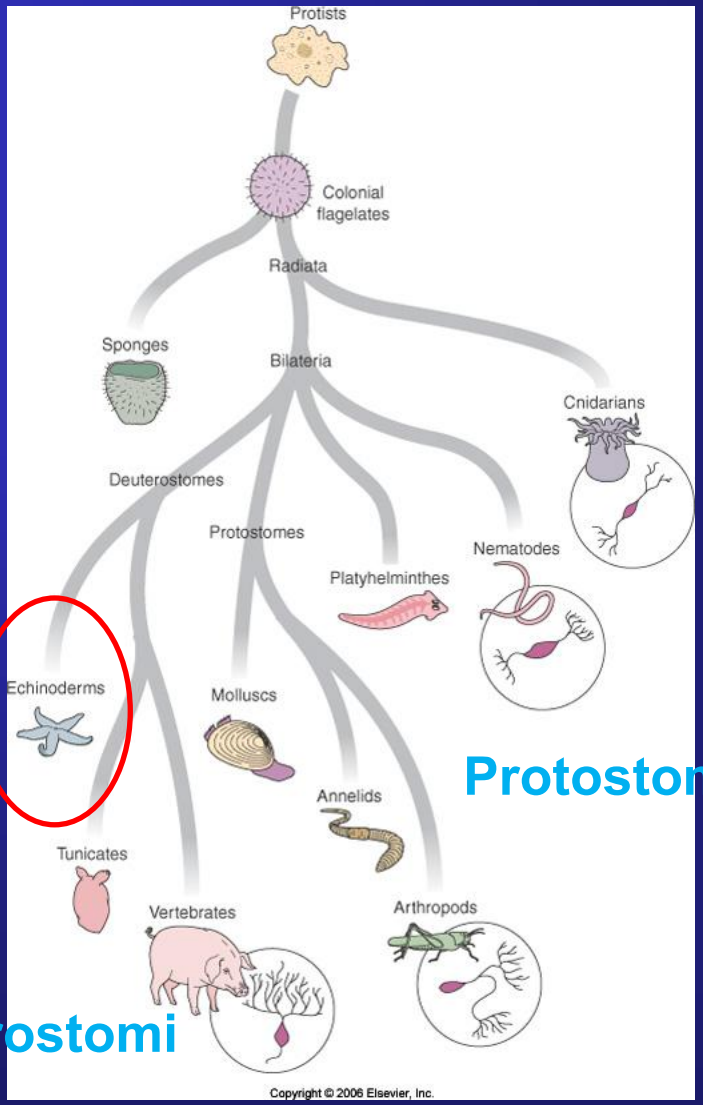
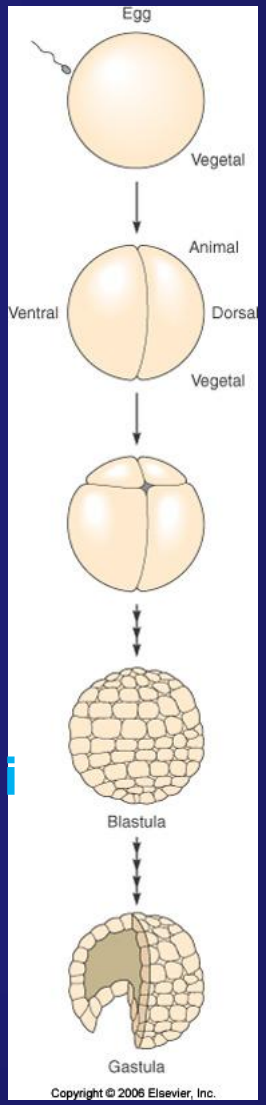
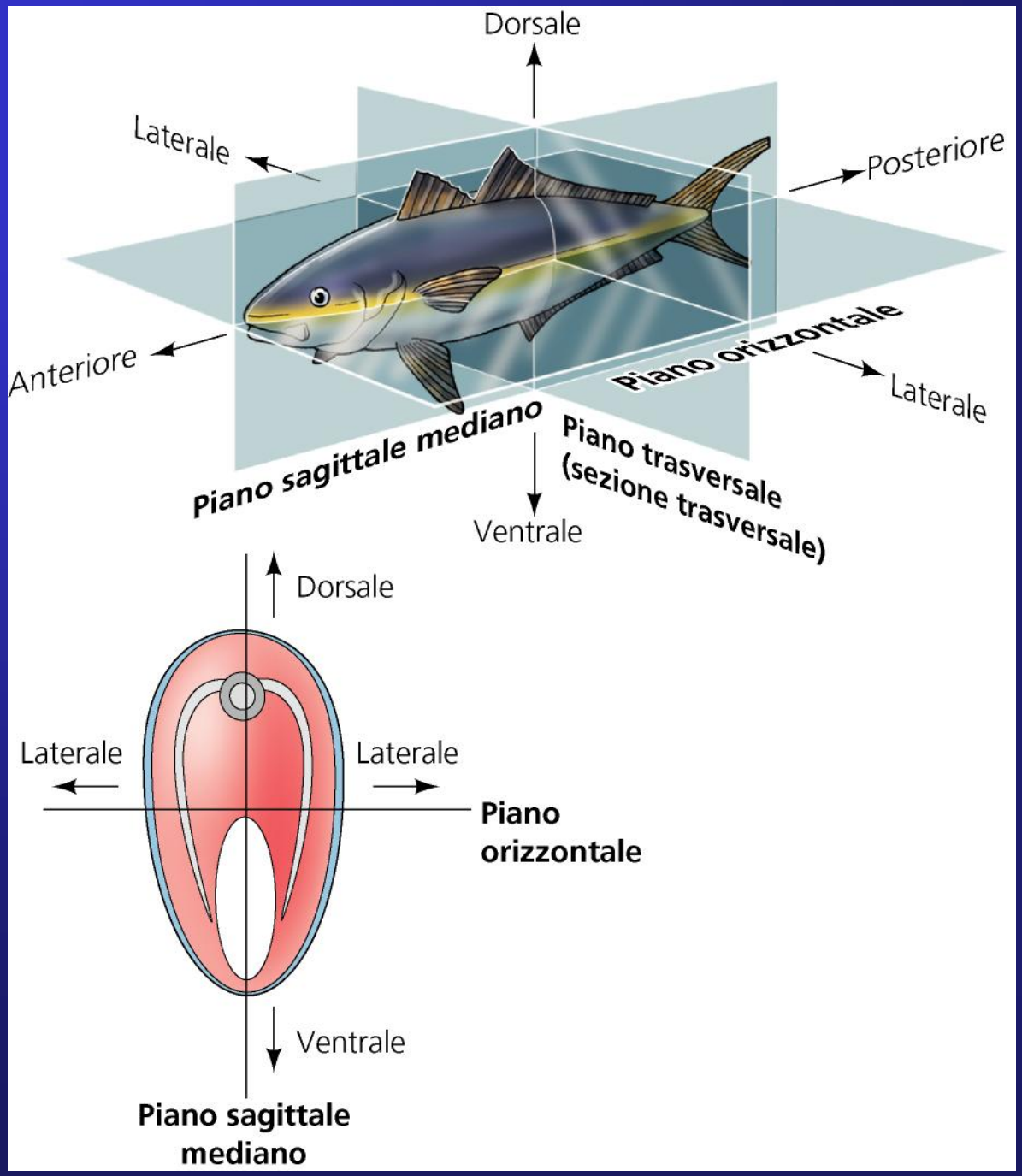
SVILUPPO PRECOCE DEL RICCIO DI MARE

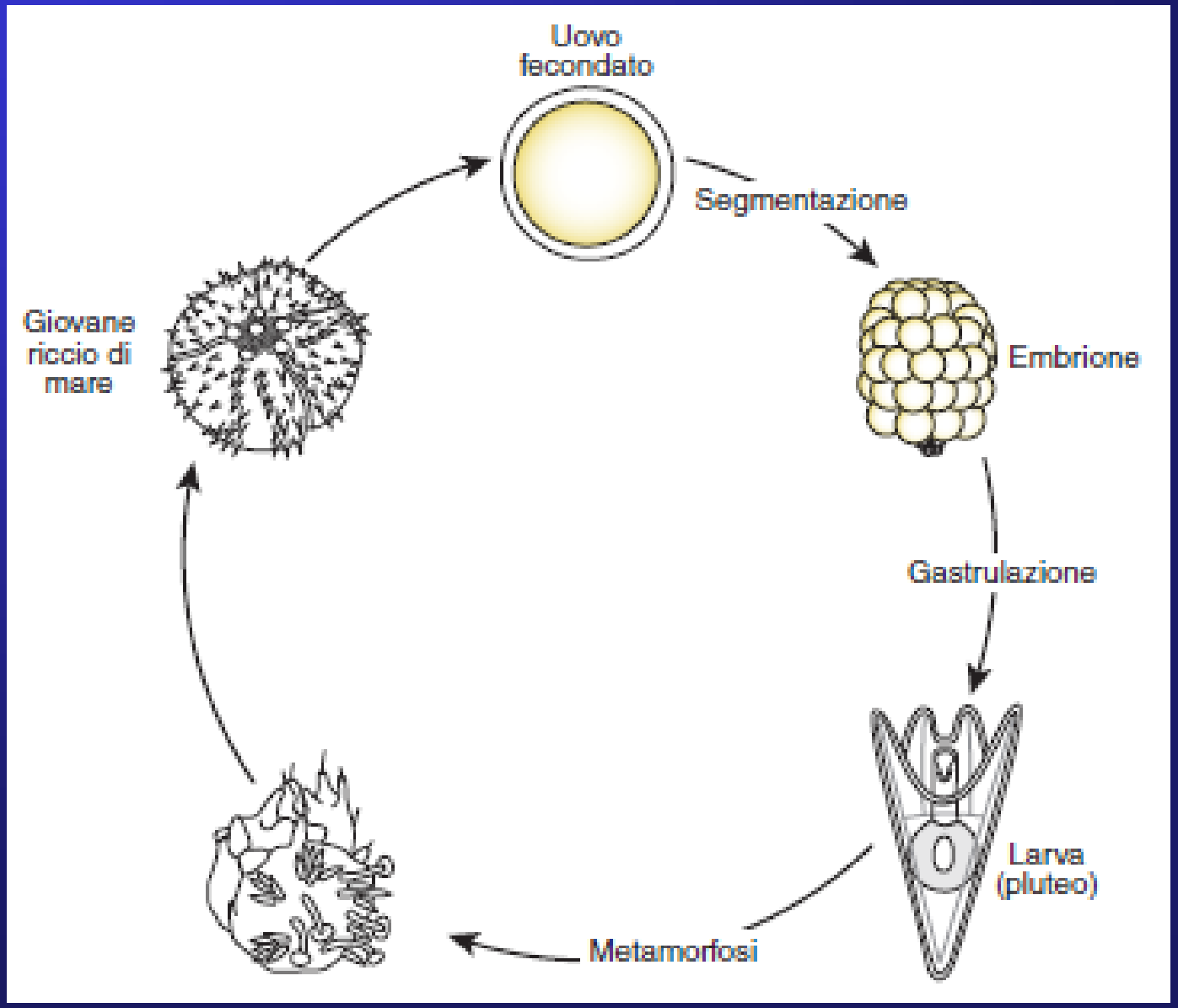




Protostomi: nel canale alimentare si forma prima la bocca
Deuterostomi: nel canale alimentare la bocca si forma per ultima


Dorsale
Laterale
Posteriore
Anteriore
Piano orizzontale
Laterale
Piano sagittale mediano
Piano trasversale
(sezione trasversale)
Ventrale
Dorsale
Laterale
Laterale
Piano
orizzontale
Ventrale
Piano sagittale
mediano

Sviluppo indiretto



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

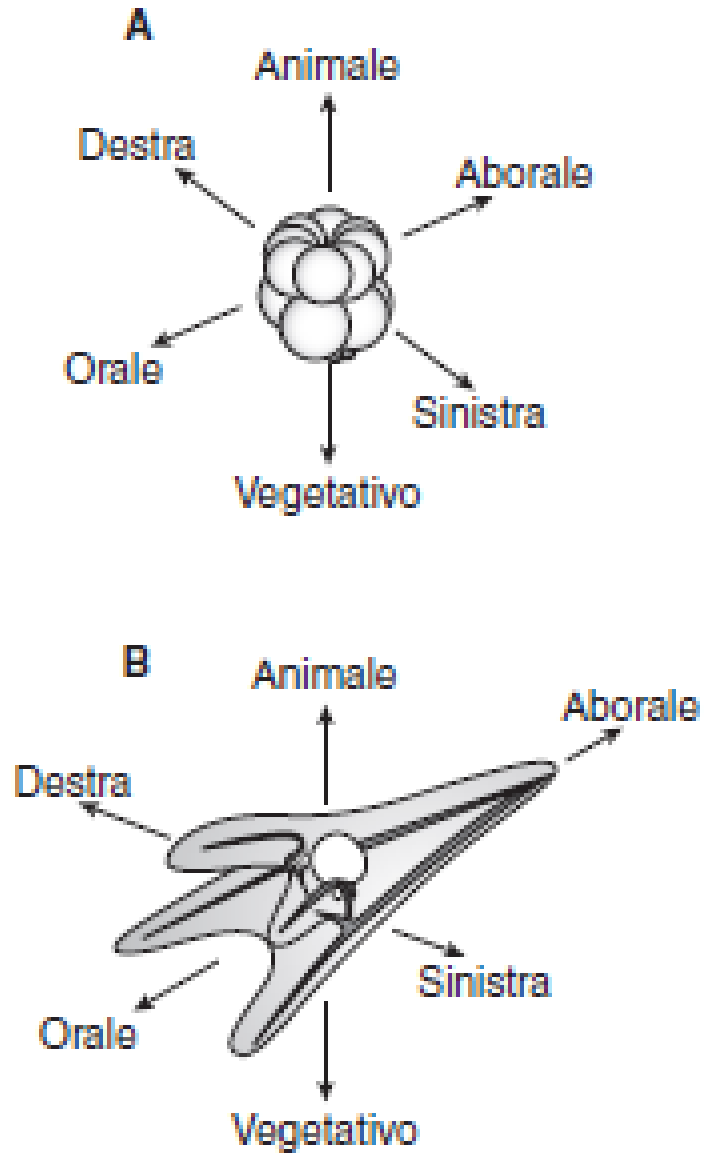


Figura 9

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

- La velocità e la modalità della segmentazione sono dipendenti dalla quantità e dalla distribuzione del tuorlo presente nell'uovo

- Il tuorlo crea un ostacolo all'insorgenza dei piani di divisione cellulare

- La citodieresi si verifica all'equatore del fuso mitotico

- La posizione e orientamento dei piani di segmentazione è dipendente dalla disposizione dei fusi mitotici, che può essere influenzata dal tuorlo ma anche da altri fattori

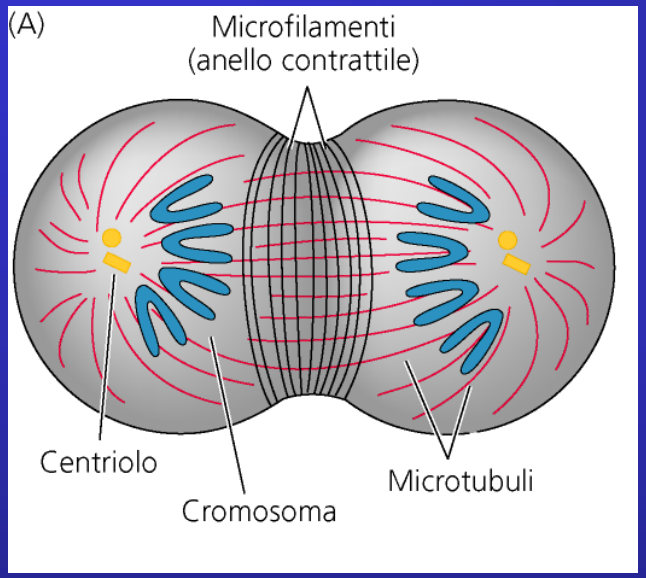
TABELLA 1

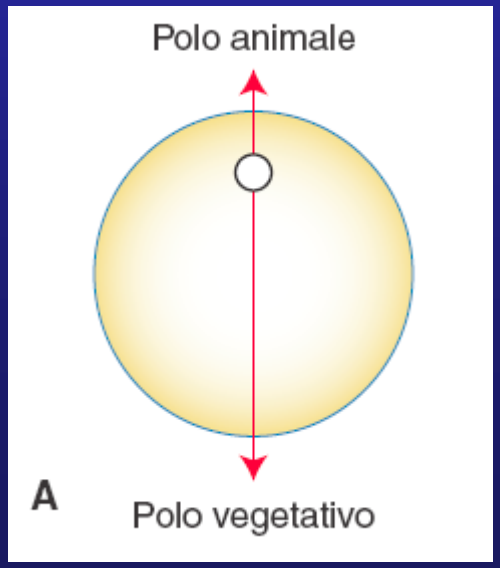
Classificazione dei tipi di uova in base alla quantità di vitello.

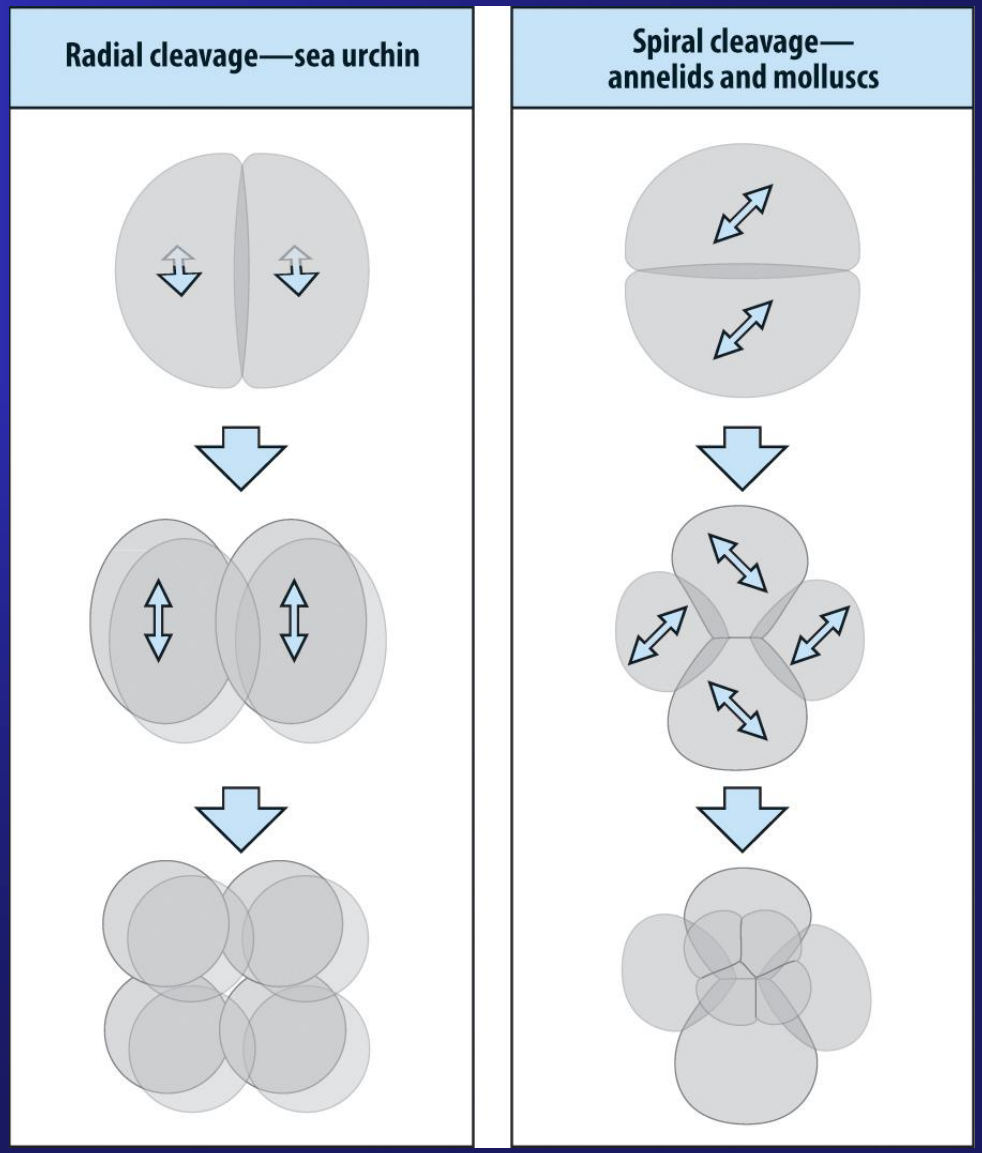
Tipo di uova	Quantità di vitello	Distribuzione citoplasmatica	Dimensioni	Es. Taxa
Alecitico	Senza vitello		Circa 70 µm	Mammiferi Euteri
Oligolecitico	Scarso vitello	Abbastanza omogenea	Circa 100 µm	Echinodermi
Mesolecitico	Quantità medie	Ineguale, a gradiente	Circa 1 mm	Anfibi, Anellidi
Centrolecitico	Abbondante	Massa centrale	Circa 1 mm	Insetti
Telolecitico	Molto abbondante	Occupa tutto l'uovo tranne una piccola zona al polo animale, in cui è situato il citoplasma	Fino a oltre 10 cm	Cefalopodi molti pesci Sauropsidi (Rettili e Uccelli) Mammiferi ovipari (Monotremi)

Uova macrolecitiche

La posizione/orientamento del fuso mitotico può dipendere da altri fattori oltre alla distribuzione del tuorlo, determinando specifiche modalità di segmentazione che differiscono per la disposizione dei piani di divisione

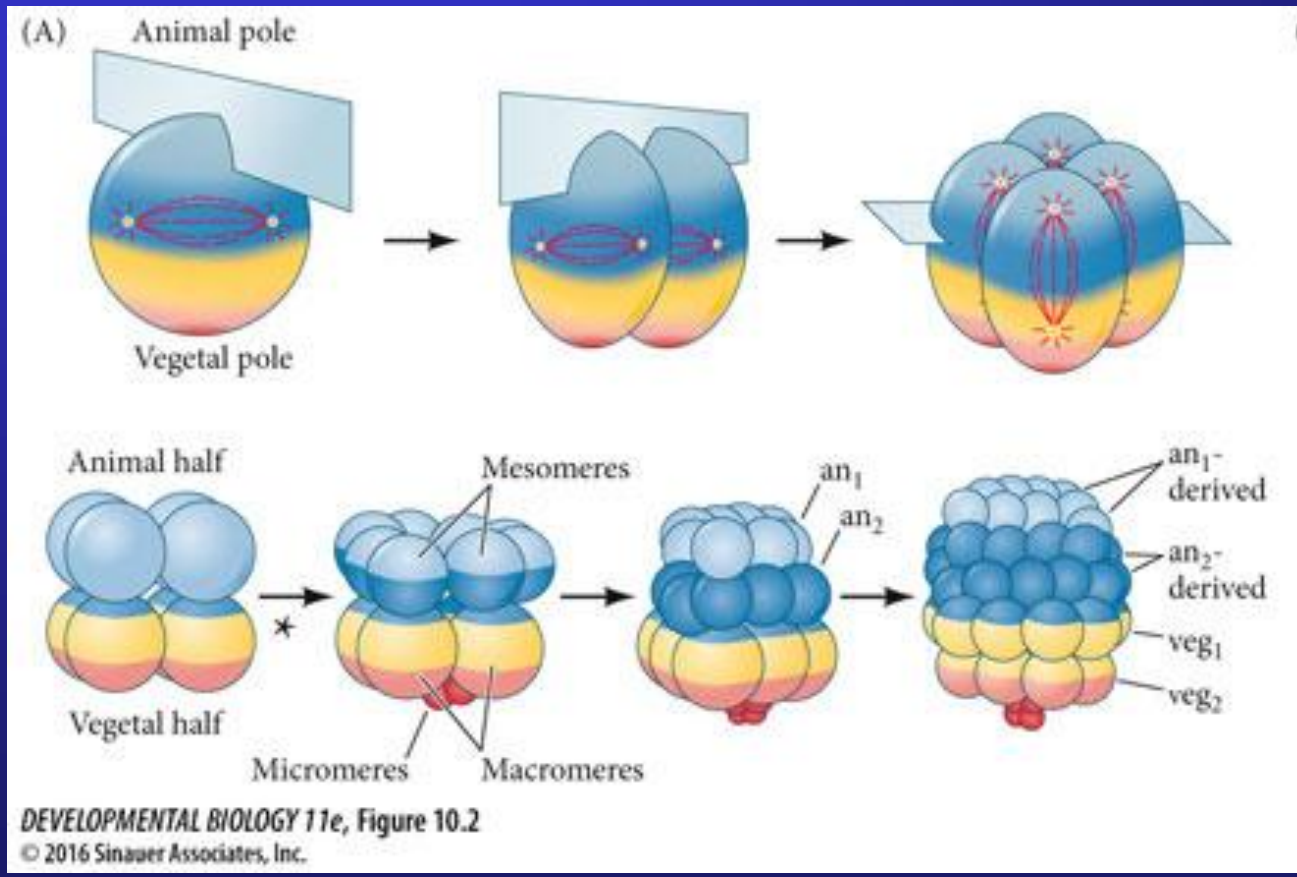


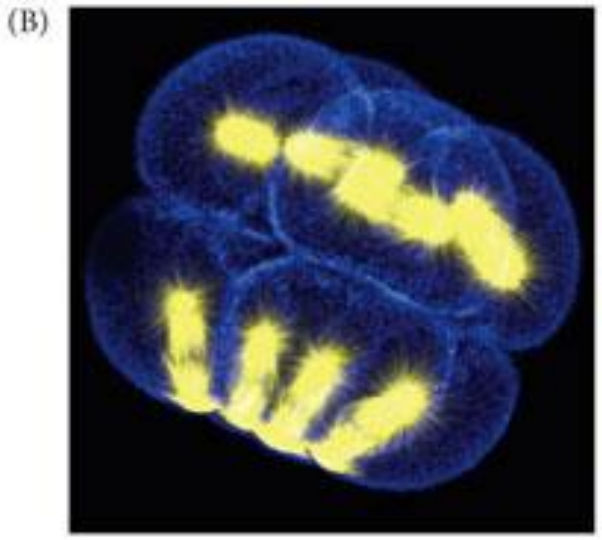




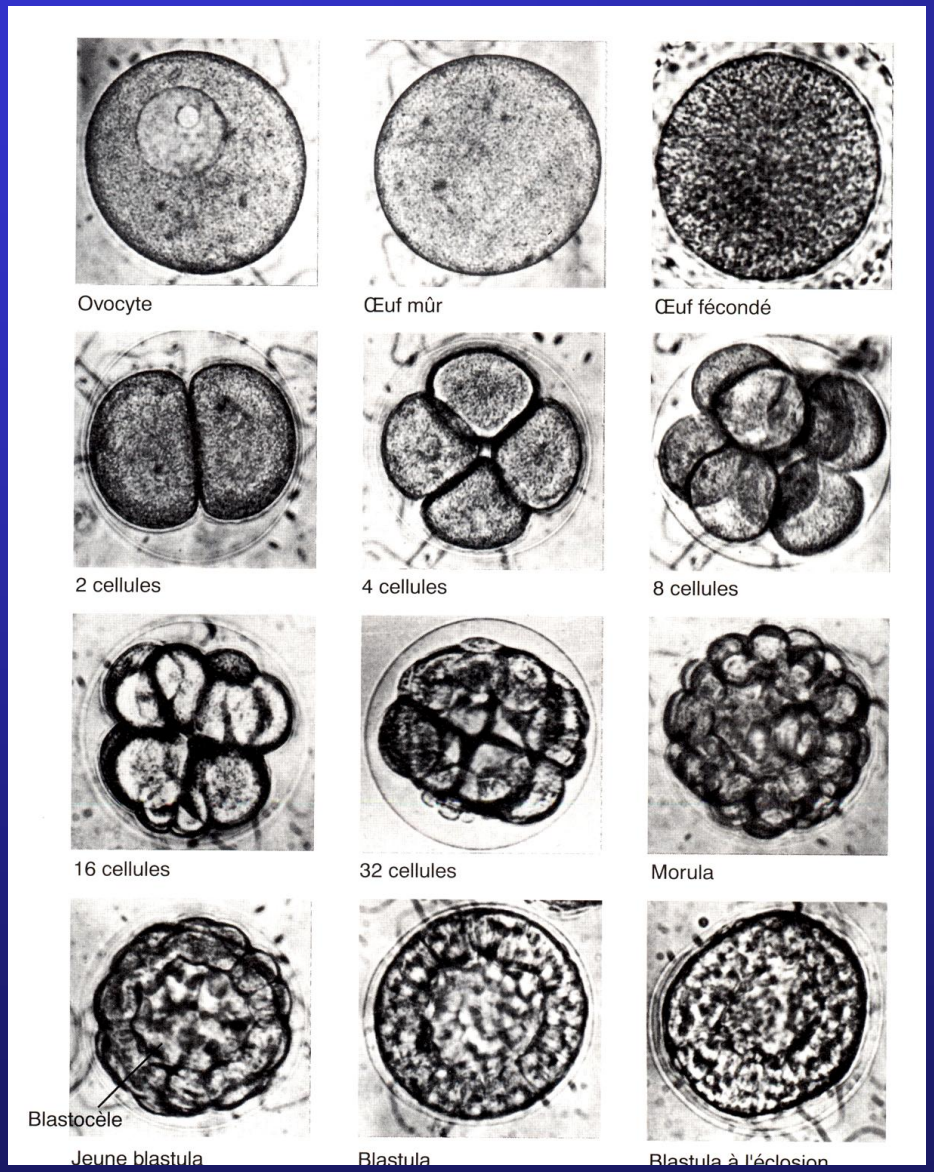
SEGMENTAZIONE

Uovo oligolecitico – Segmentazione oloblastica radiale



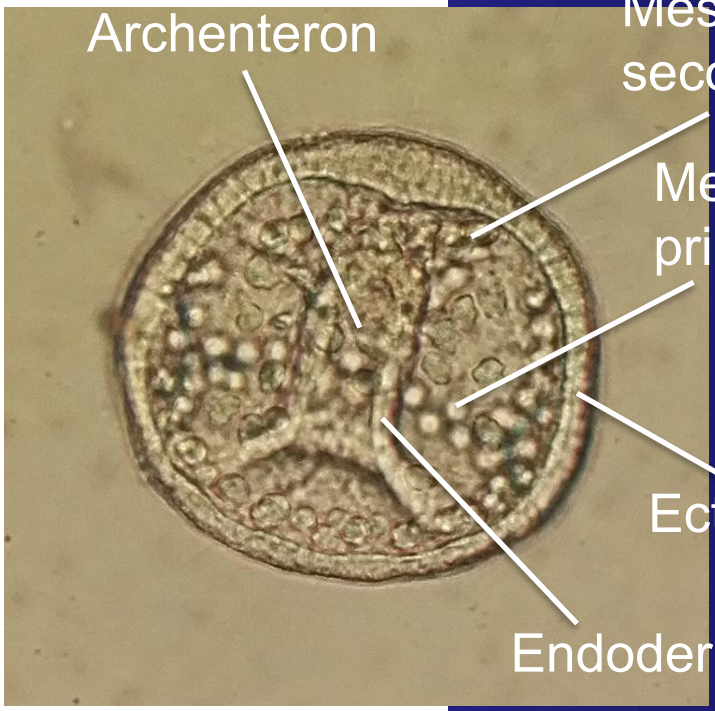


Notare la posizione e orientamento dei fusi mitotici!


Ovocyte
Œuf mûr
Œuf fécondé
2 cellules
4 cellules
8 cellules
16 cellules
32 cellules
Morula
Blastocèle
Jeune blastula
Blastula
Blastula à l'éclosion

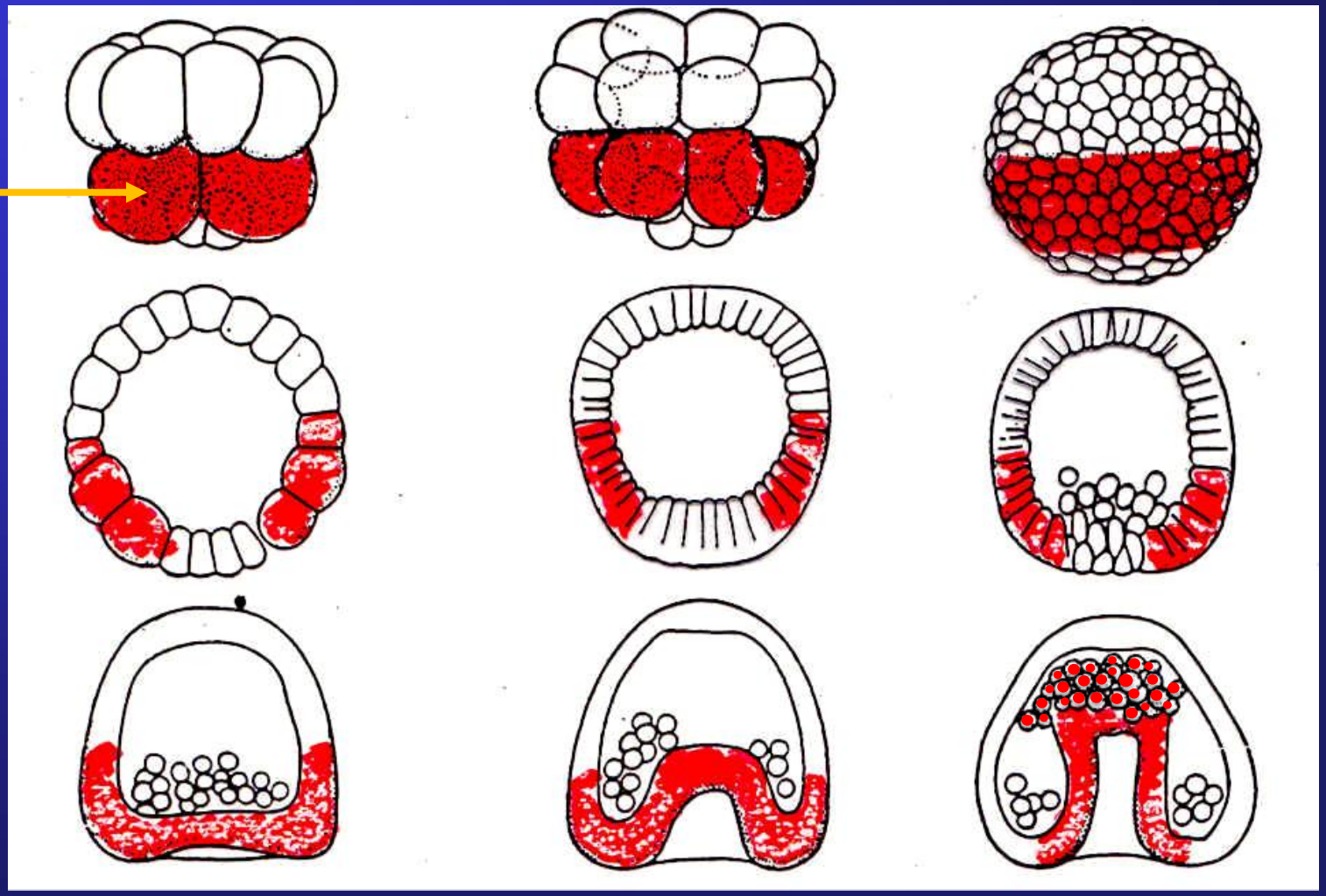

Mesomeri
Macromeri
Micromeri


9 hr
9.5 hr
10 hr
10.5 hr
11 hr
11.5 hr
Blastopore
12 hr
13 hr
13.5 hr
Syncytial cables
15 hr
17 hr
18 hr
Blastopore
Syncytial cables
DEVELOPMENTAL BIOLOGY 11e, Figure 10.10
© 2016 Sinauer Associates, Inc.


Archenteron
Mesenchima secondario
Mesenchima primario
Ectoderma
Endoderma

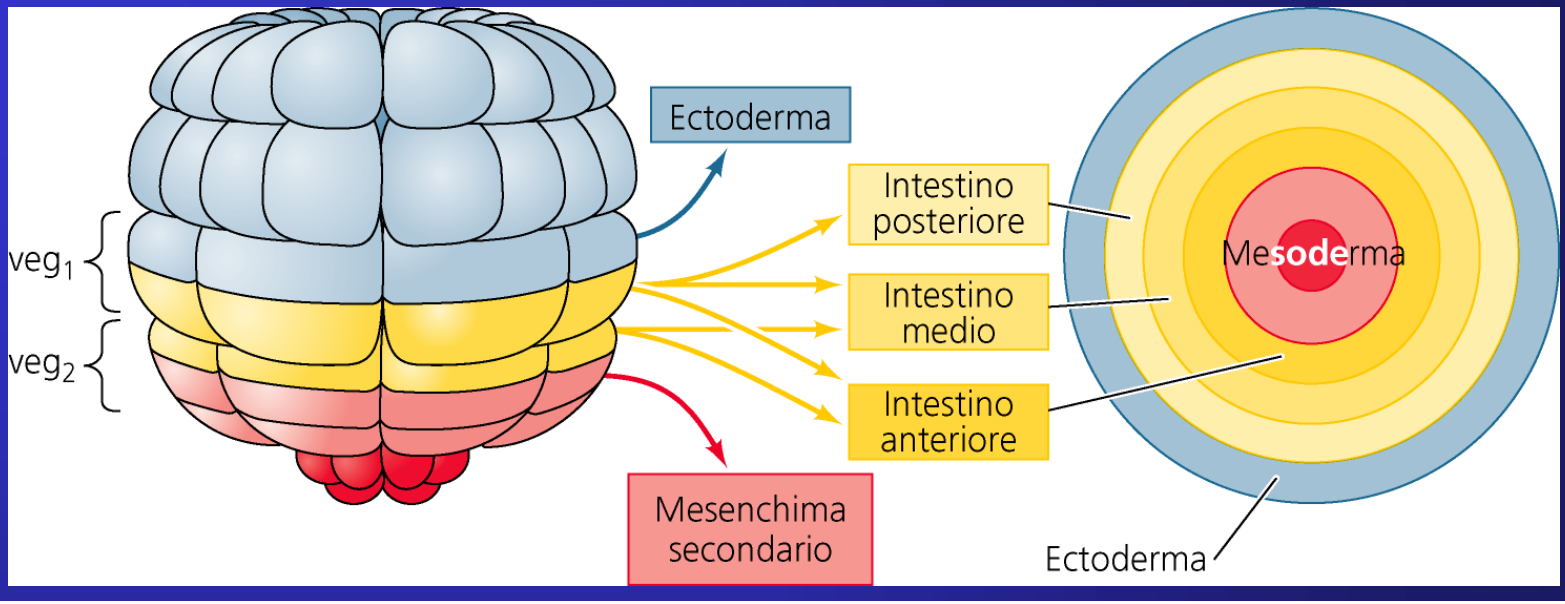
Skeletal rods
Anus
Mouth
24 hr

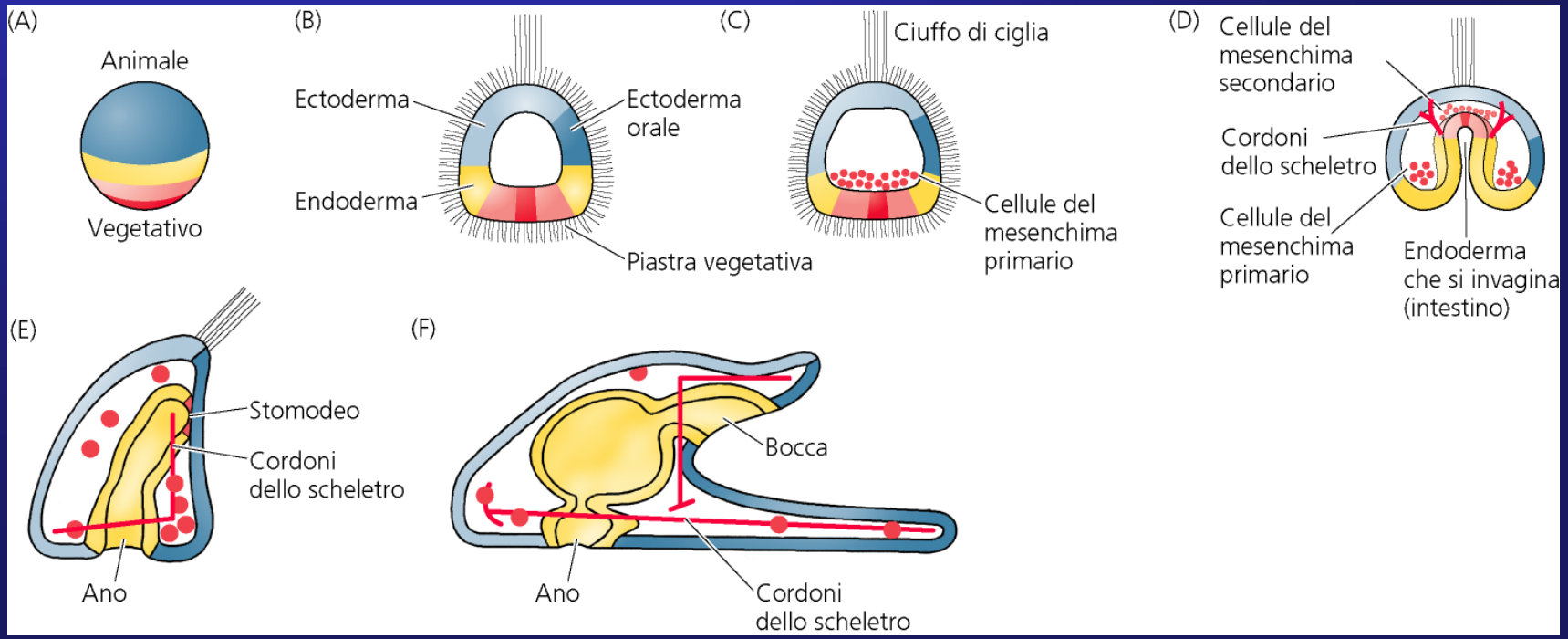
Iniezione di colorante vitale nei macromeri

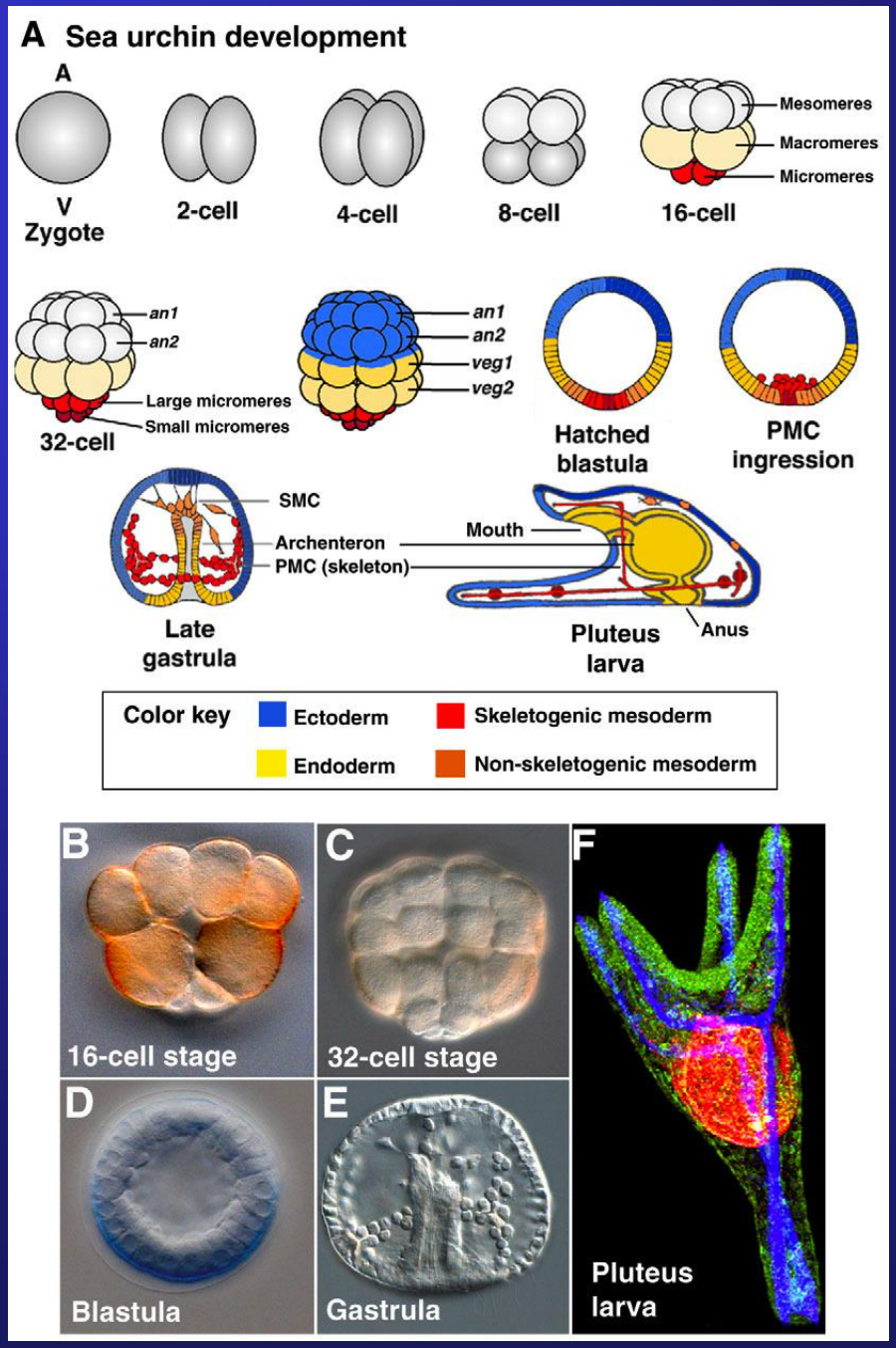


La colorazione si ritrova nell'endoderma e nel mesenchima secondario della larva

Mappa dei territori presuntivi






A Sea urchin development
A
V
Zygote
2-cell
4-cell
8-cell
16-cell
Mesomeres
Macromeres
Micromeres
an1
an2
Large micromeres
Small micromeres
32-cell
an1
an2
veg1
veg2
Hatched blastula
PMC ingression
SMC
Archenteron
PMC (skeleton)
Late gastrula
Mouth
Anus
Pluteus larva
Color key
Ectoderm
Endoderm
Skeletogenic mesoderm
Non-skeletogenic mesoderm
B
16-cell stage
C
32-cell stage
D
Blastula
E
Gastrula
F
Pluteus larva

Formazione blastocele

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

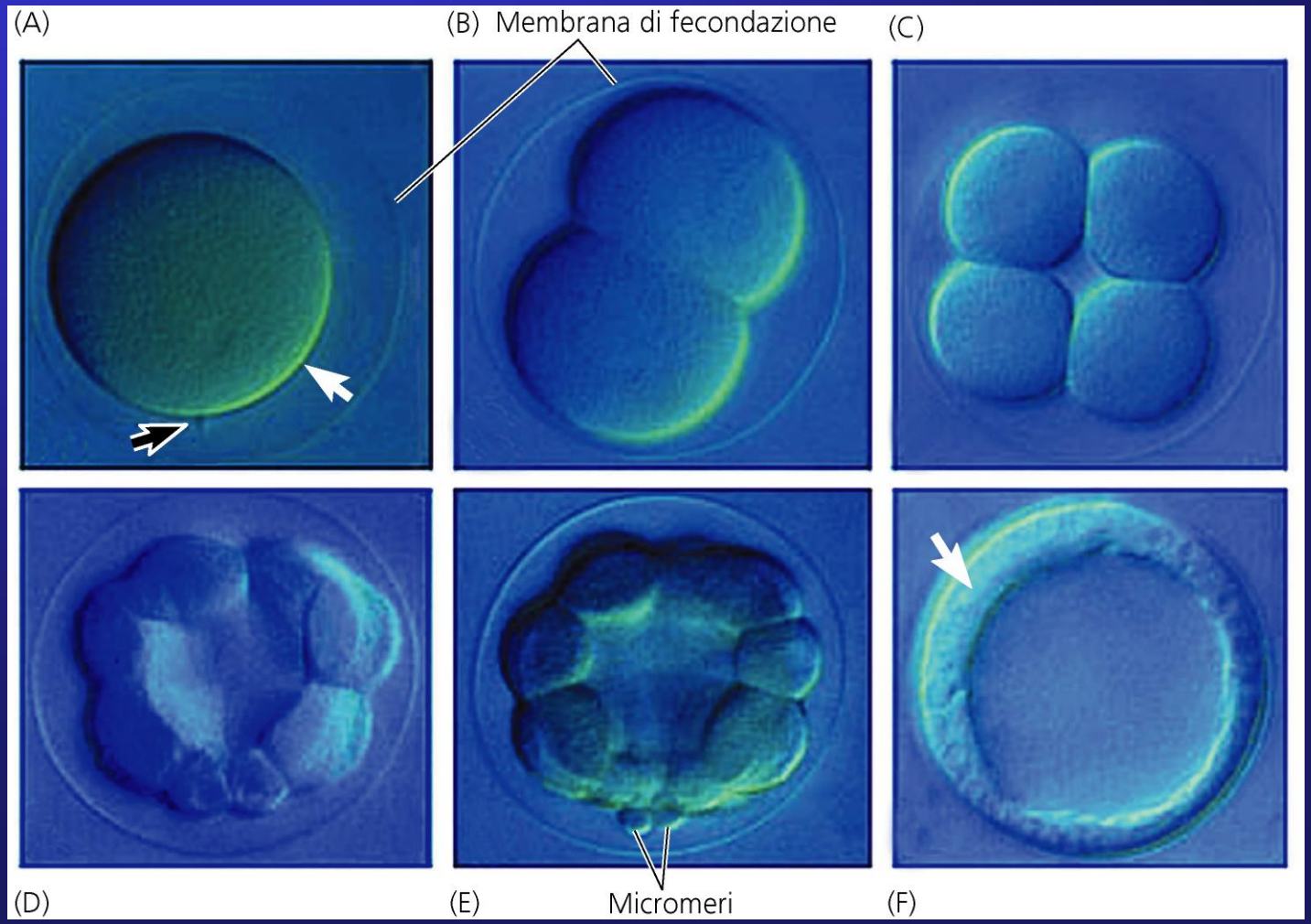
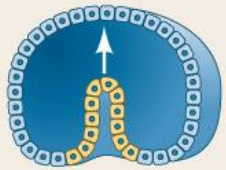
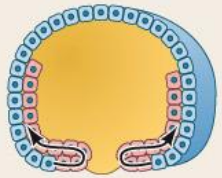
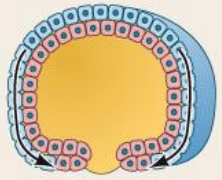


TABLE 1.1 Types of cell movement during gastrulation[a]

Gastrulazione

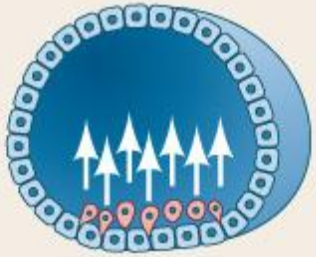
Type of movement	Description	Illustration	Example
Invagination	Infolding of a sheet (epithelium) of cells, much like the indention of a soft rubber ball when it is poked.		Sea urchin endoderm
Involution	Inward movement of an expanding outer layer so that it spreads over the internal surface of the remaining 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, *Drosophila* 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

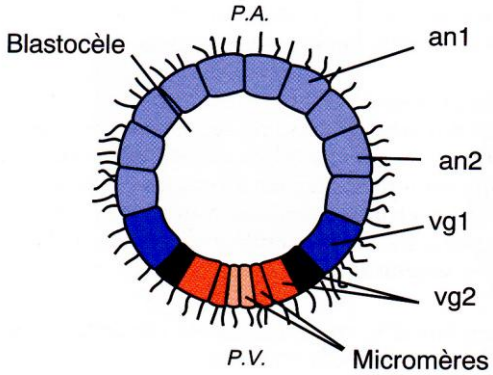
[a] The gastrulation of any particular organism is an ensemble of several of these movements.

DEVELOPMENTAL BIOLOGY 11e, Table 1.1

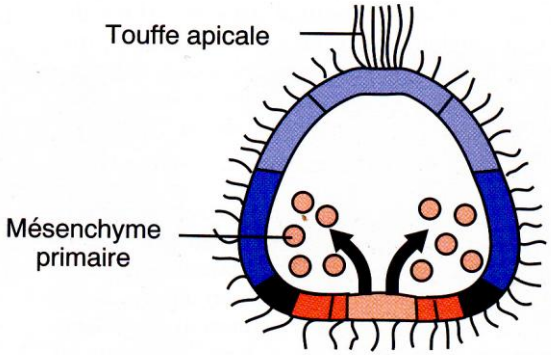
Ingressione o immigrazione

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.





Blastula avant la gastrulation

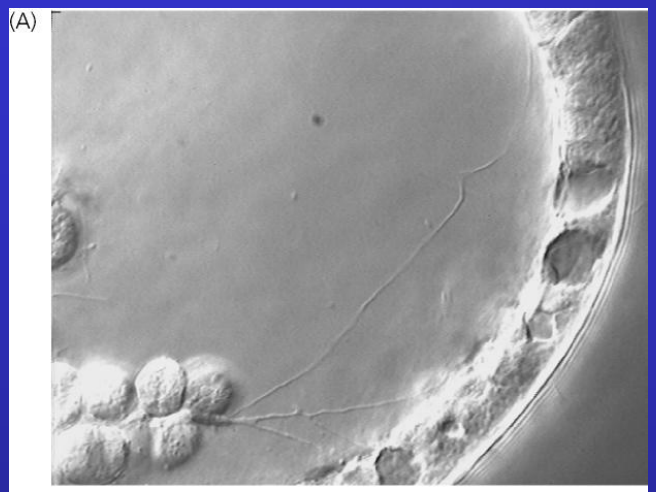


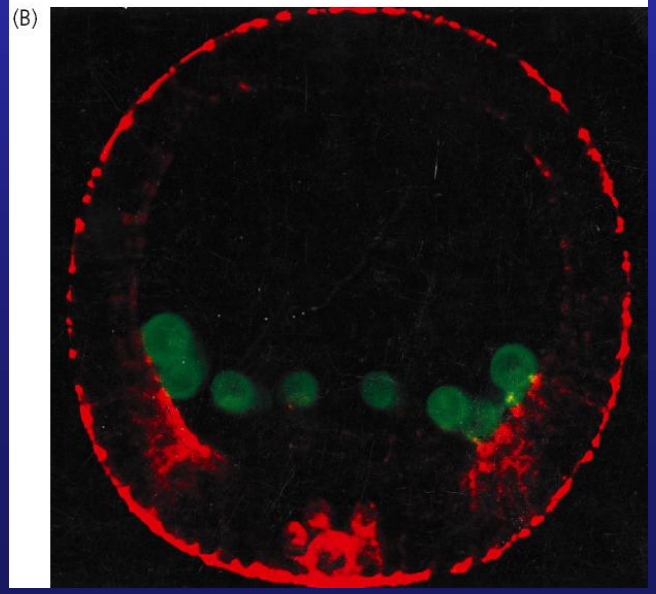
Début de la gastrulation

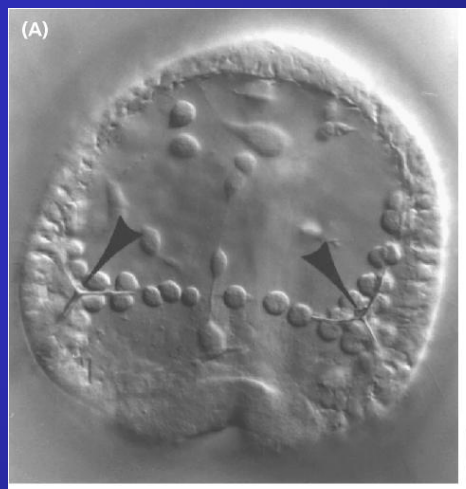

A

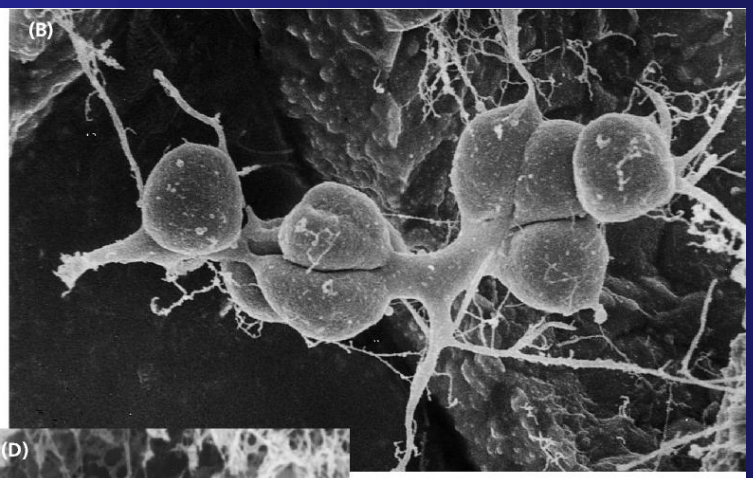
Figura 5

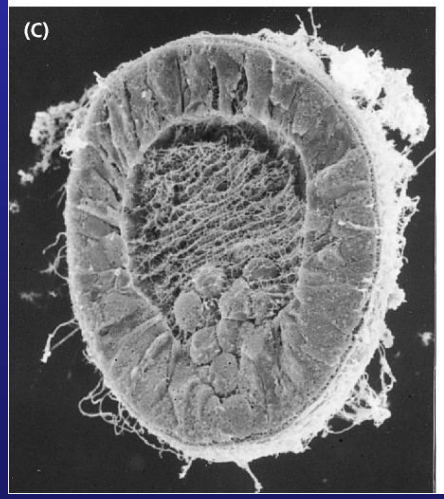
Mesenchima primario → Scheletro calcareo della larva

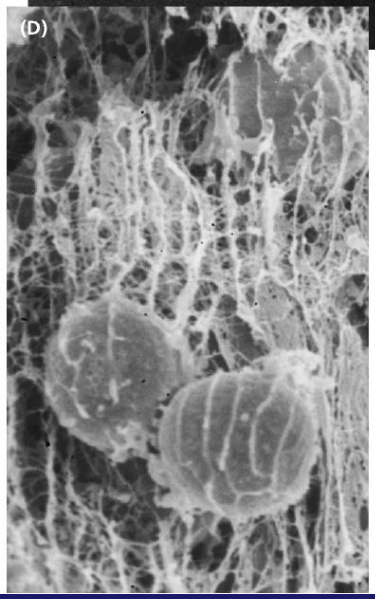




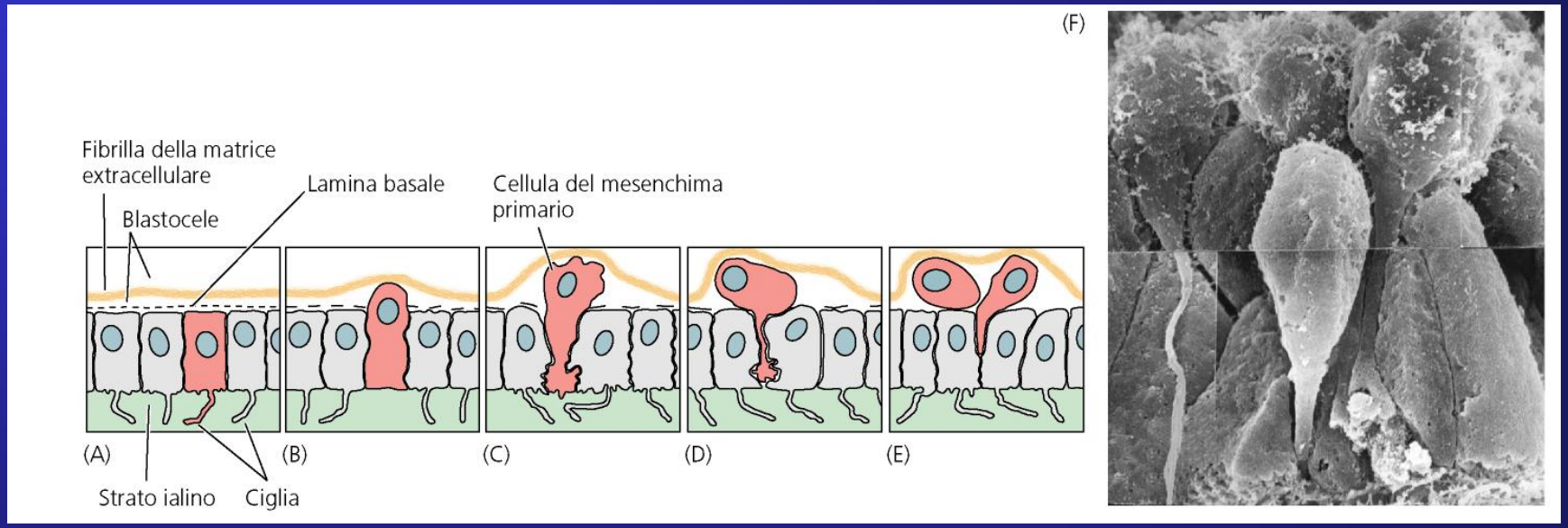




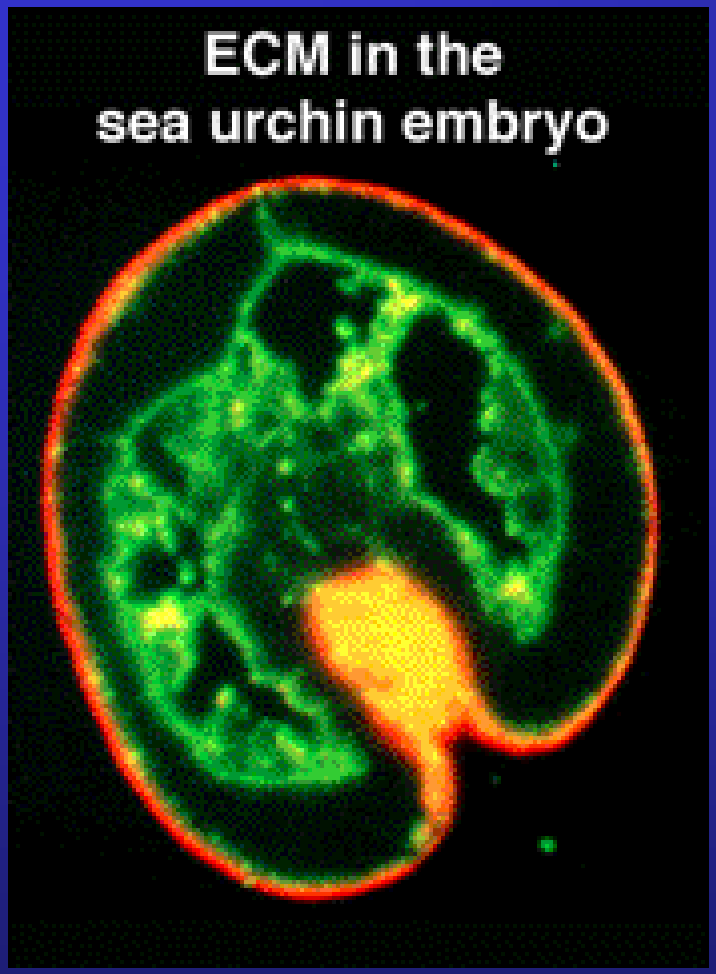


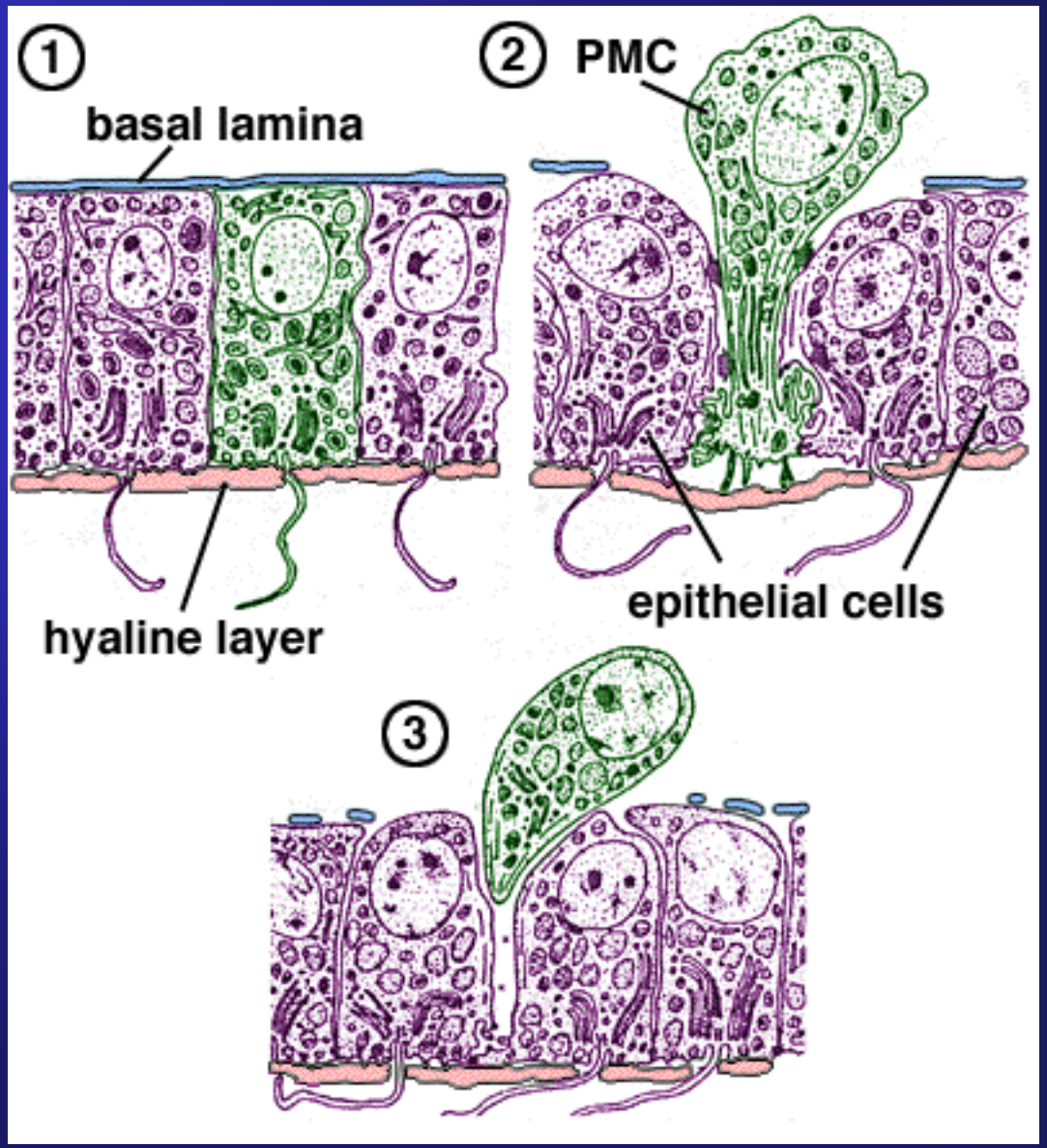


Ingressione o immigrazione

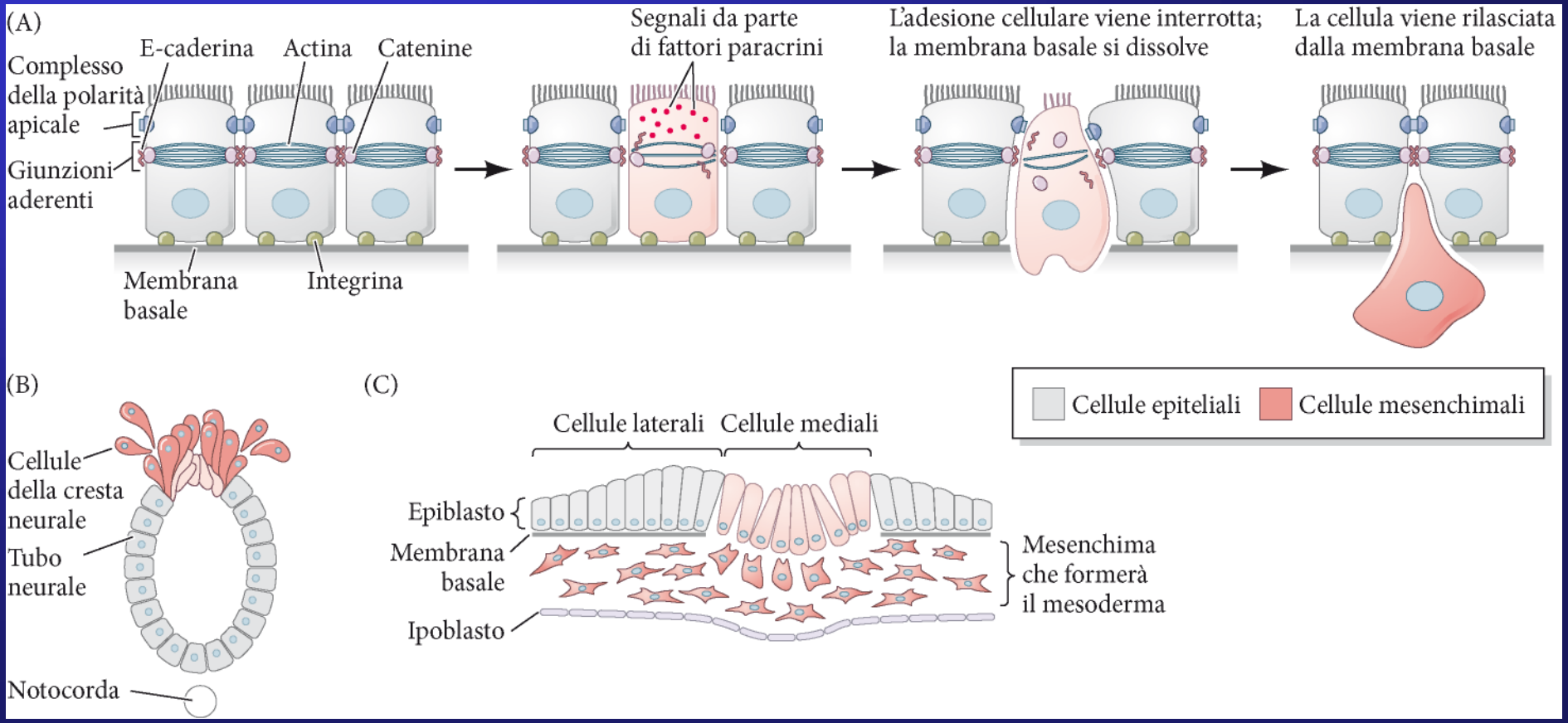


-Alterata affinità tra i blastomeri
-Aumentata affinità per le proteine del blastocele (matrice extra-cellulare)


ECM in the
sea urchin embryo


1
basal lamina
hyaline layer
2
PMC
epithelial cells
3

TRANSIZIONE EPITELIO-MESENCHIMATICA: meccanismo alla base del movimento di ingressione



I MOVIMENTI DI IMMIGRAZIONE SONO MEDIATI DA INTERAZIONI CON LA MATRICE EXTRA-CELLULARE PRODOTTA DALLE CELLULE DEL TETTO DEL BLASTOCELE

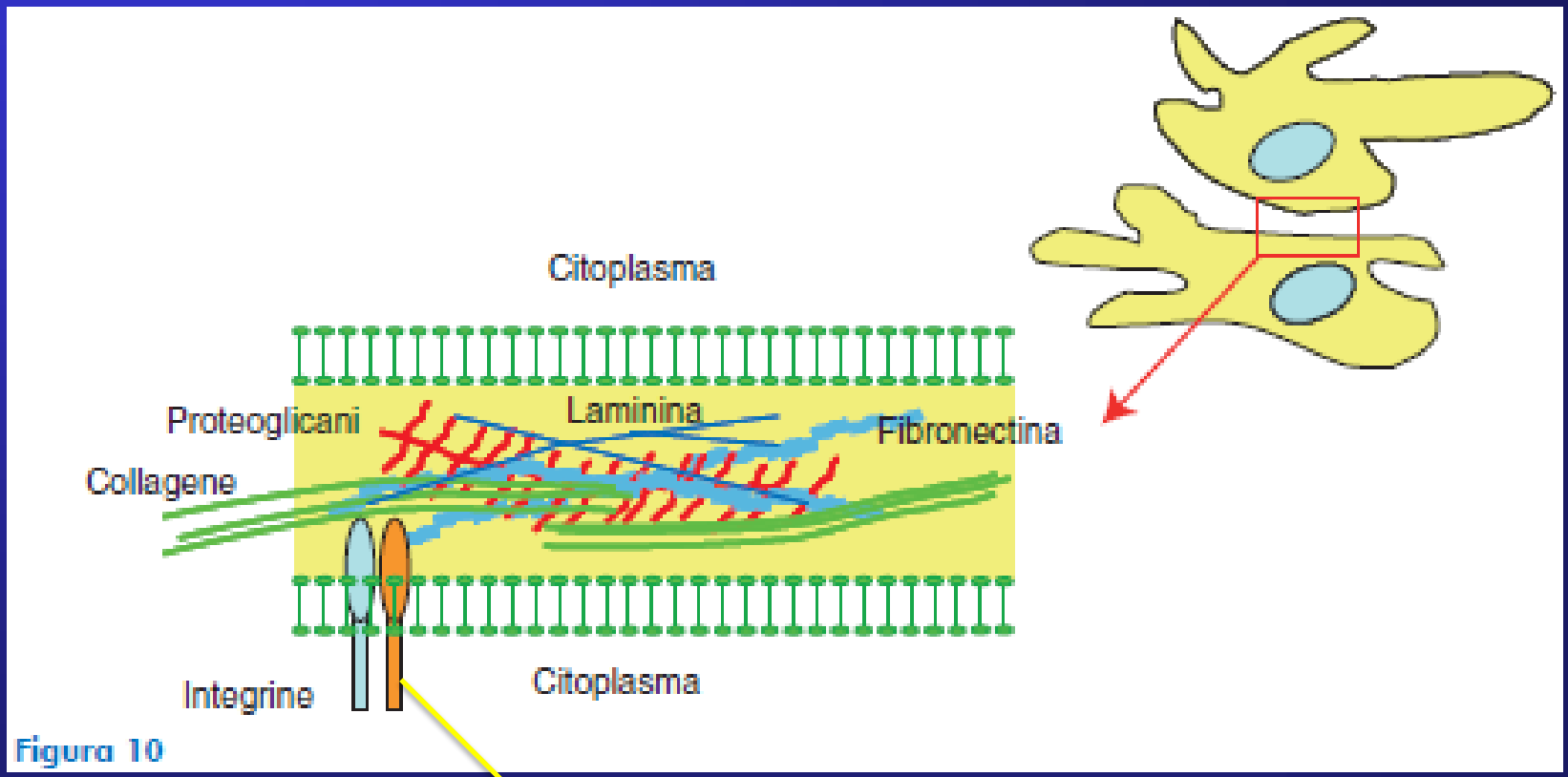
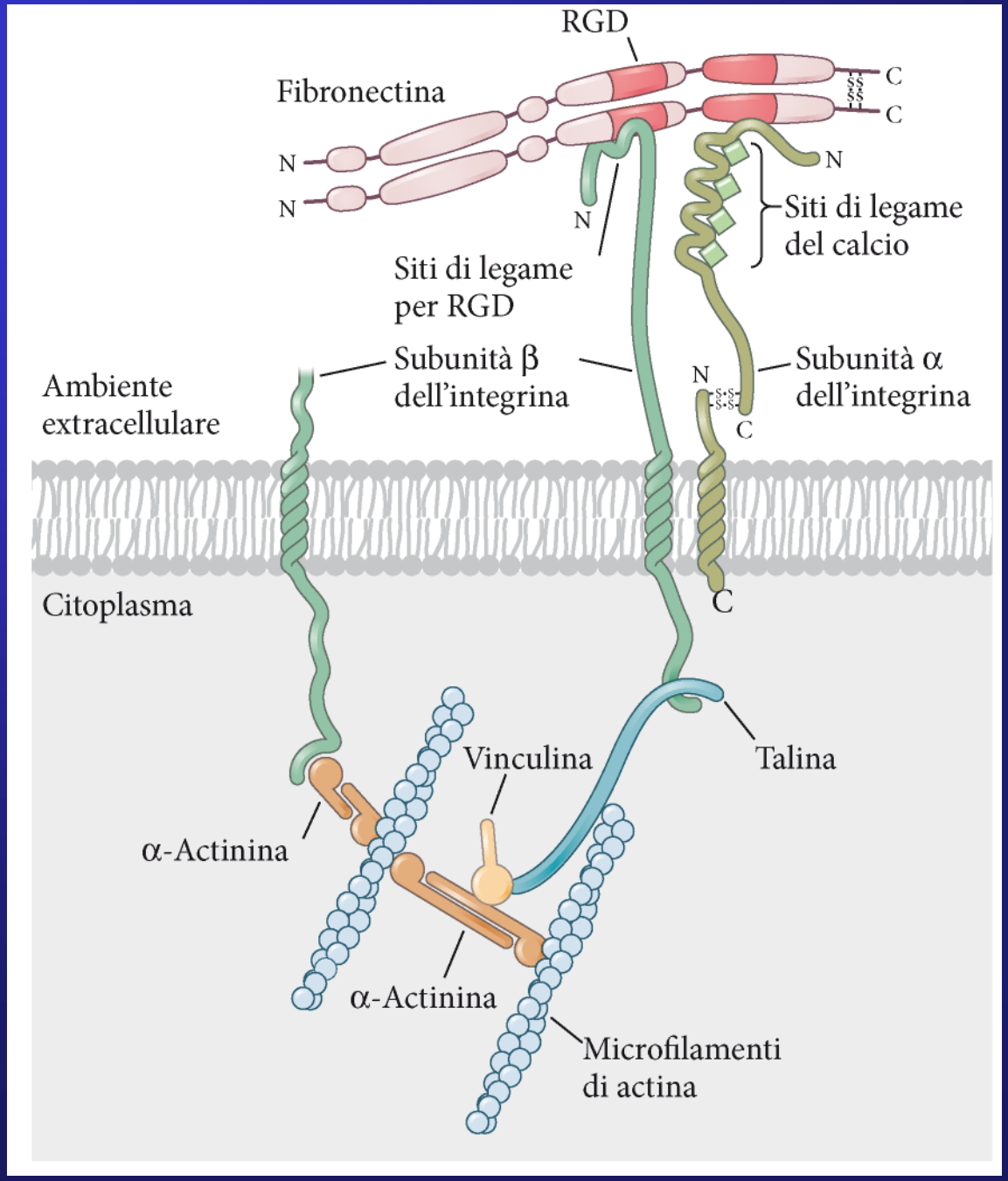


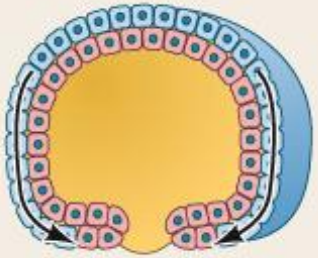
Figura 10

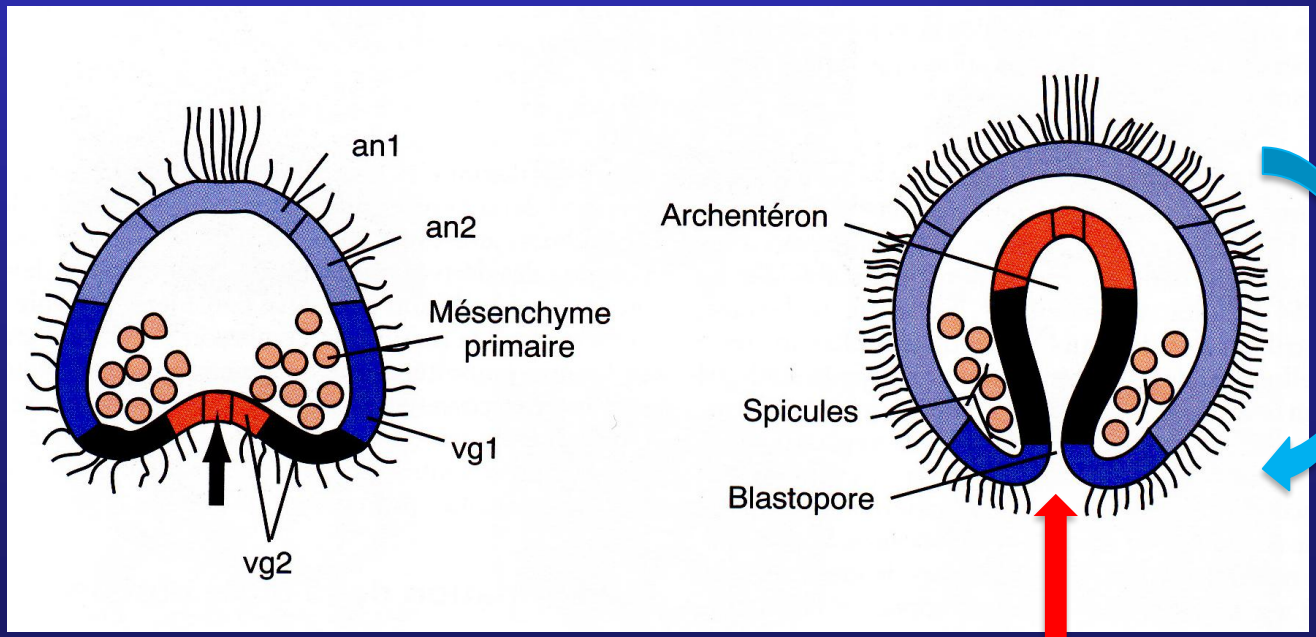
LE CELLULE MESENCHIMATICHE MIGRANTI ESPRIMONO INTEGRINE SULLA MEMBRANA CELLULARE


RGD
Fibronectina
C
C
N
N
N
N
Siti di legame
del calcio
Siti di legame
per RGD
Subunità β
dell'integrina
Subunità α
dell'integrina
Ambiente
extracellulare
N
C
C
Citoplasma
Vinculina
Talina
α-Actinina
α-Actinina
Microfilamenti
di actina

Invagination	Infolding of a sheet (epithelium) of cells, much like the indention 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.

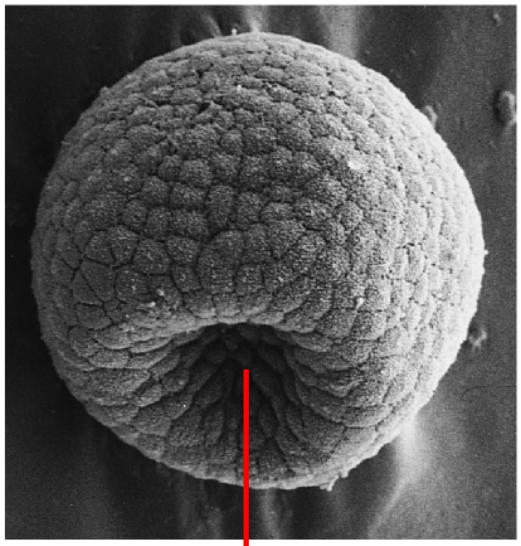


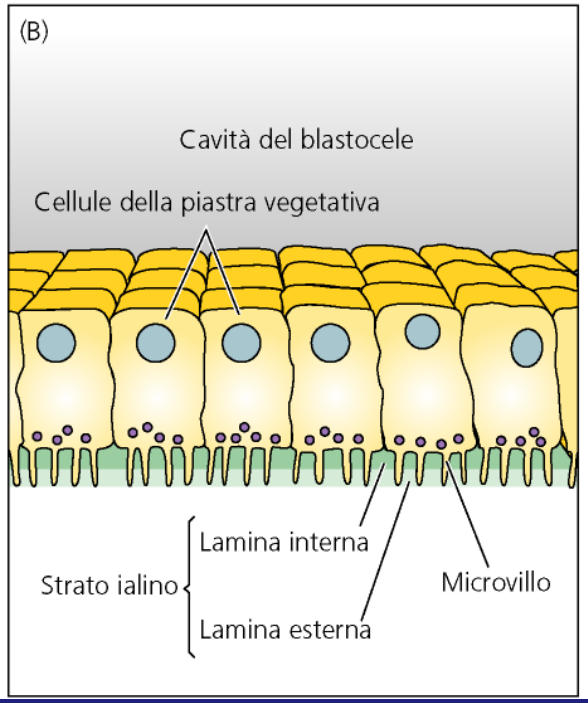


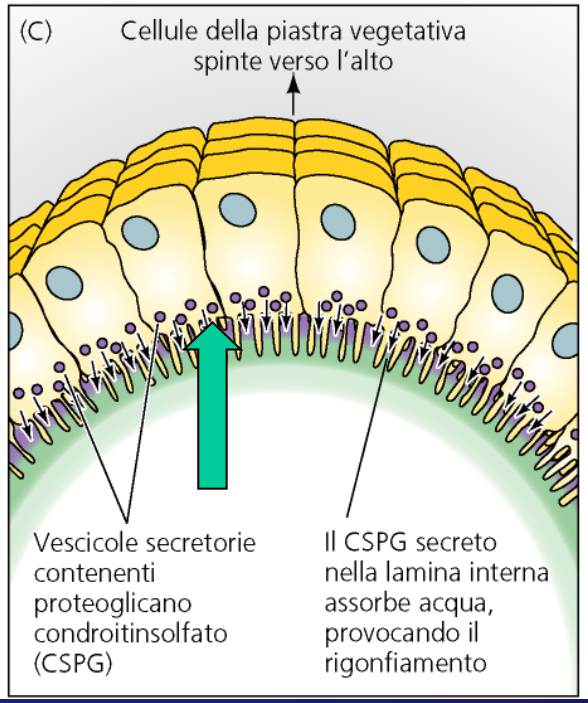
Epibolia

Invaginazione delle cellule derivate dai macromeri
Epibolia dell'ectoderma

Meccanismi del movimento di invaginazione: cause estrinseche



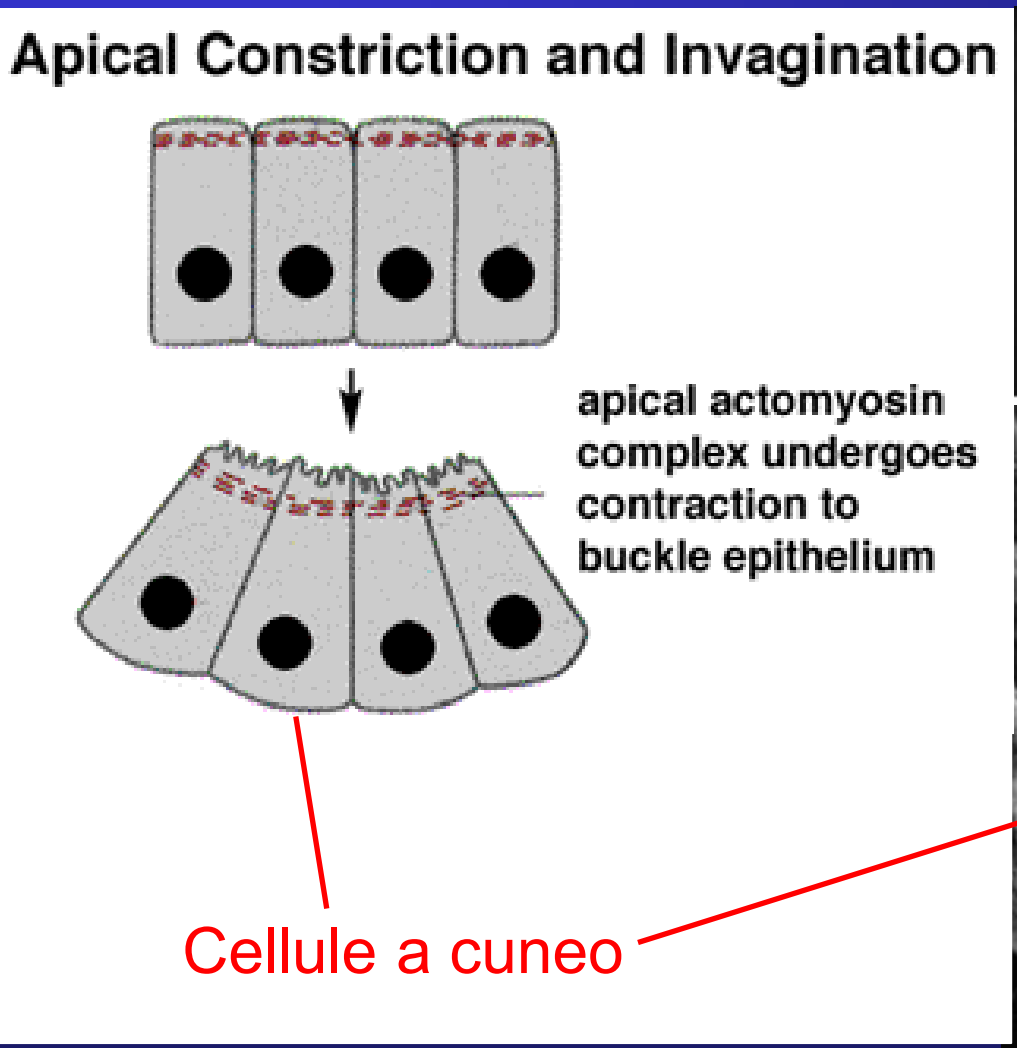


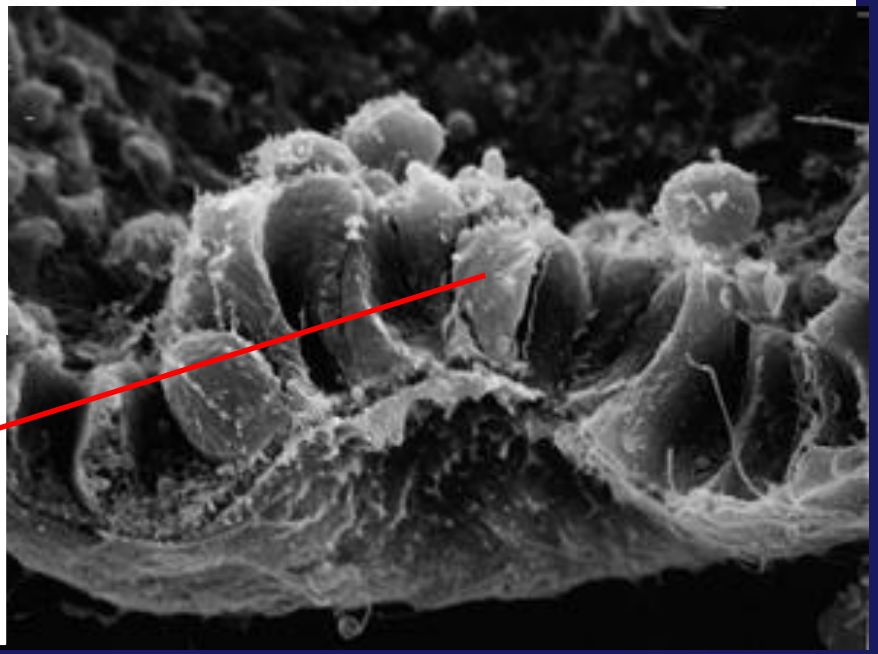


Blastoporo

-deposizione di proteoglicani nello strato ialino
-rigonfiamento dello strato ialino

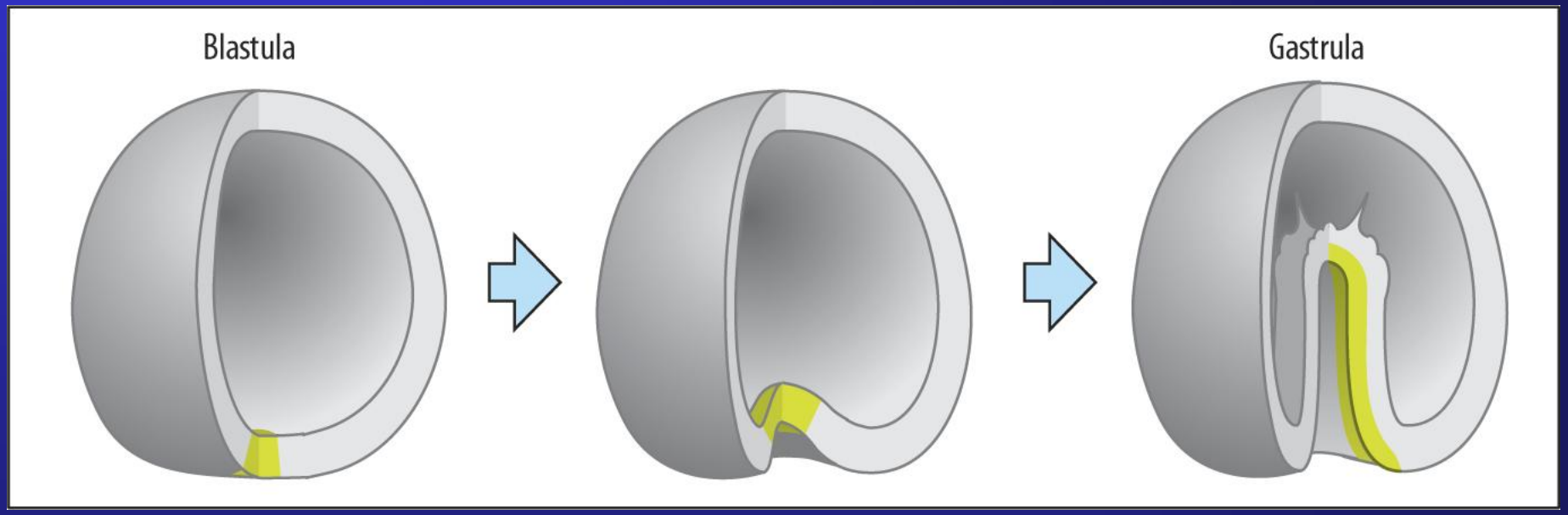
Meccanismi del movimento di invaginazione: cause intrinseche



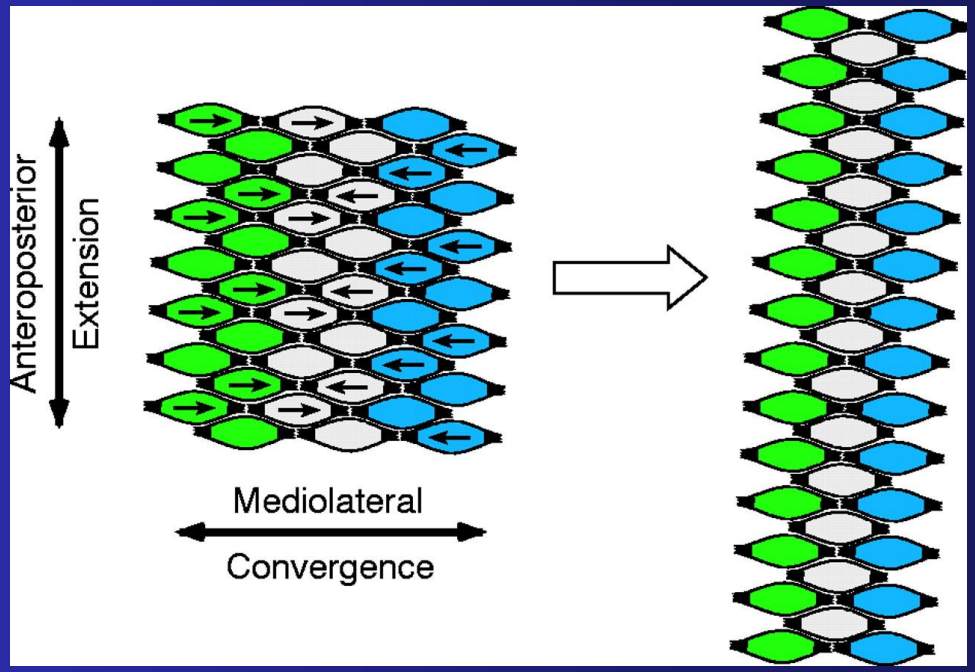


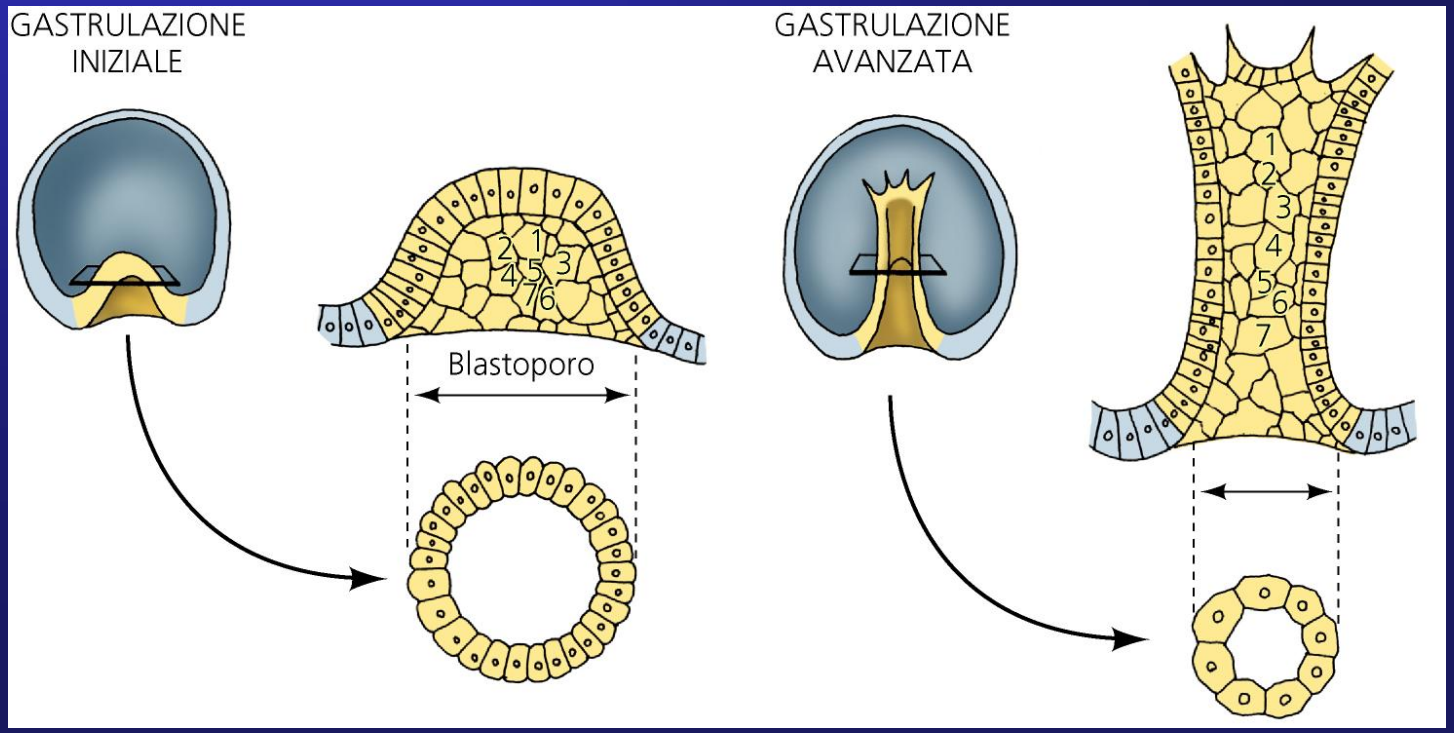
Cellule a cuneo

Formazione dell’archenteron



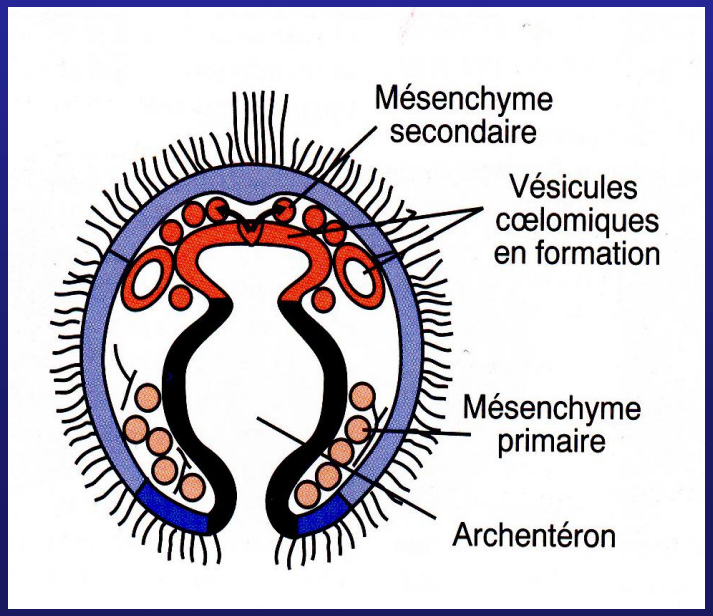
Meccanismi di formazione dell'archenteron: movimento di estensione convergente causato da processi di intercalazione medio-laterale

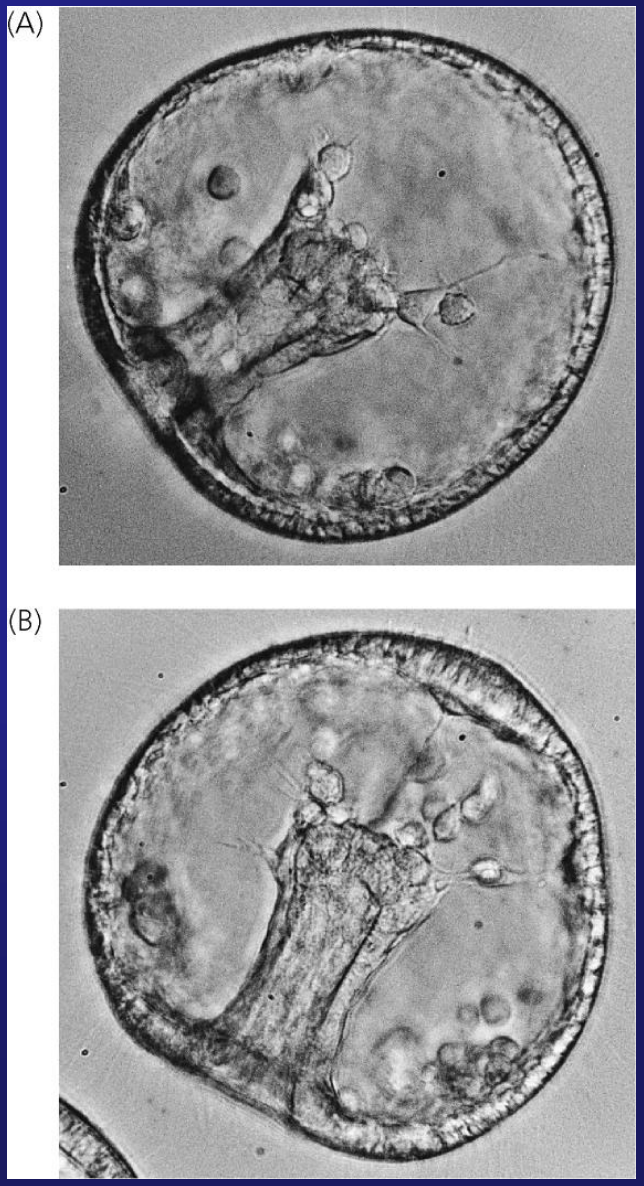


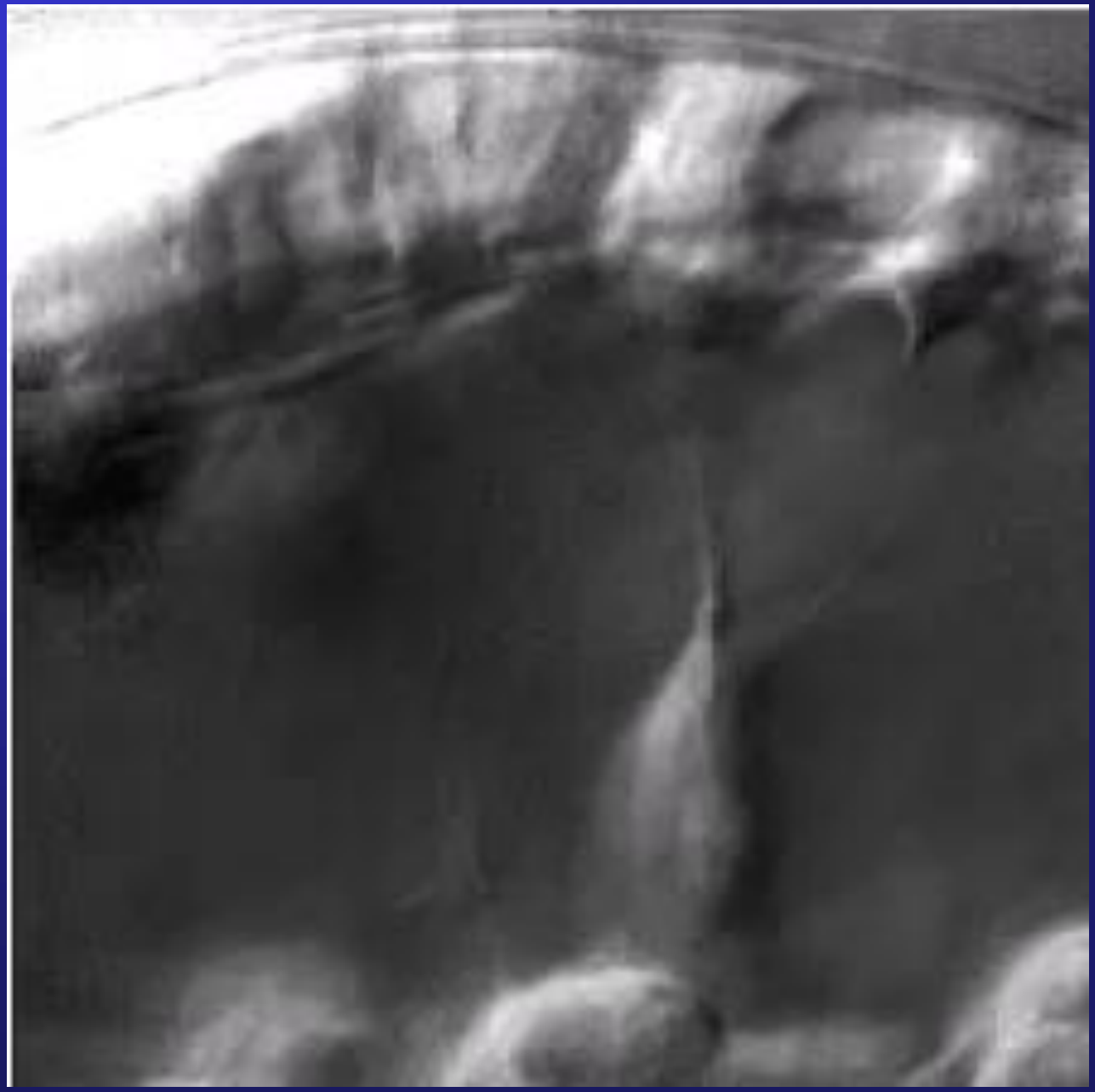


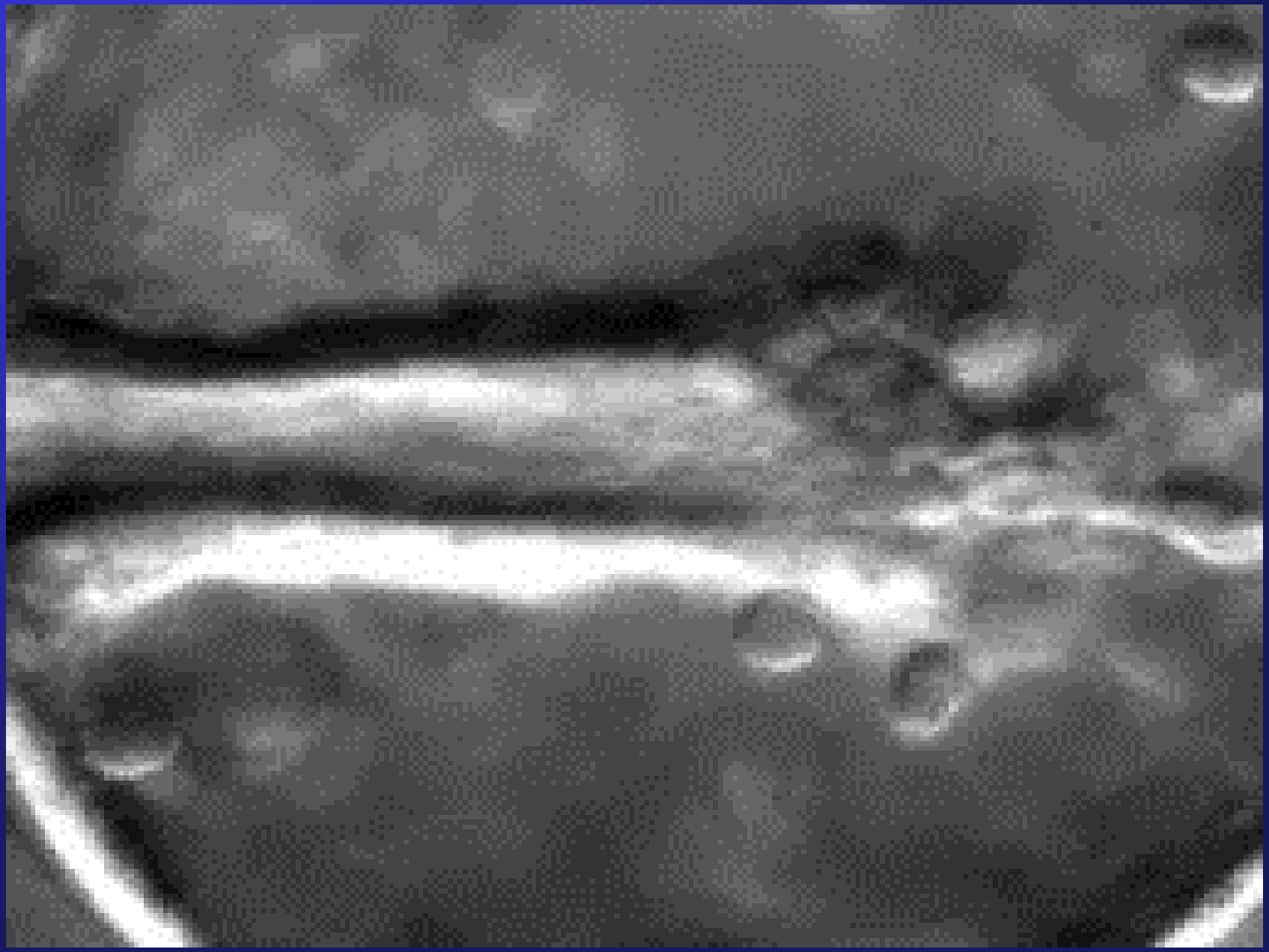
Meccanismi di formazione dell'archenteron: ruolo del mesenchima secondario

Vescicole celomatiche
Muscolatura larvale
Contribuisce al contatto tra archenteron e la regione dello stomodeo (bocca) tramite contrazione di filopodi

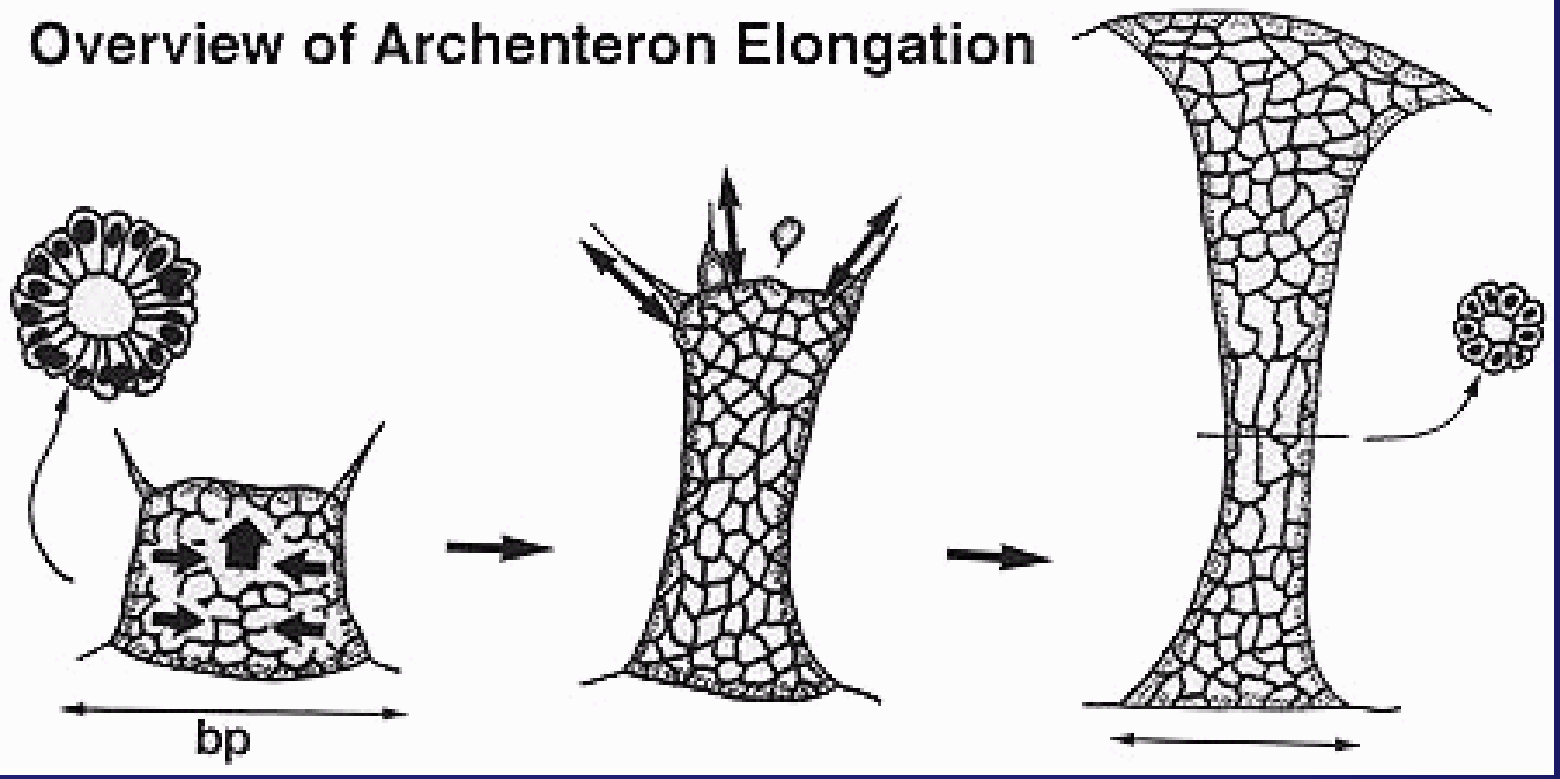




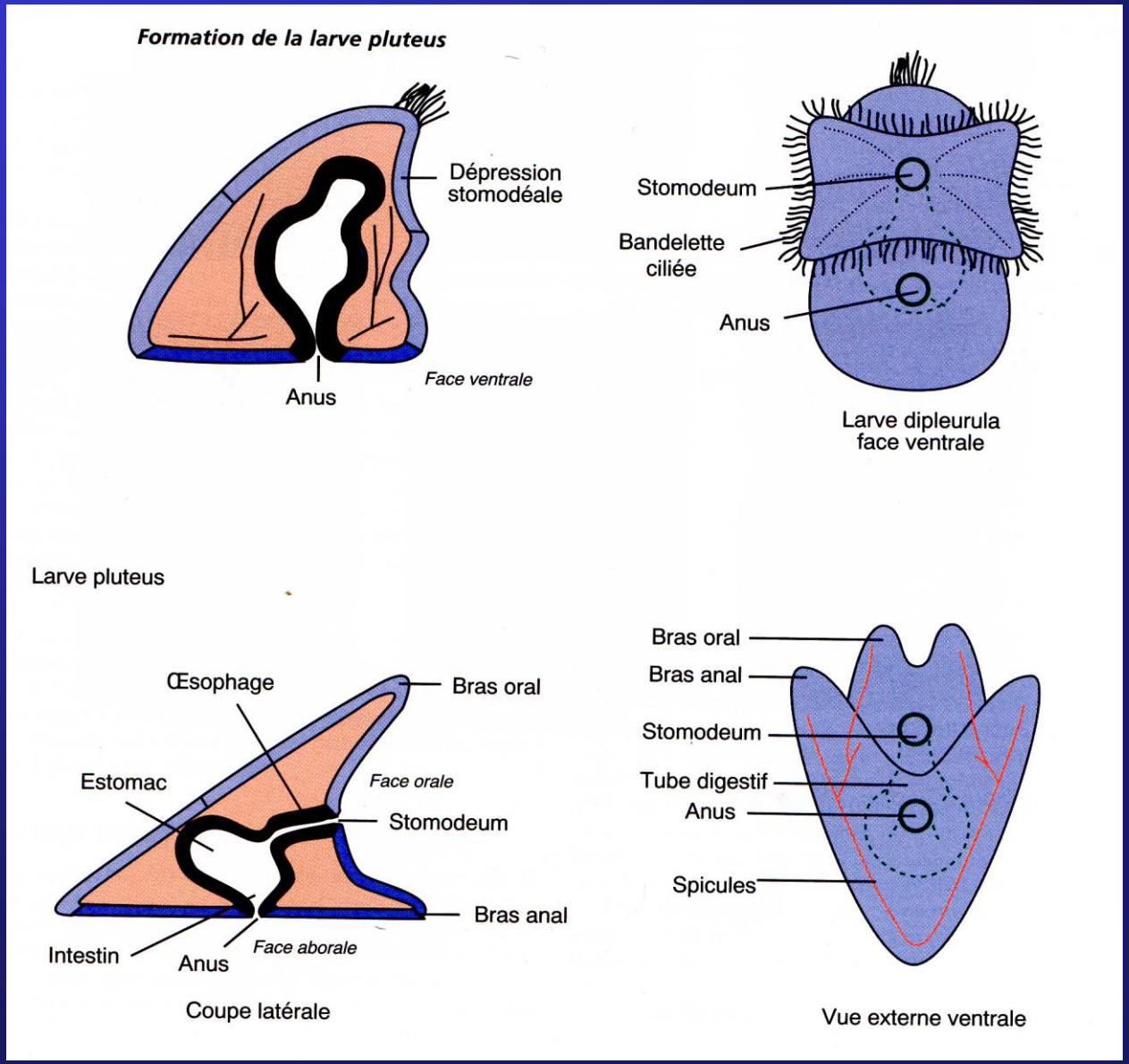


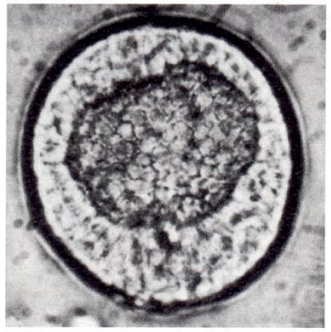


Overview of Archenteron Elongation

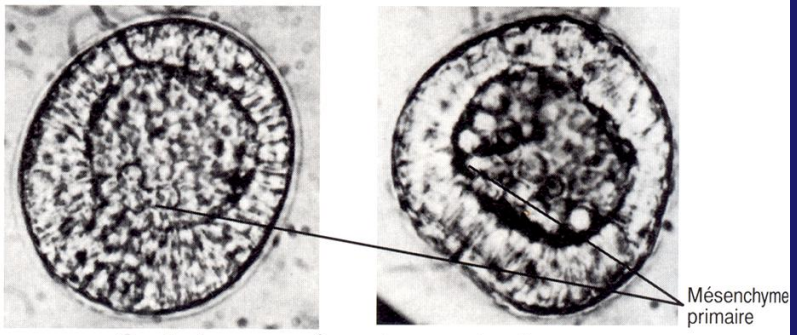


Formazione della larva pluteo



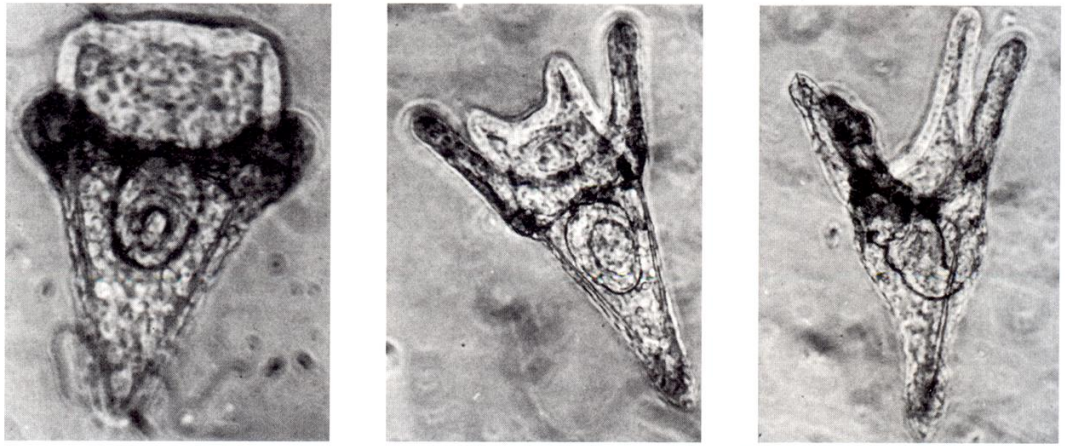


Blastula nageuse



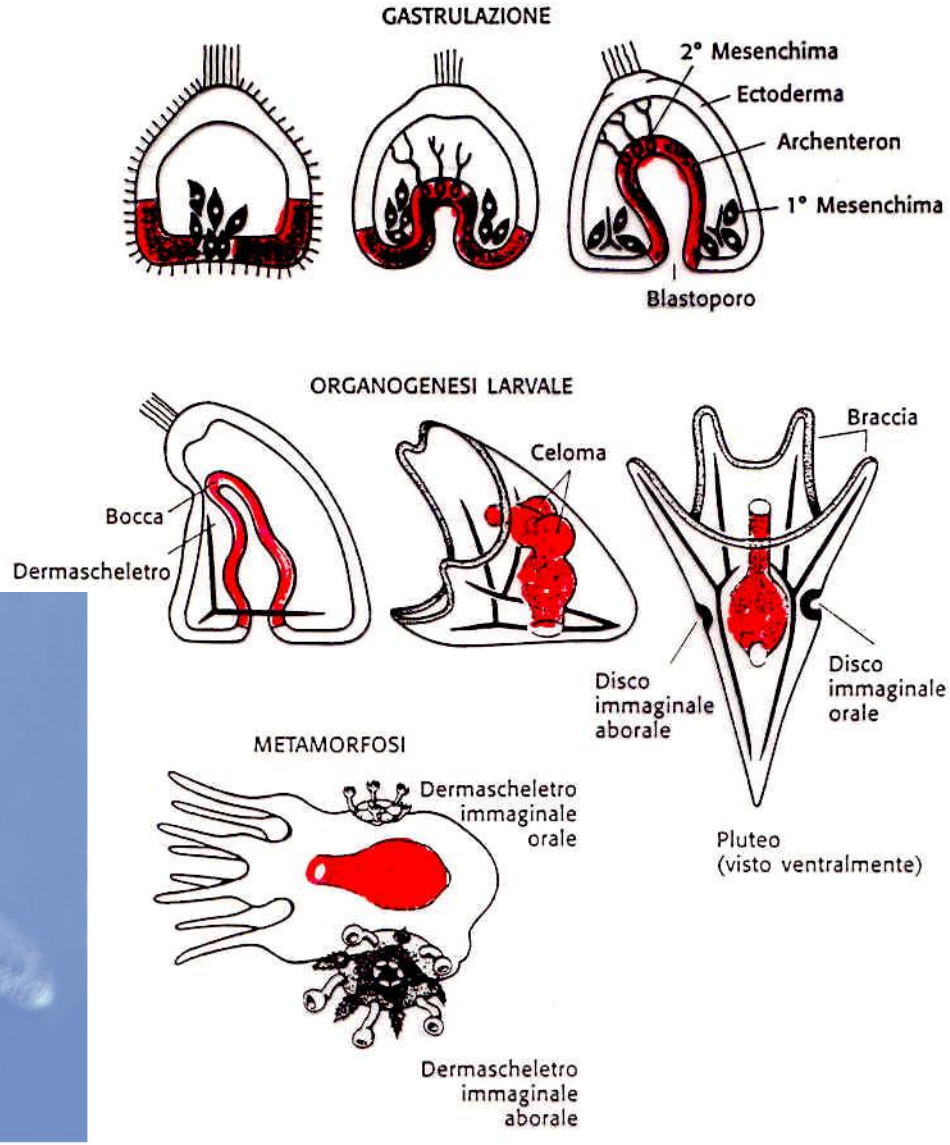
Gastrula avec mésenchyme primaire

Gastrula avec archentéron et mésenchyme secondaire



Jeune pluteus
vue ventrale

Pluteus âgées en vues ventrale et latérale



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.