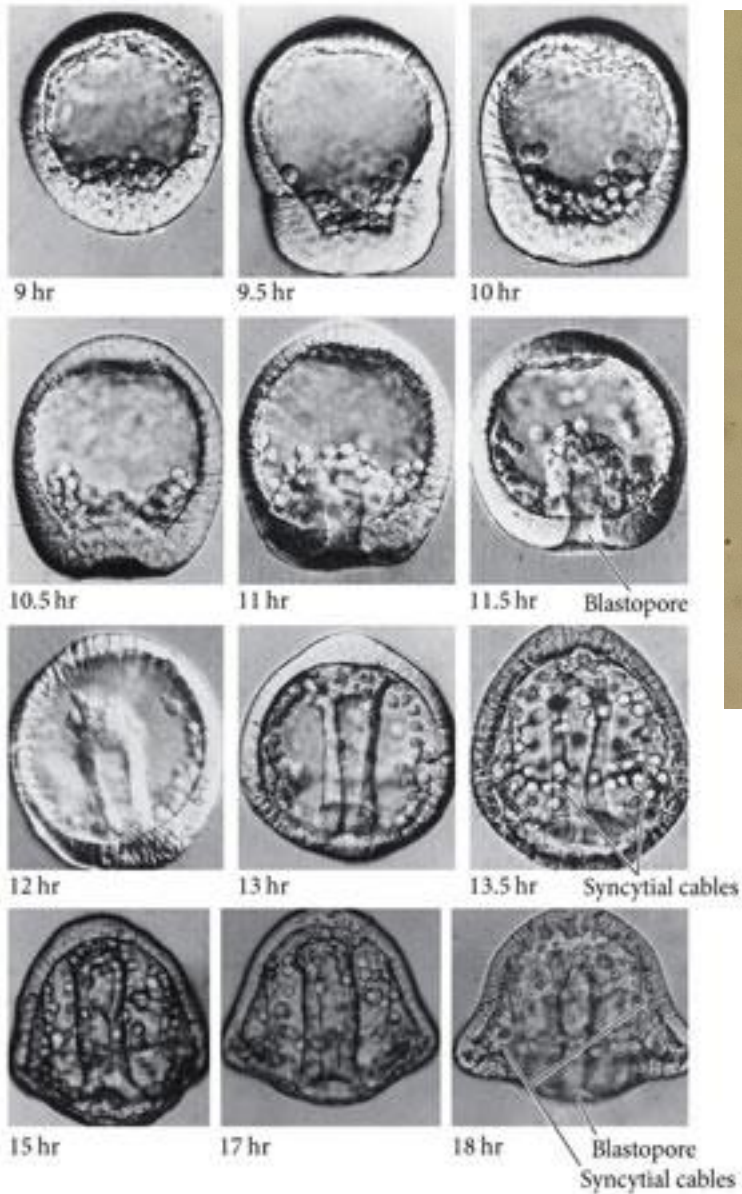
Blastula à l'éclosion

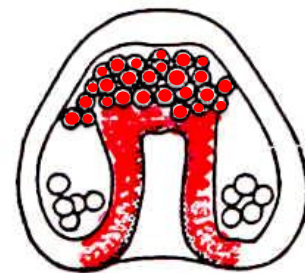
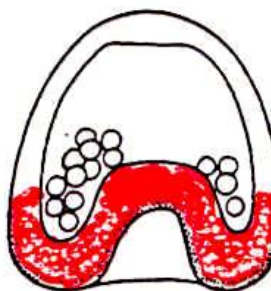
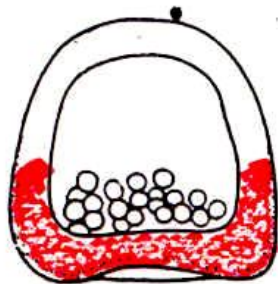
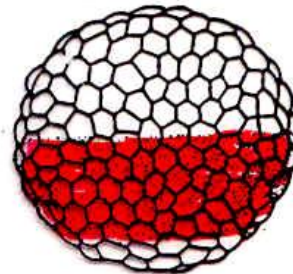
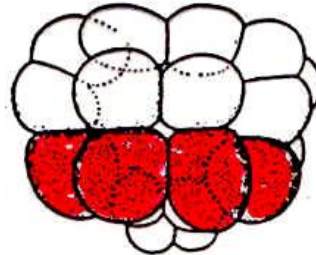
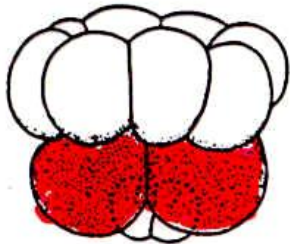
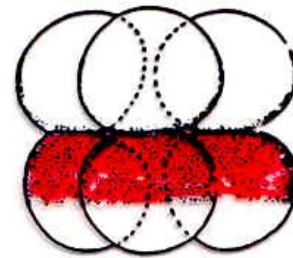
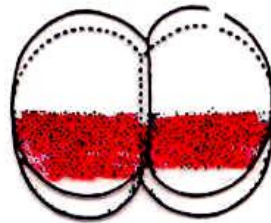
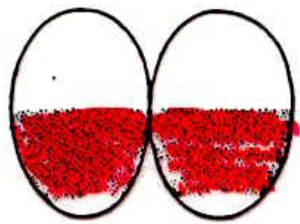
Mesomeri



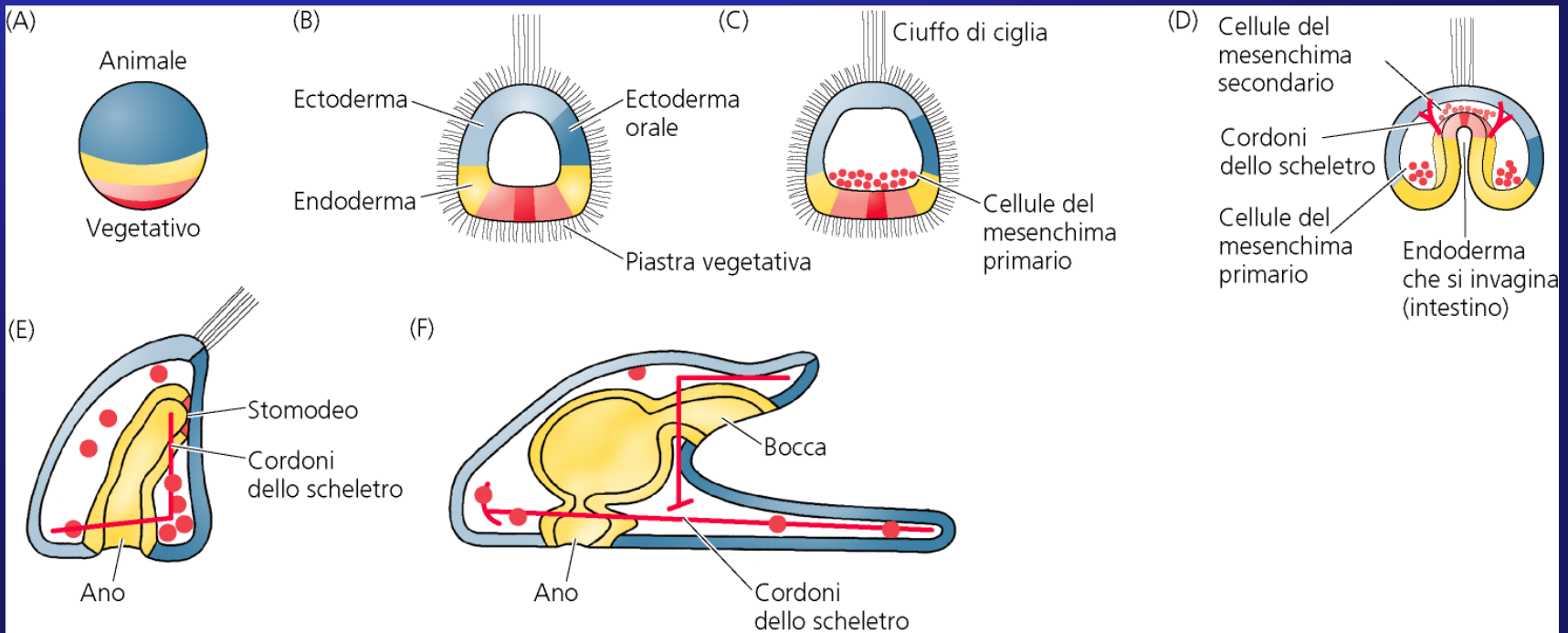
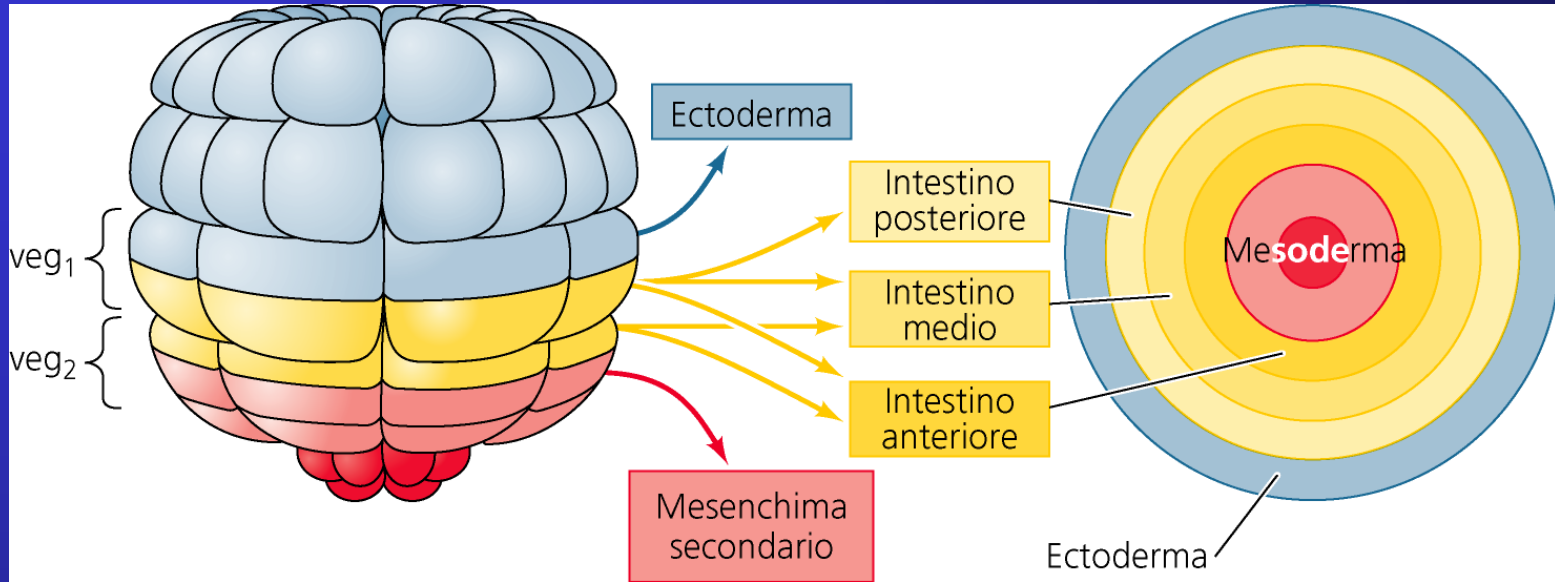
Macromeri

Micromeri

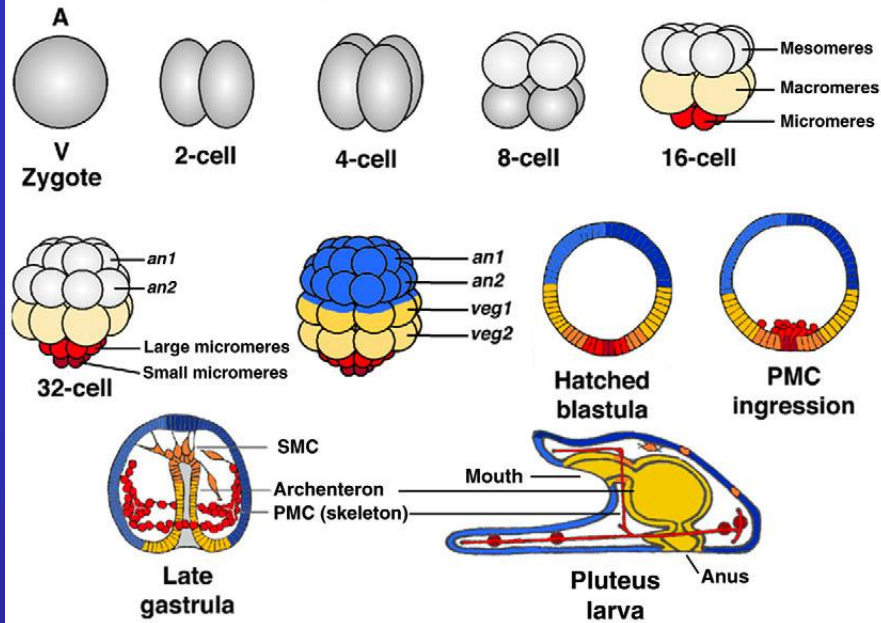




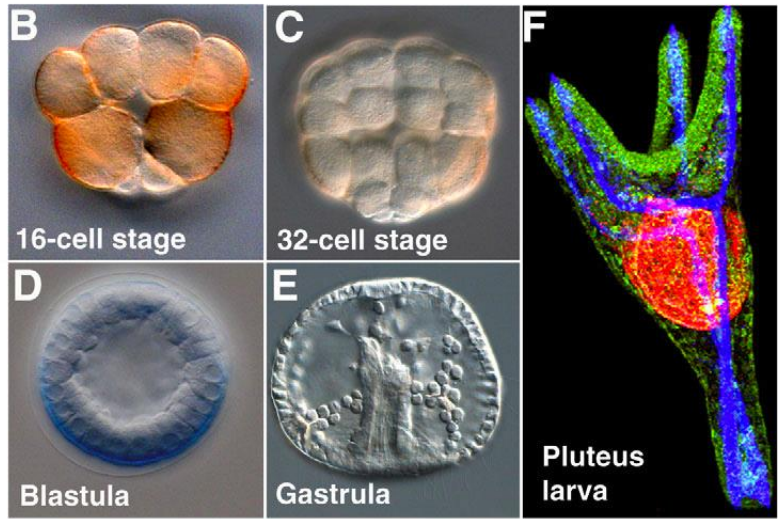
Mappa dei territori presuntivi



A Sea urchin development

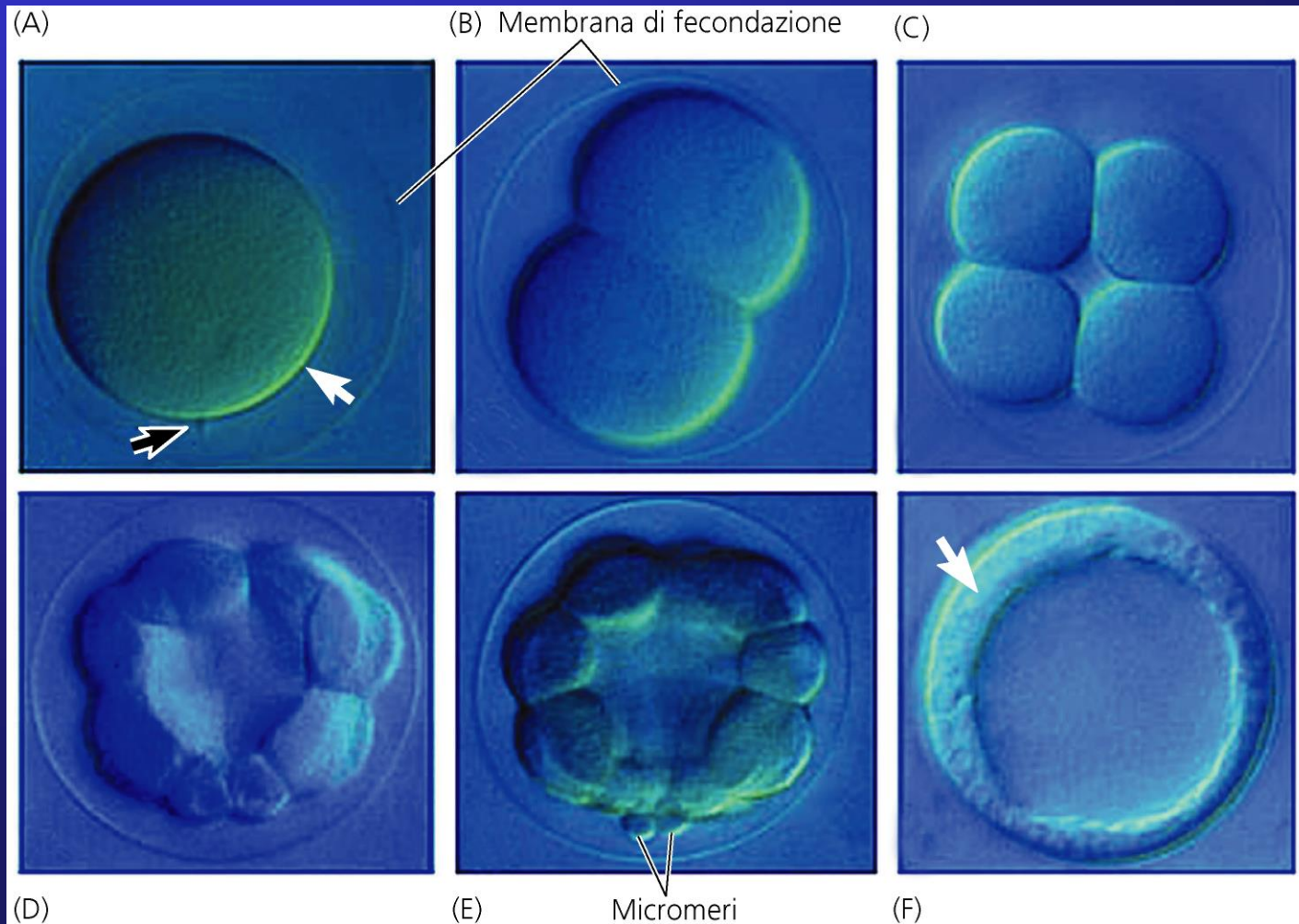


Color key	■ Ectoderm	■ Skeletogenic mesoderm
	■ Endoderm	■ Non-skeletogenic mesoderm



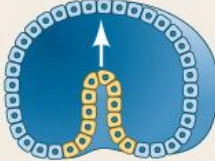
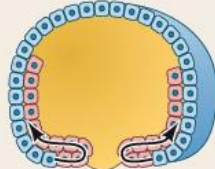


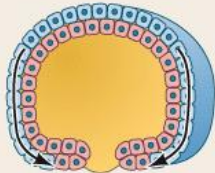
Formazione blastocele

- Alta affinità tra i blastomeri
- Deposizione di proteoglicani nella cavità blastocelica
- Forza centrifuga che determina il progressivo allontanamento dei blastomeri.



Gastrulazione

TABLE 1.1 Types of cell movement during gastrulation^a

Type of movement	Description	Illustration	Example
Invagination	Infolding of a sheet (epithelium) of cells, much like the indentation of a soft rubber ball when it is poked.		Sea urchin endoderm
Involution	Inward movement of an expanding outer layer so that it spreads over the internal surface of the remaining external cells.		Amphibian mesoderm
Ingression	Migration of individual cells from the surface into the embryo's interior. Individual cells become mesenchymal (i.e., separate from one another) and migrate independently.		Sea urchin mesoderm, <i>Drosophila</i> neuroblasts
Delamination	Splitting of one cellular sheet into two more or less parallel sheets. While on a cellular basis it resembles ingression, the result is the formation of a new (additional) epithelial sheet of cells.		Hypoblast formation in birds and mammals
Epiboly	Movement of epithelial sheets (usually ectodermal cells) spreading as a unit (rather than individually) to enclose deeper layers of the embryo. Can occur by cells dividing, by cells changing their shape, or by several layers of cells intercalating into fewer layers; often, all three mechanisms are used.		Ectoderm formation in sea urchins, tunicates, and amphibians

^a The gastrulation of any particular organism is an ensemble of several of these movements.

Ingression

Migration of individual cells from the surface into the embryo's interior. Individual cells become mesenchymal (i.e., separate from one another) and migrate independently.

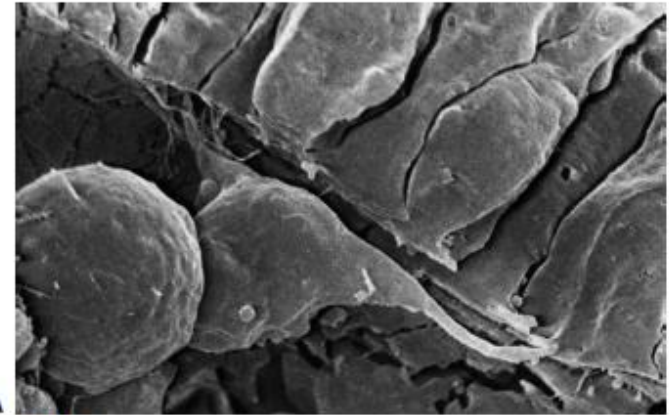
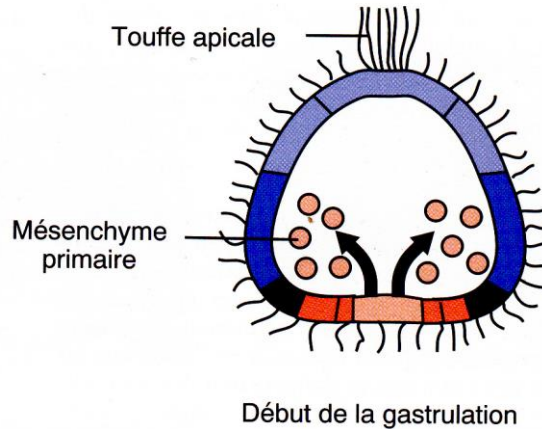
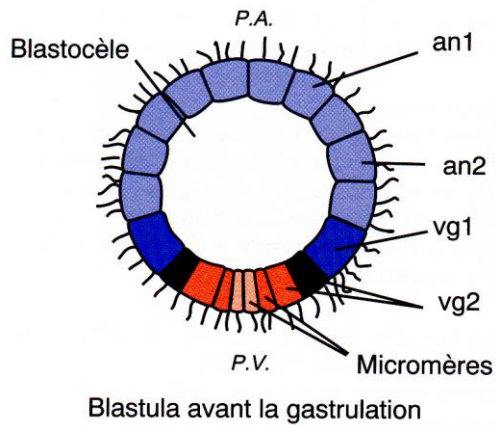
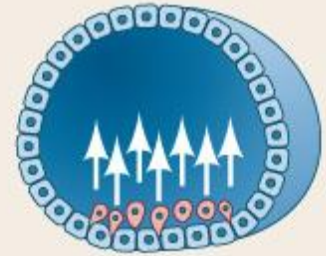
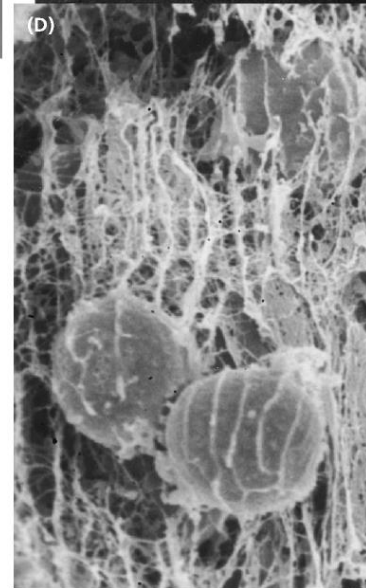
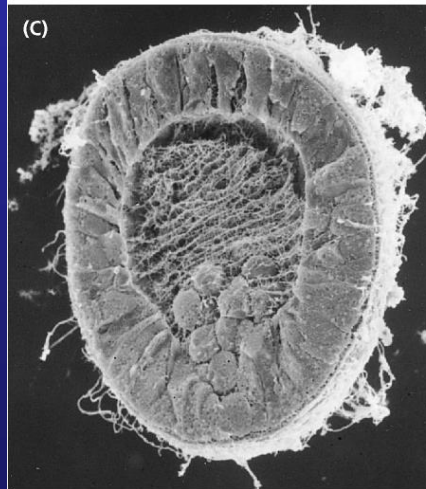
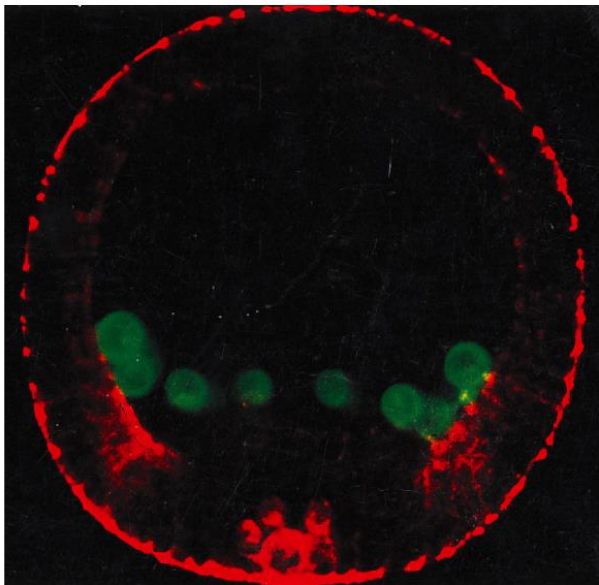
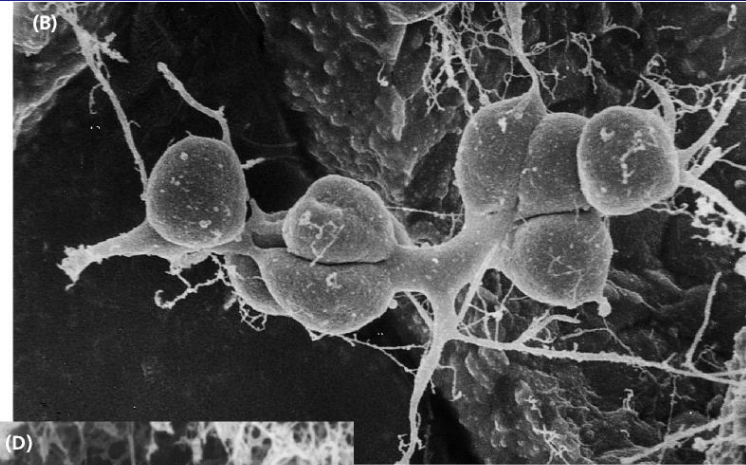
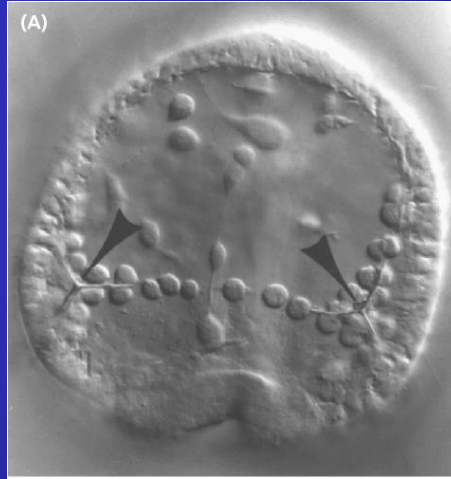
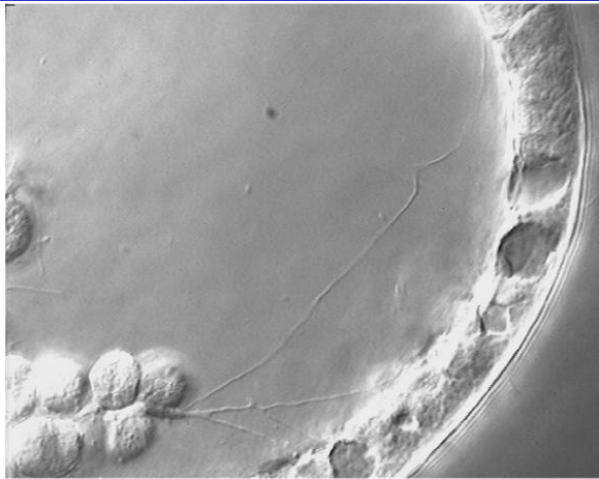


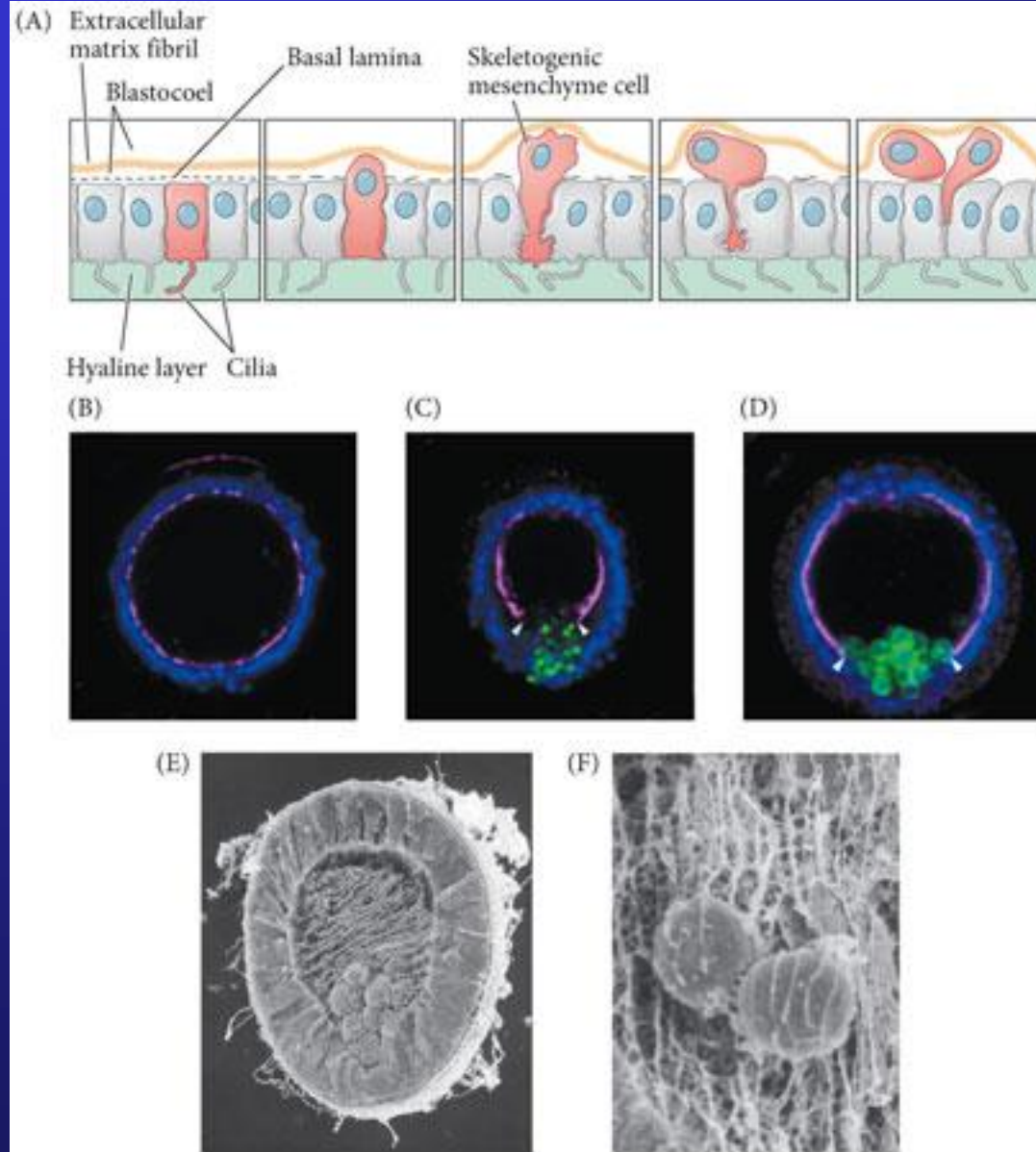
Figura 5

Mesenchima primario → Scheletro calcareo della larva



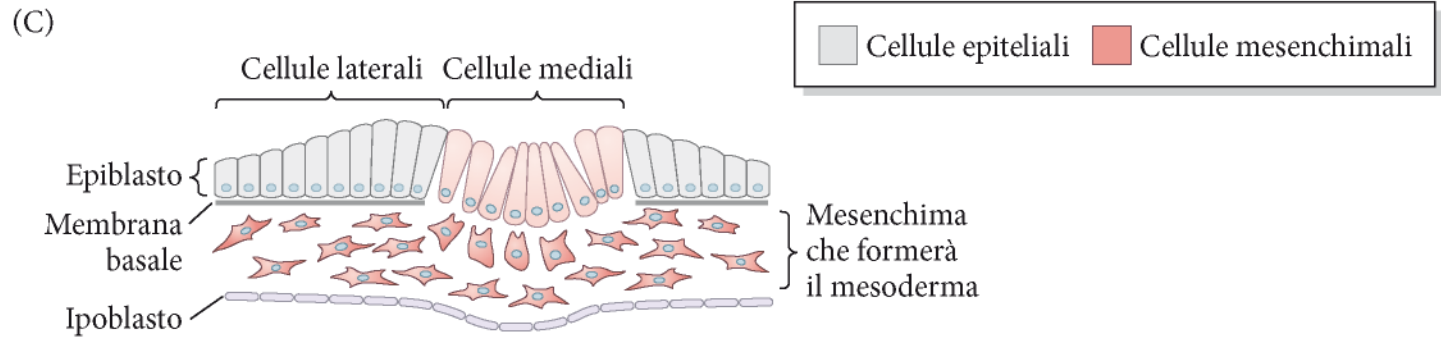
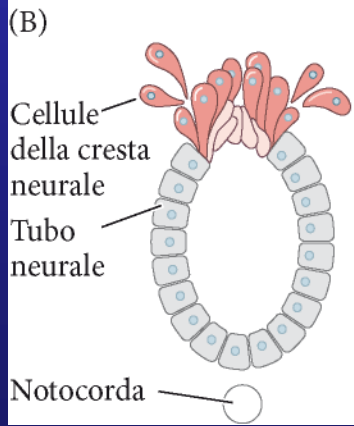
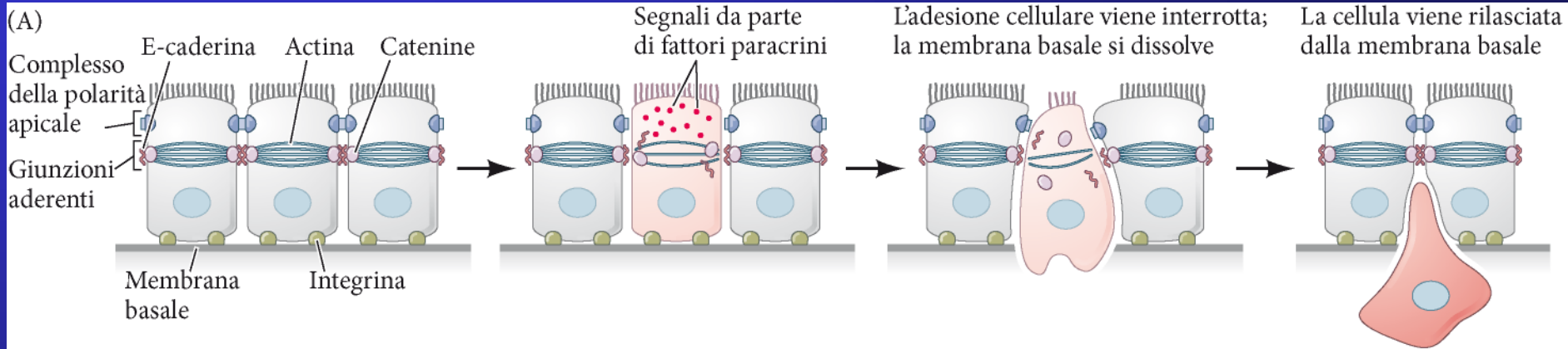


Immigrazione

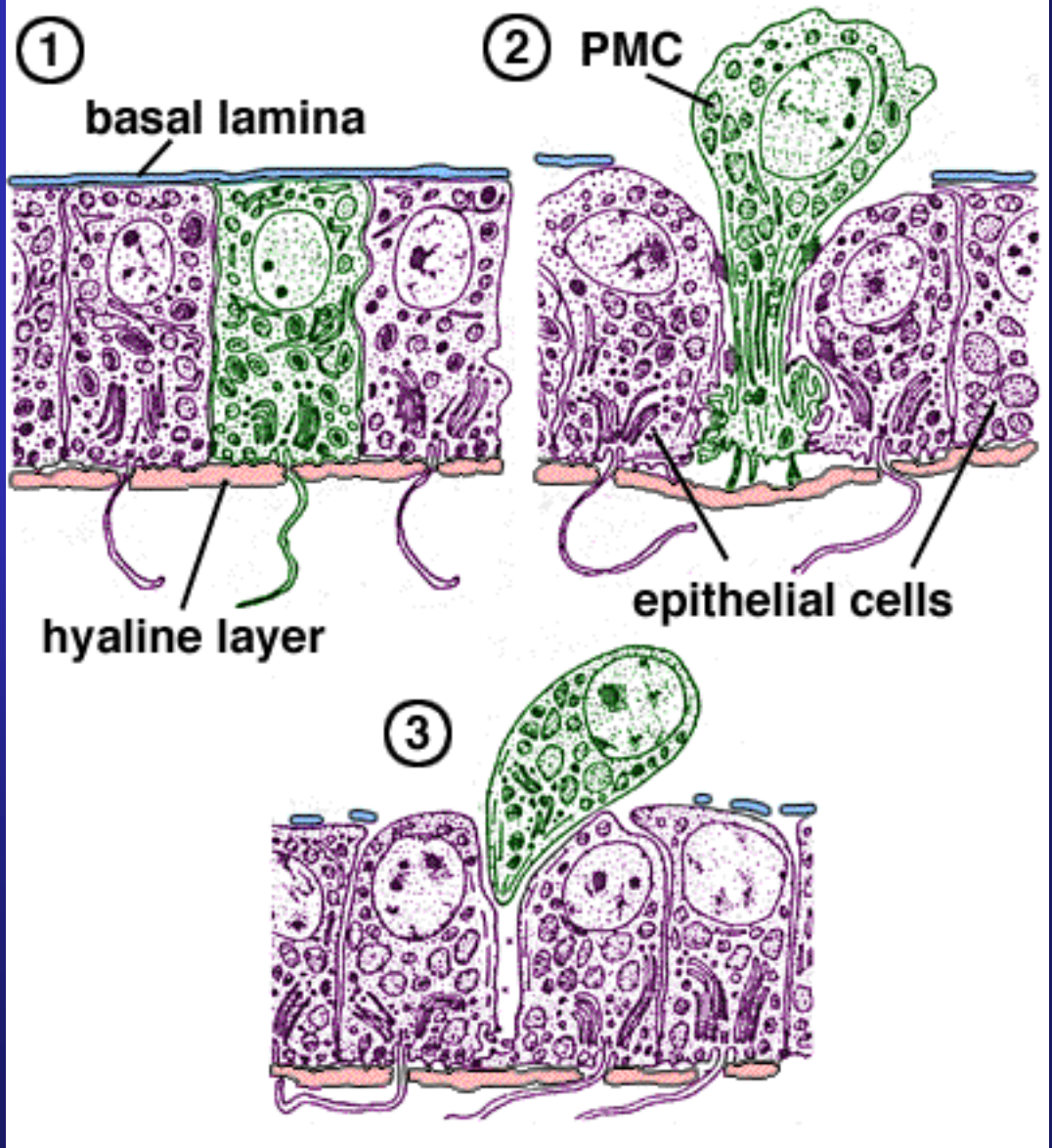
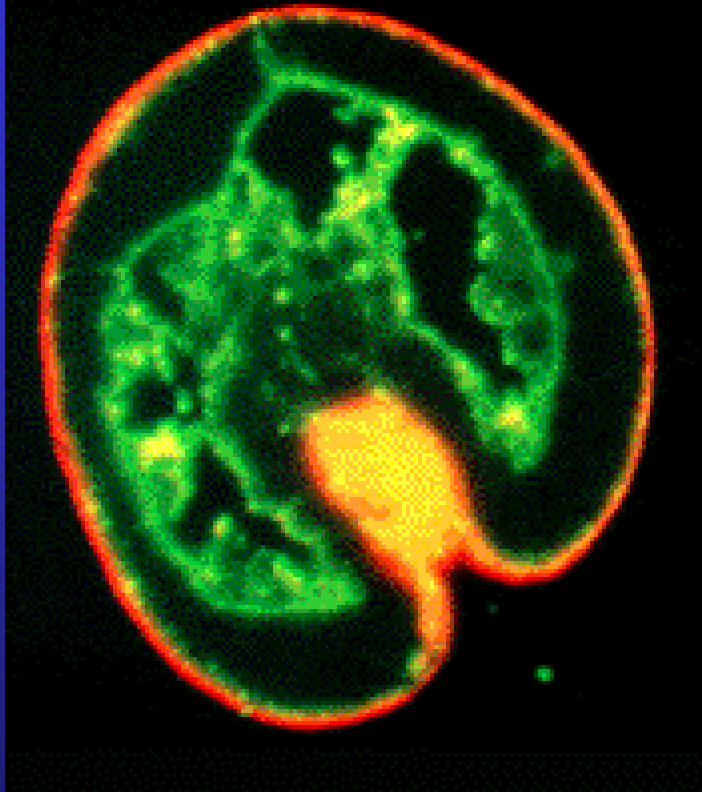


- Ridotta affinità tra i blastomeri
- Ridotta affinità per lo strato ialino
- Aumentata affinità per le proteine del blastocele

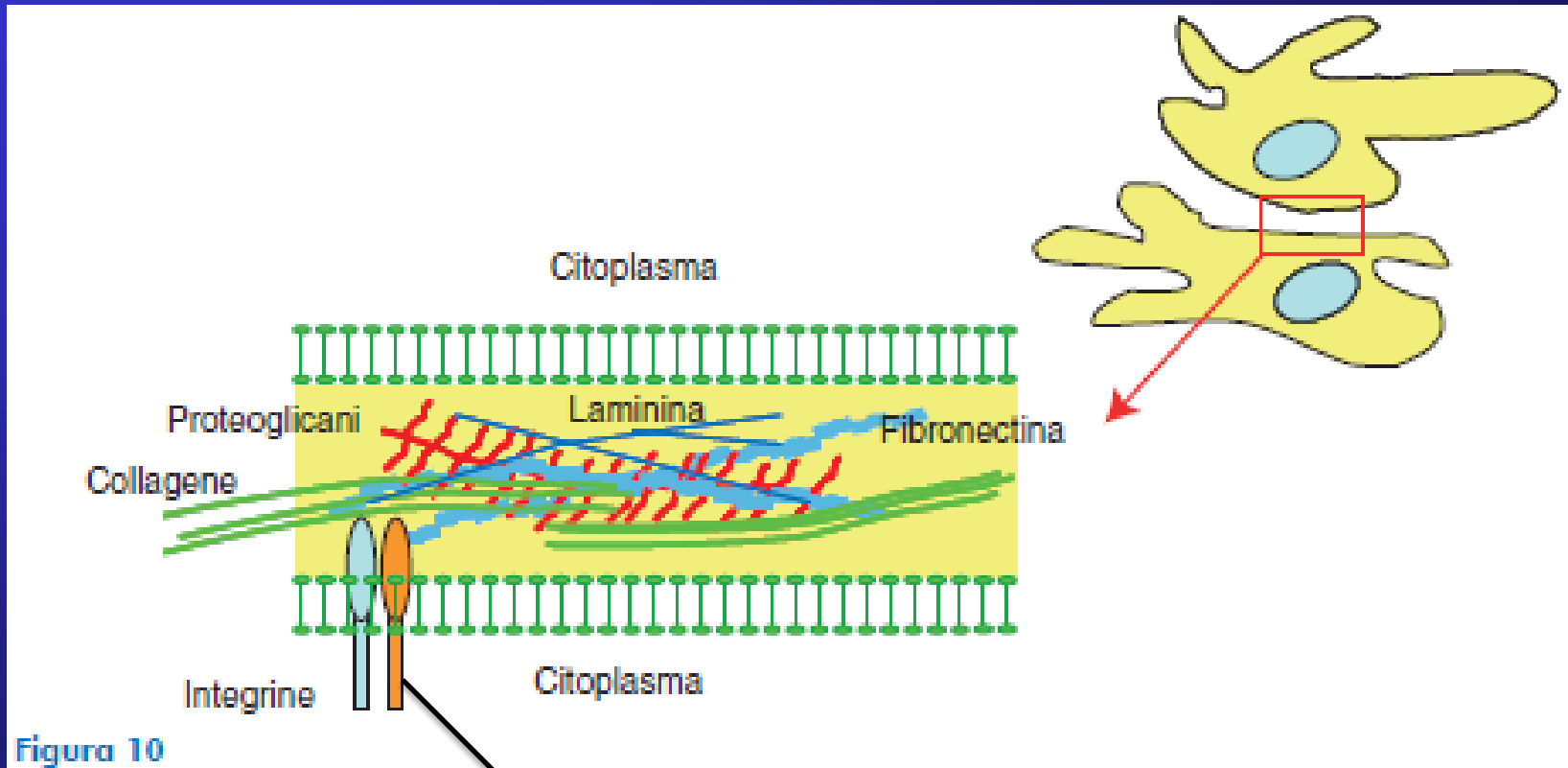
TRANSIZIONE EPITELIO-MESENCHIMATICA



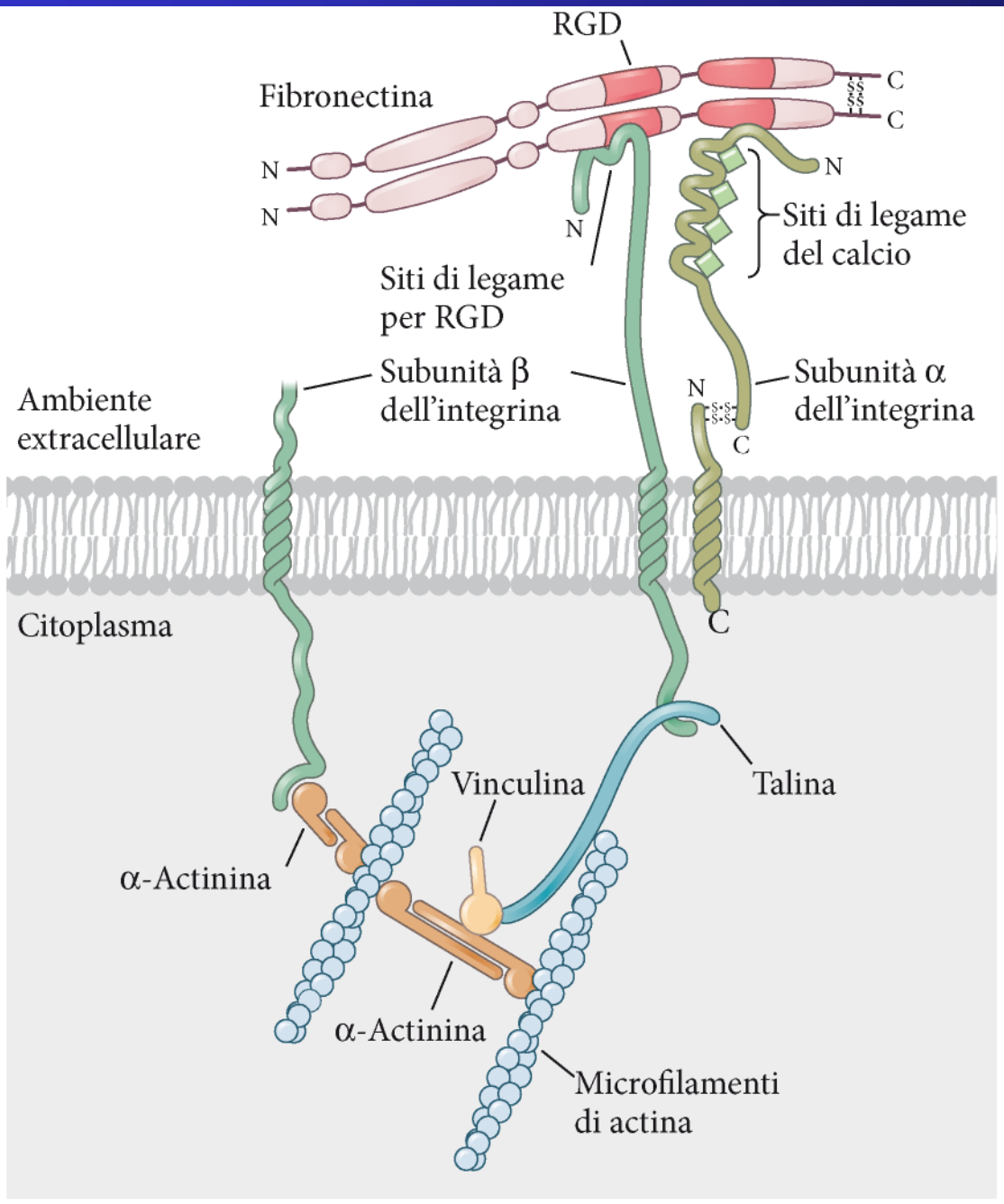
ECM in the sea urchin embryo



**I MOVIMENTI DI IMMIGRAZIONE SONO MEDIATI DA INTERAZIONI
CON LA MATRICE EXTRA-CELLULARE PRODotta DALLE CELLULE
CHE RIVESTONO IL BLASTOCELE**



**LE CELLULE MESENCHIMATICHE MIGRANTI ESPRIMONO
INTEGRINE SULLA MEMBRANA CELLULARE**



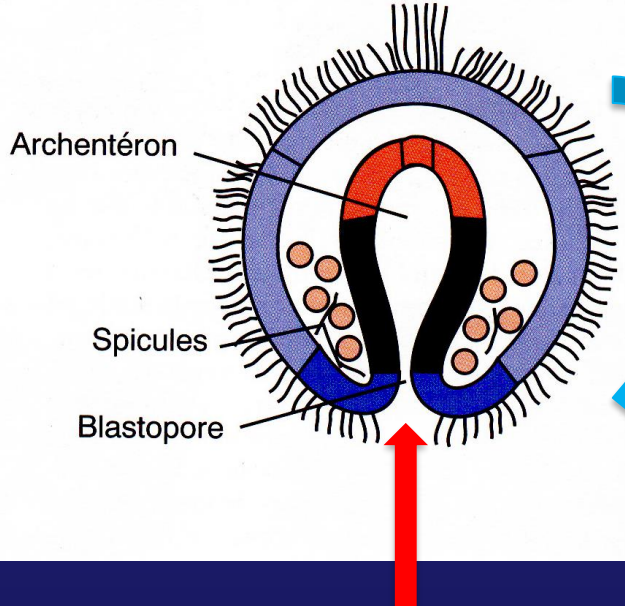
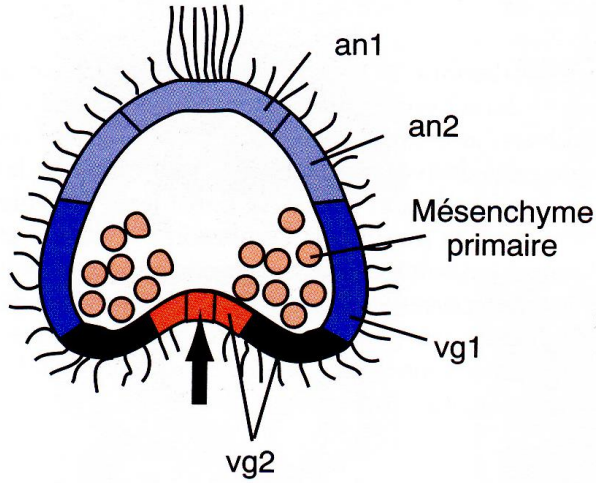
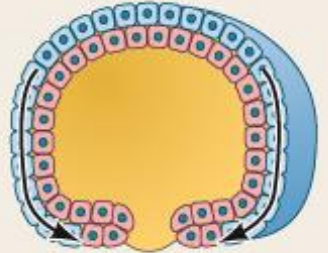
Invagination

Infolding of a sheet (epithelium) of cells, much like the indentation of a soft rubber ball when it is poked.



Epiboly

Movement of epithelial sheets (usually ectodermal cells) spreading as a unit (rather than individually) to enclose deeper layers of the embryo. Can occur by cells dividing, by cells changing their shape, or by several layers of cells intercalating into fewer layers; often, all three mechanisms are used.

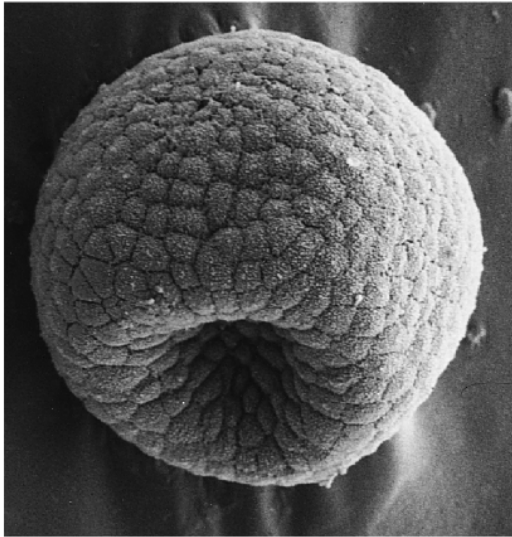


Epibolia

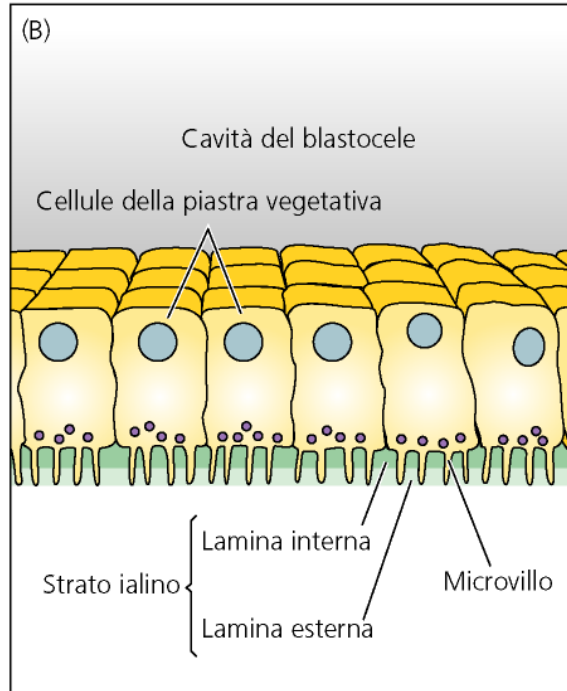
Invaginazione delle cellule derivate dai macromeri
Epibolia dell'ectoderma

Invaginazione

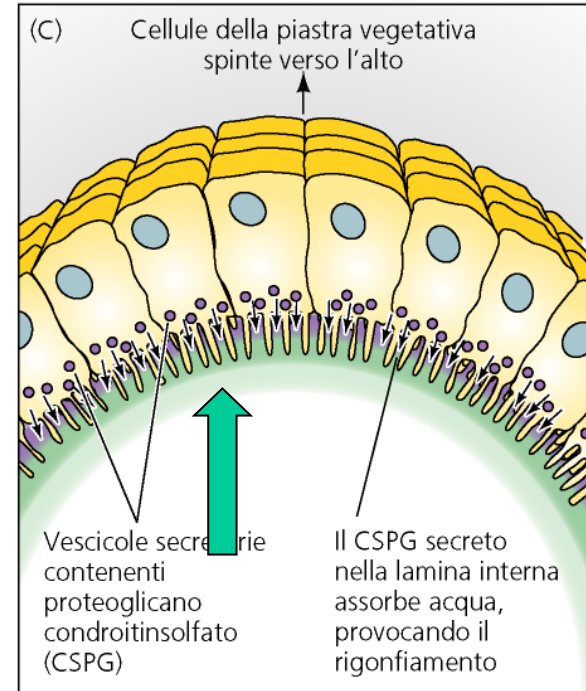
(A)



(B)

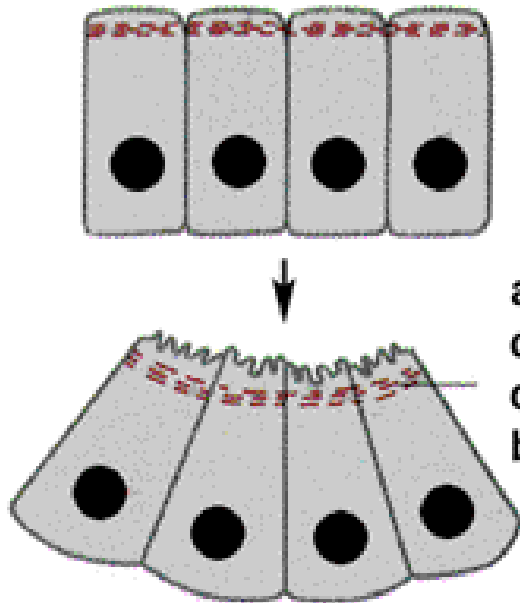


(C)

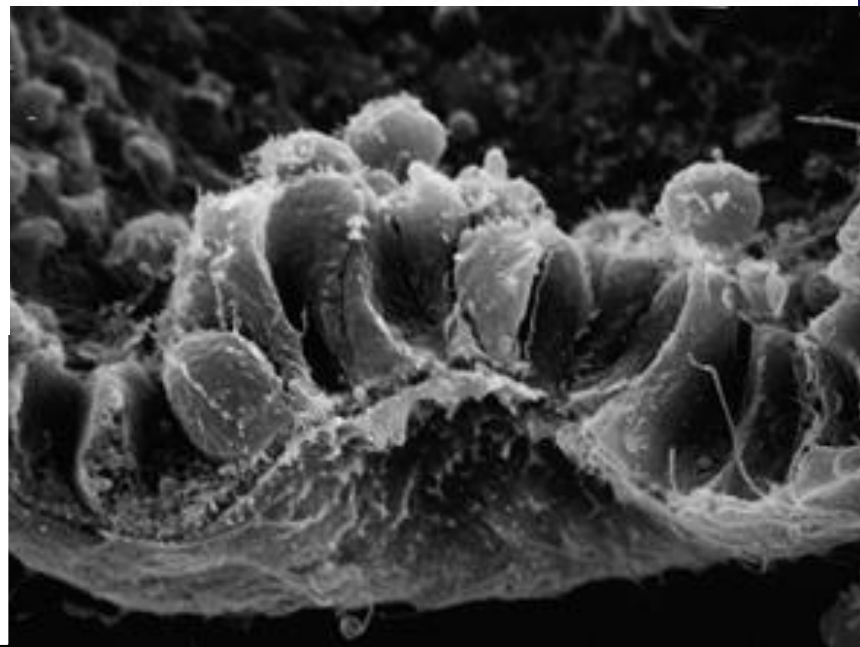


- perdita adesività dei blastomeri alla proteina ialina
- aumento adesività per proteine del blastocele
- deposizione di proteoglicani nello strato ialino
- rigonfiamento dello strato ialino

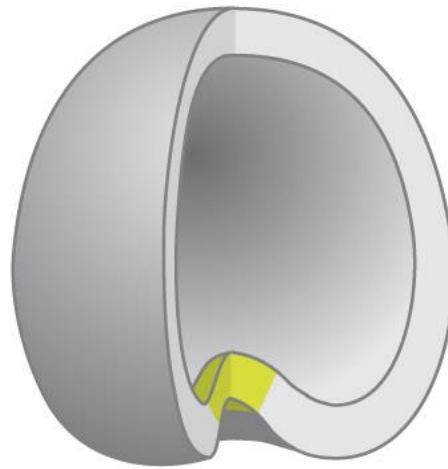
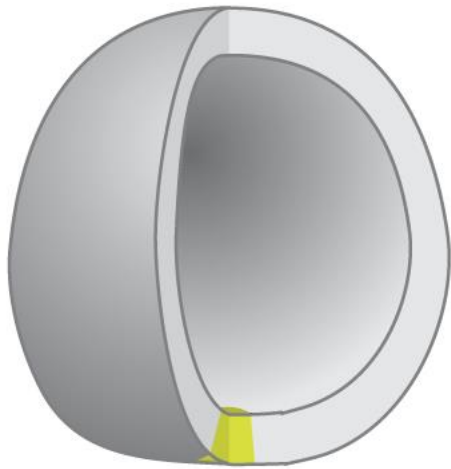
Apical Constriction and Invagination



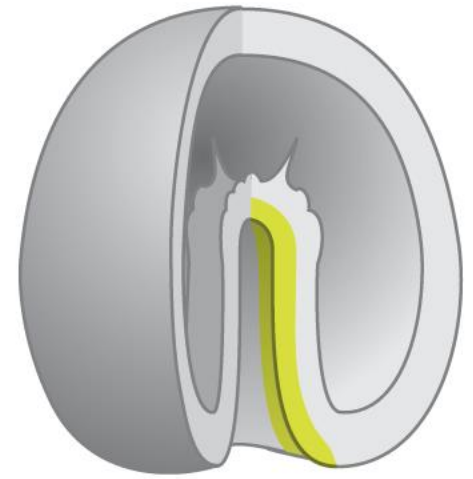
apical actomyosin complex undergoes contraction to buckle epithelium



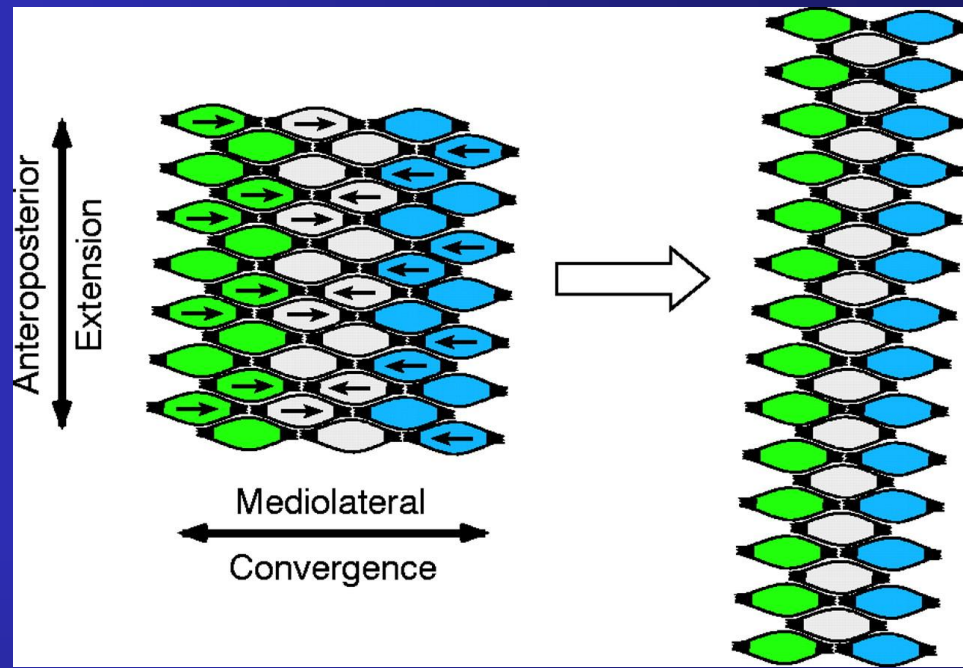
Blastula



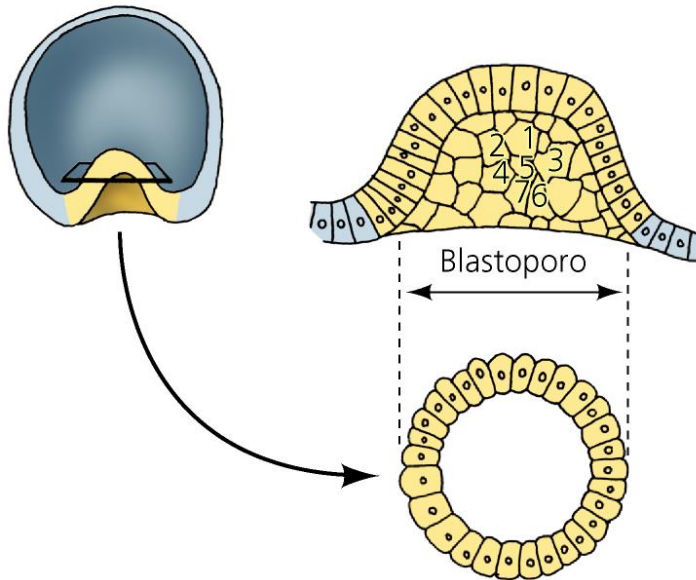
Gastrula



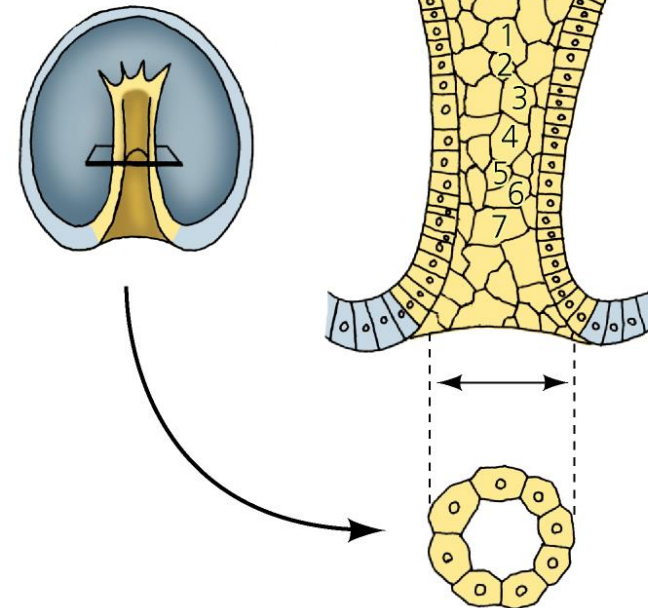
Formazione dell'archenteron



GASTRULAZIONE INIZIALE



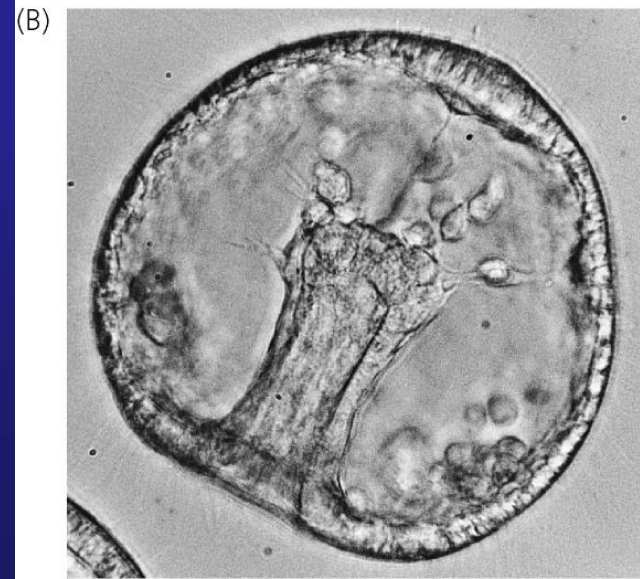
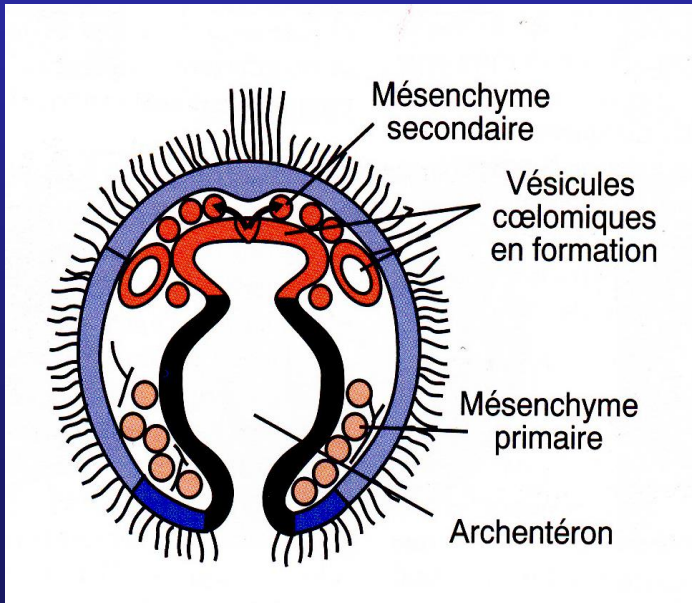
GASTRULAZIONE AVANZATA



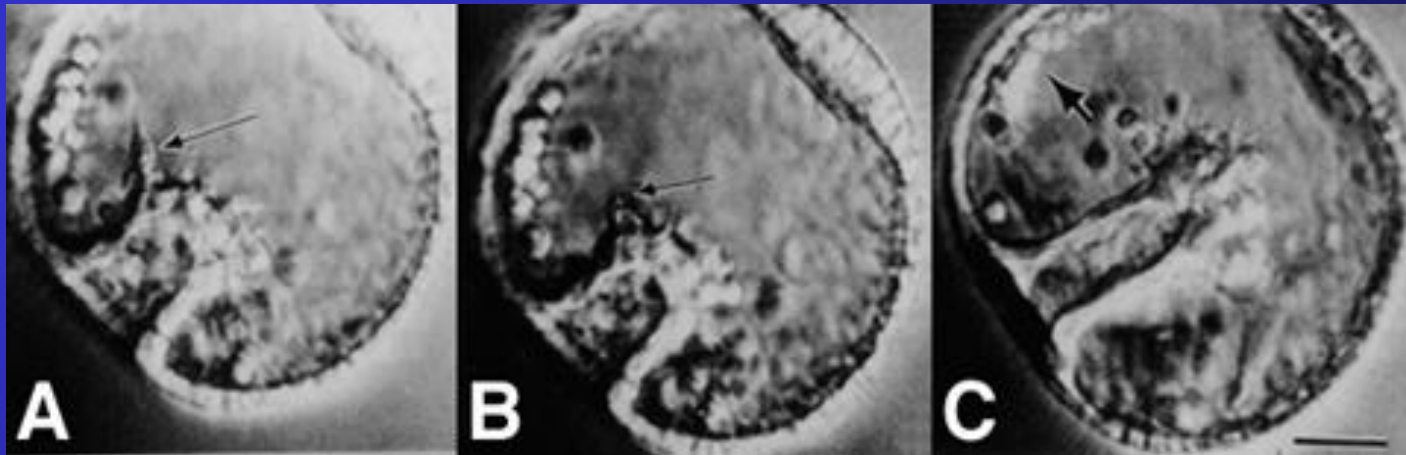
Mesenchima secondario



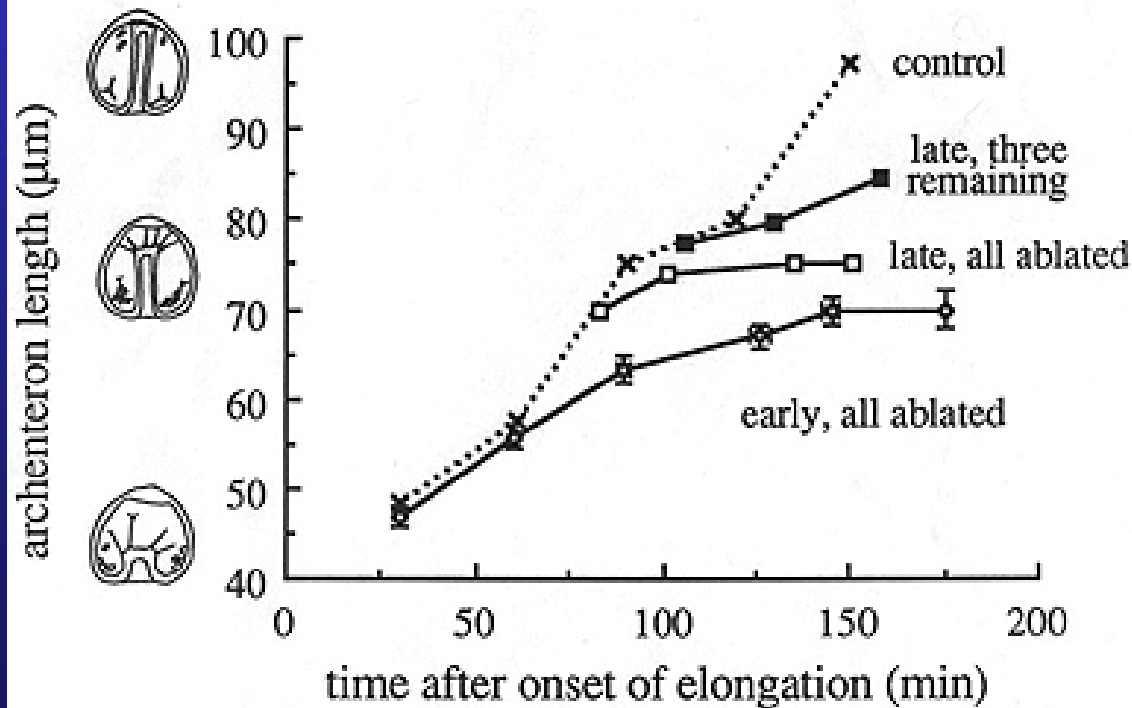
Vescicole celomatiche
Muscolatura larvale
Contribuisce alla formazione del
contatto tra archenteron e la
regione dello stomodeo (bocca).

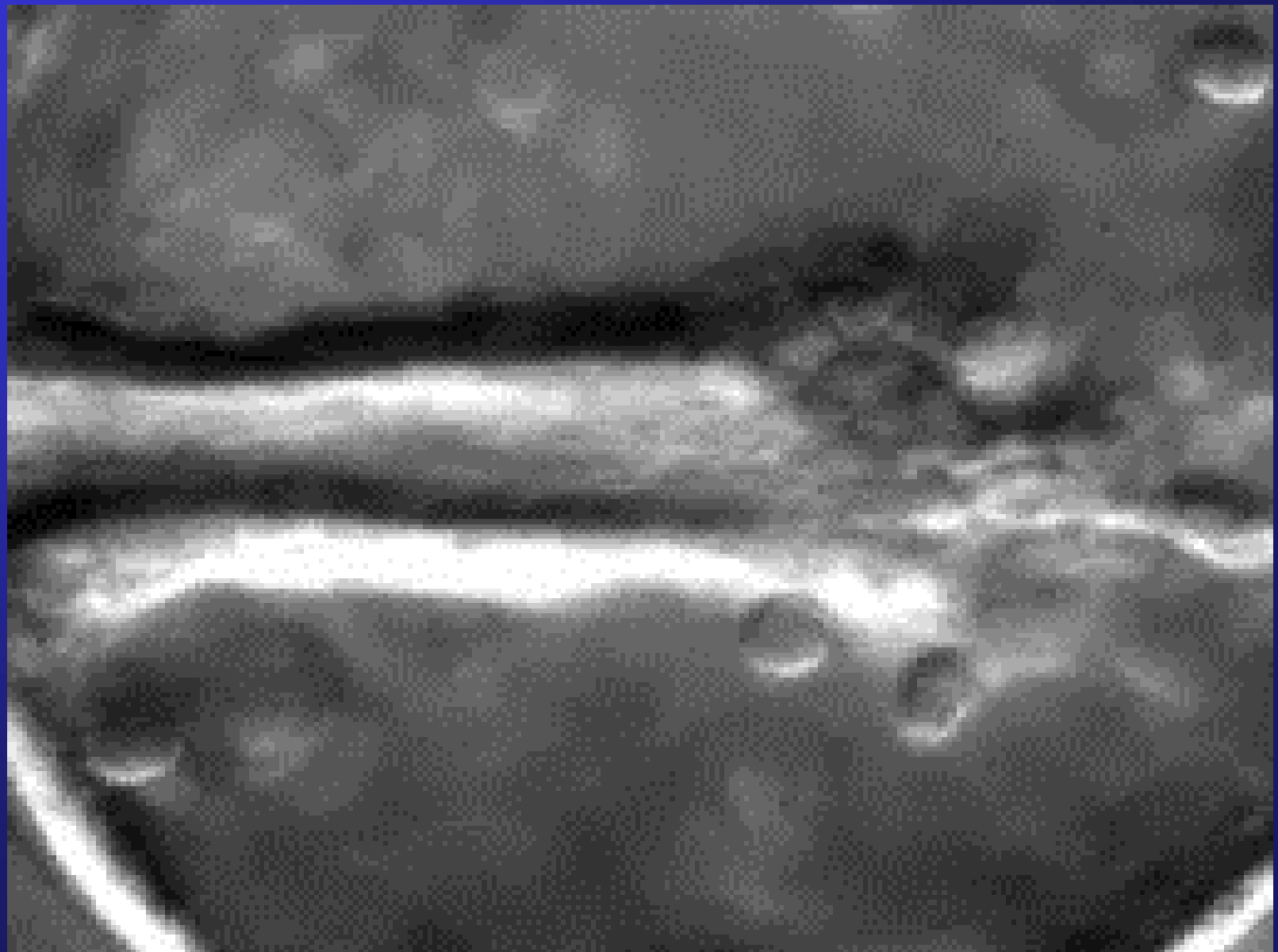




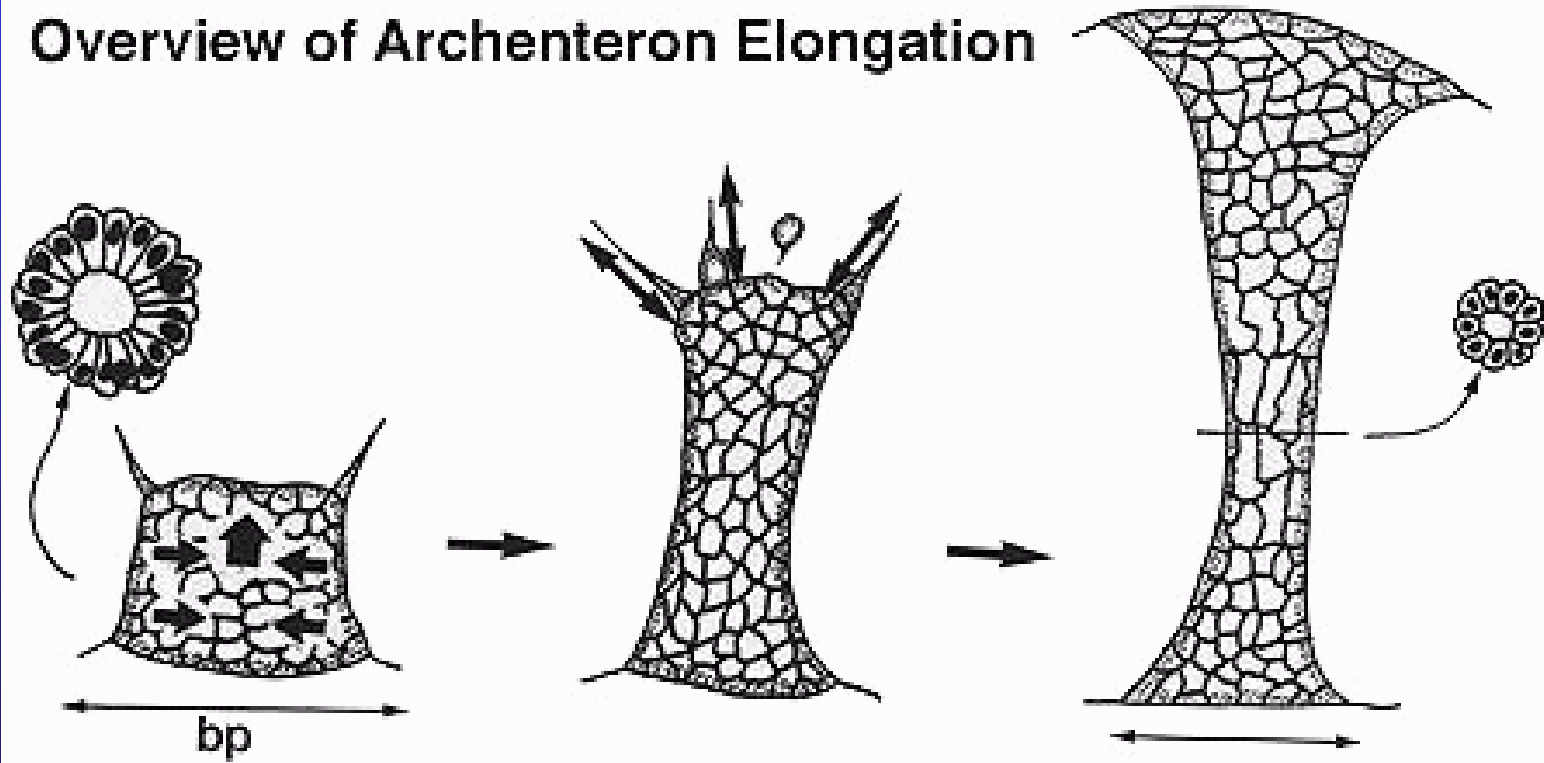


SMCs are Required Late in Gastrulation



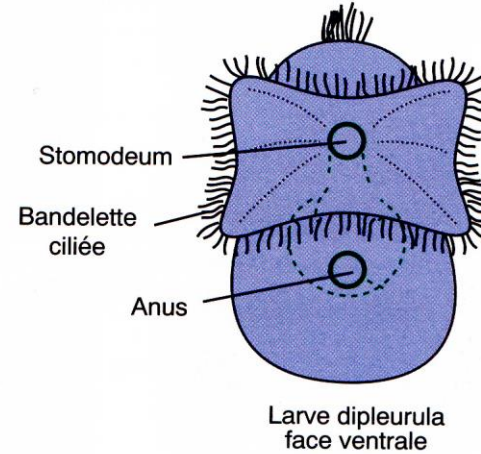
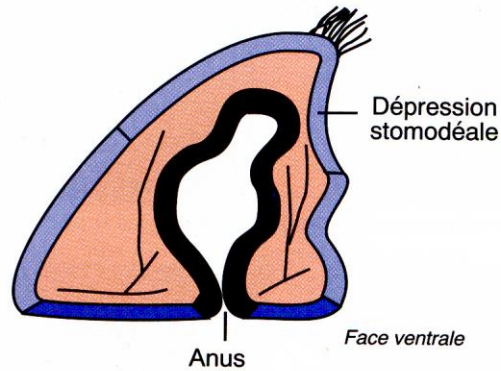


Overview of Archenteron Elongation

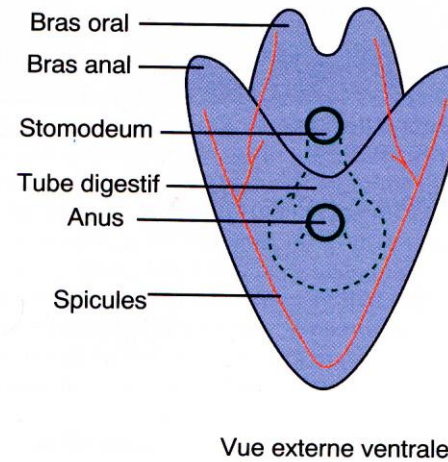
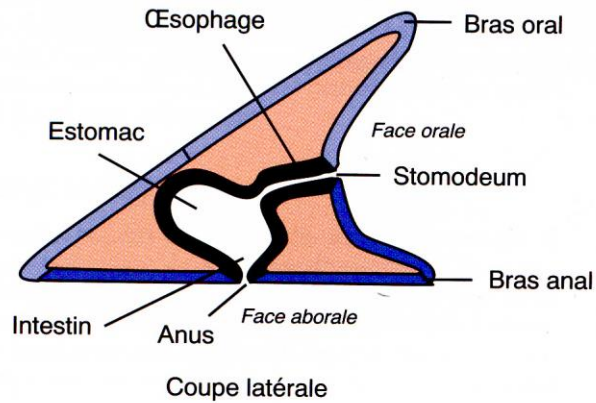


Formazione della larva pluteo

Formation de la larve pluteus

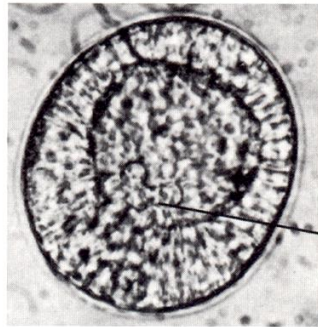


Larve pluteus

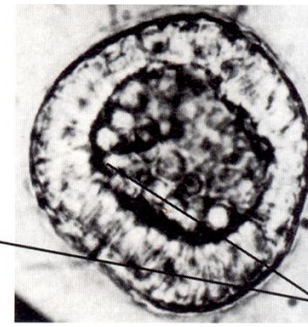




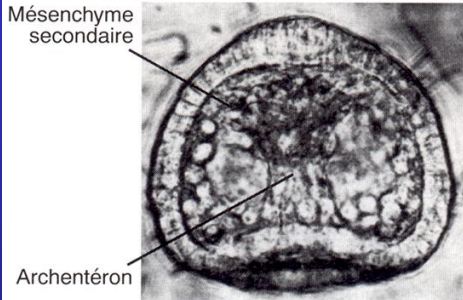
Blastula nageuse



Gastrula avec mésenchyme primaire

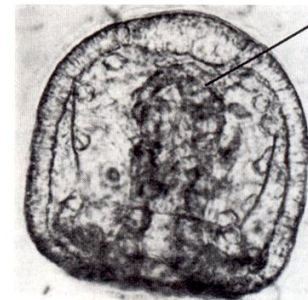
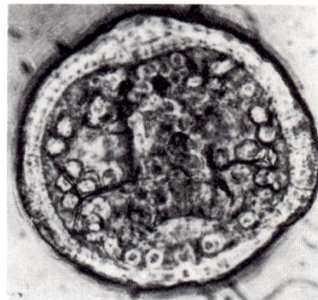


Mésenchyme primaire



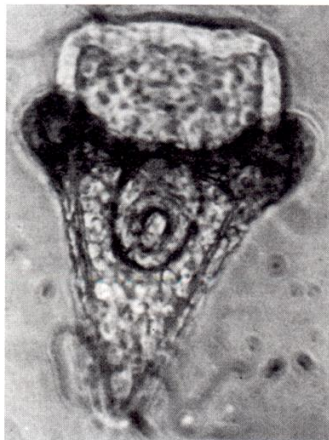
Mésenchyme secondaire

Archentéron



Vésicules coelomiques

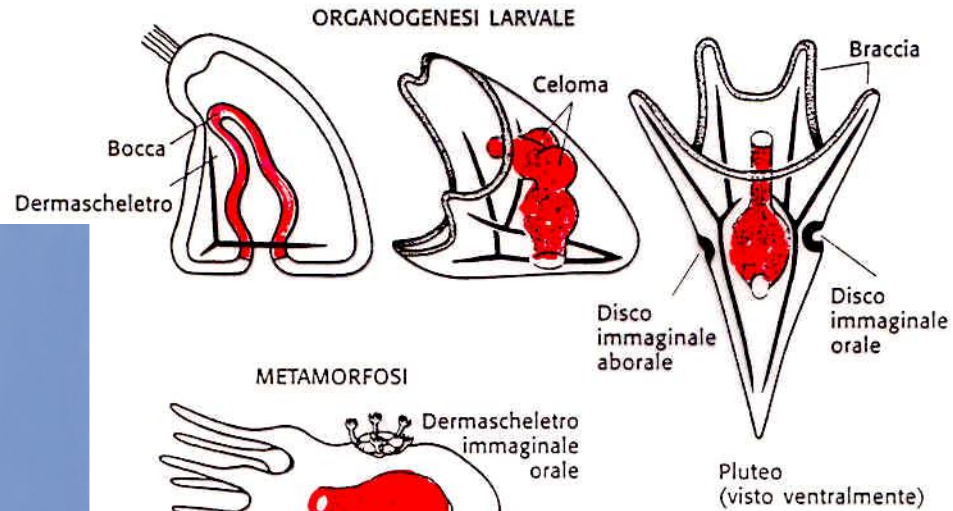
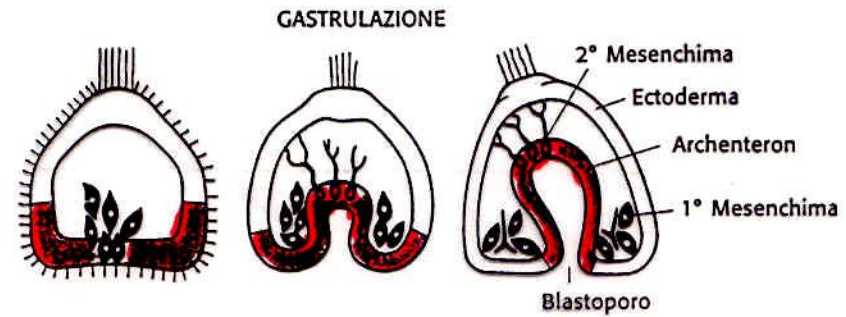
Gastrula avec archentéron et mésenchyme secondaire



Jeune pluteus
vue ventrale



Pluteus âgées en vues ventrale et latérale



Rudimento immaginale

Sviluppo dell'embrione di riccio di mare. Parte seconda: dalla gastrulazione all'inizio della metamorfosi. La gastrulazione avviene in diverse fasi e produce la cavità interna con cellule dalle quali si originano gli organi interni. La larva risultante è chiamata pluteo. È rappresentato uno solo degli stadi che partono dalla metamorfosi della larva, a simmetria bilaterale, per arrivare al riccio di mare adulto, a simmetria pentaraggiata.