

# Ectoderma e suoi derivati

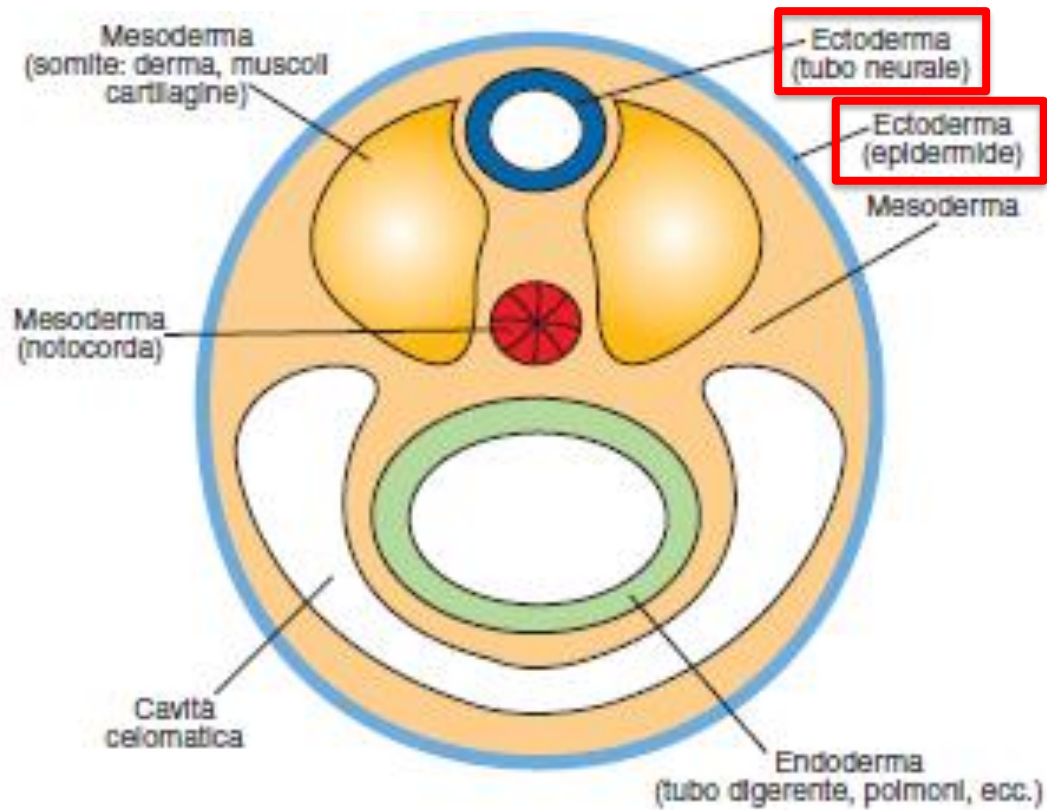
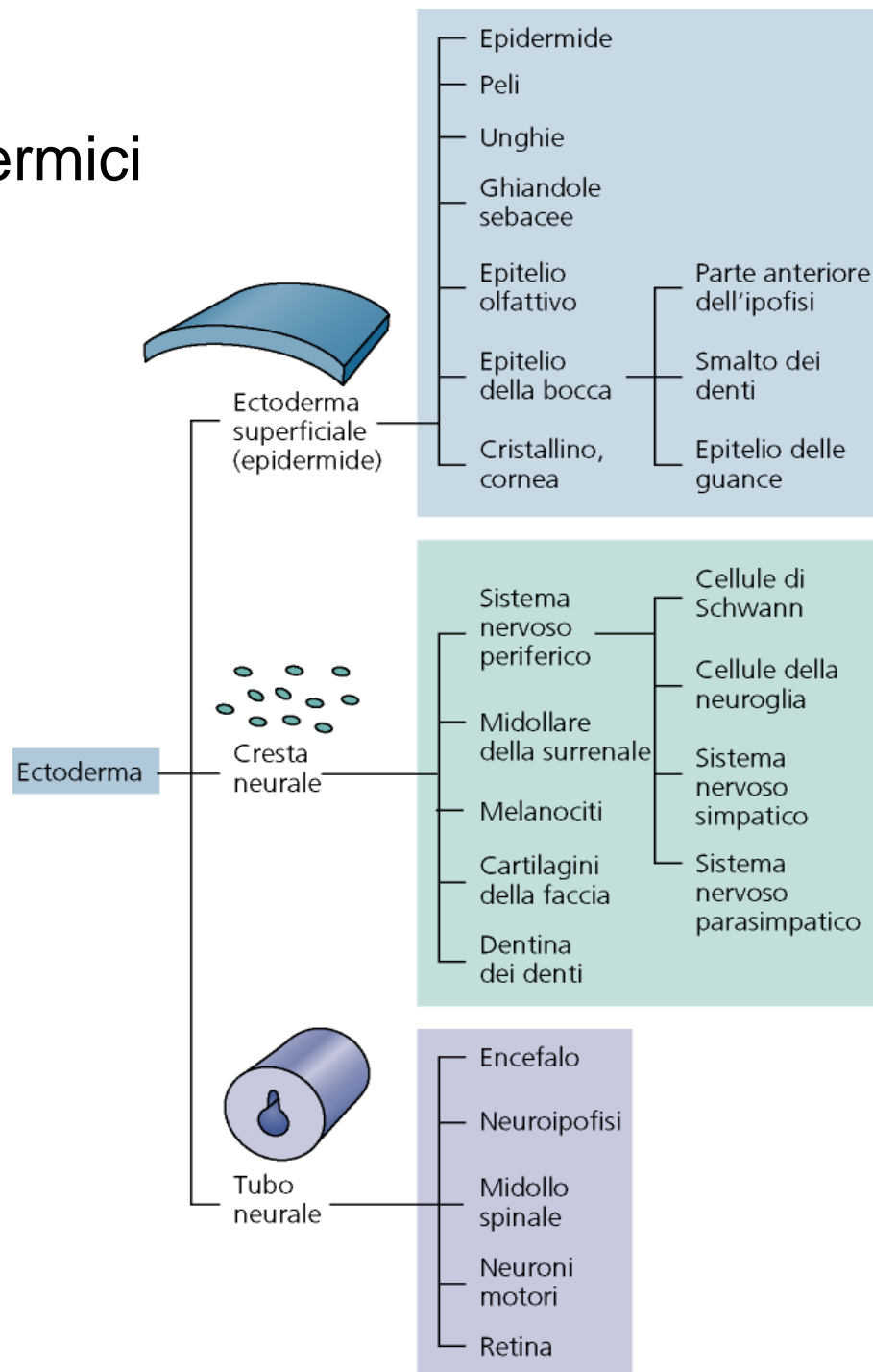


Figura 10

# Derivati ectodermici



# Neurulation primaria

Le cellule della piastra neurale si invaginano e si staccano dall'ectoderma superficiale formando un tubo cavo.

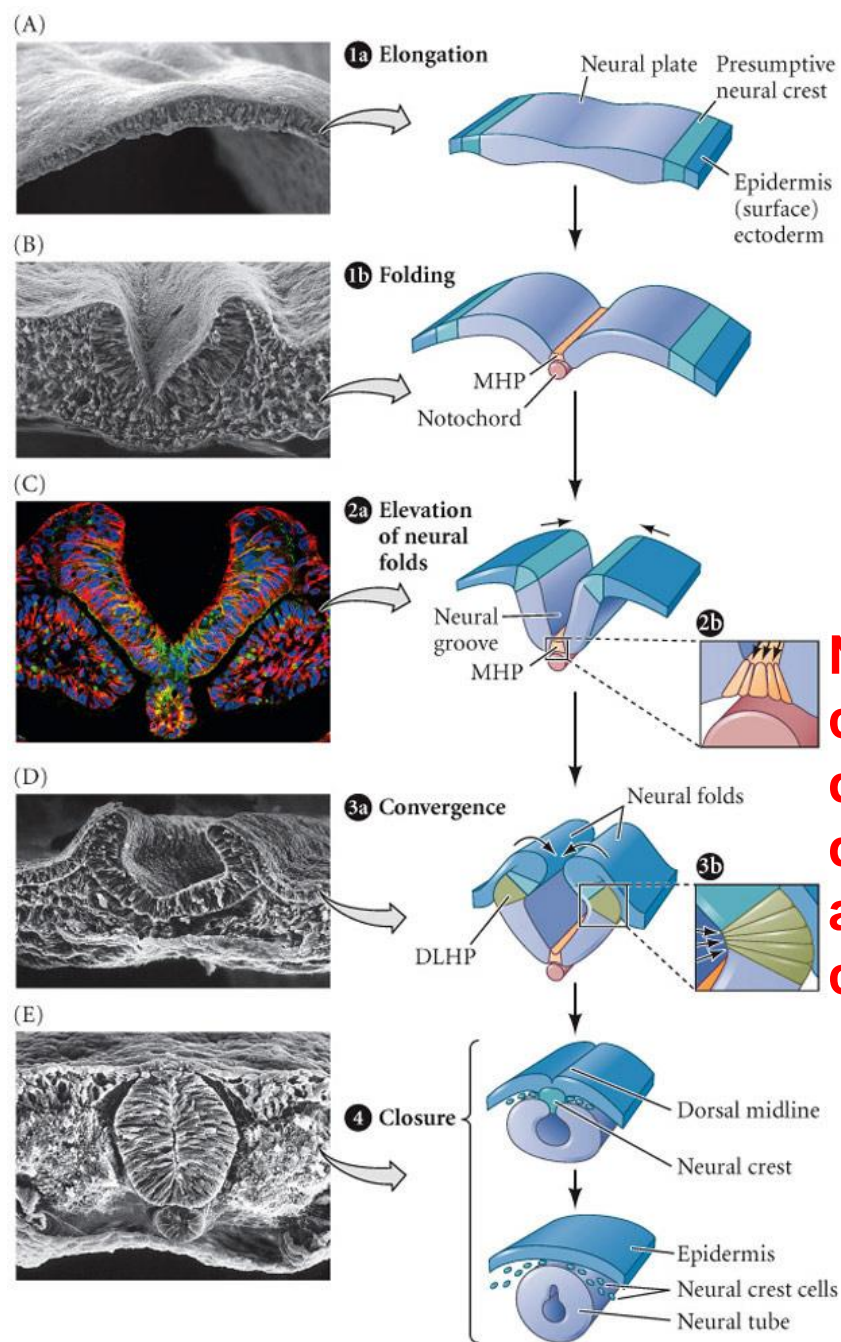
Avviene in quattro fasi: formazione della doccia neurale, sollevamento delle pliche neurali, convergenza delle pliche, fusione delle pliche e distacco del tubo neurale.

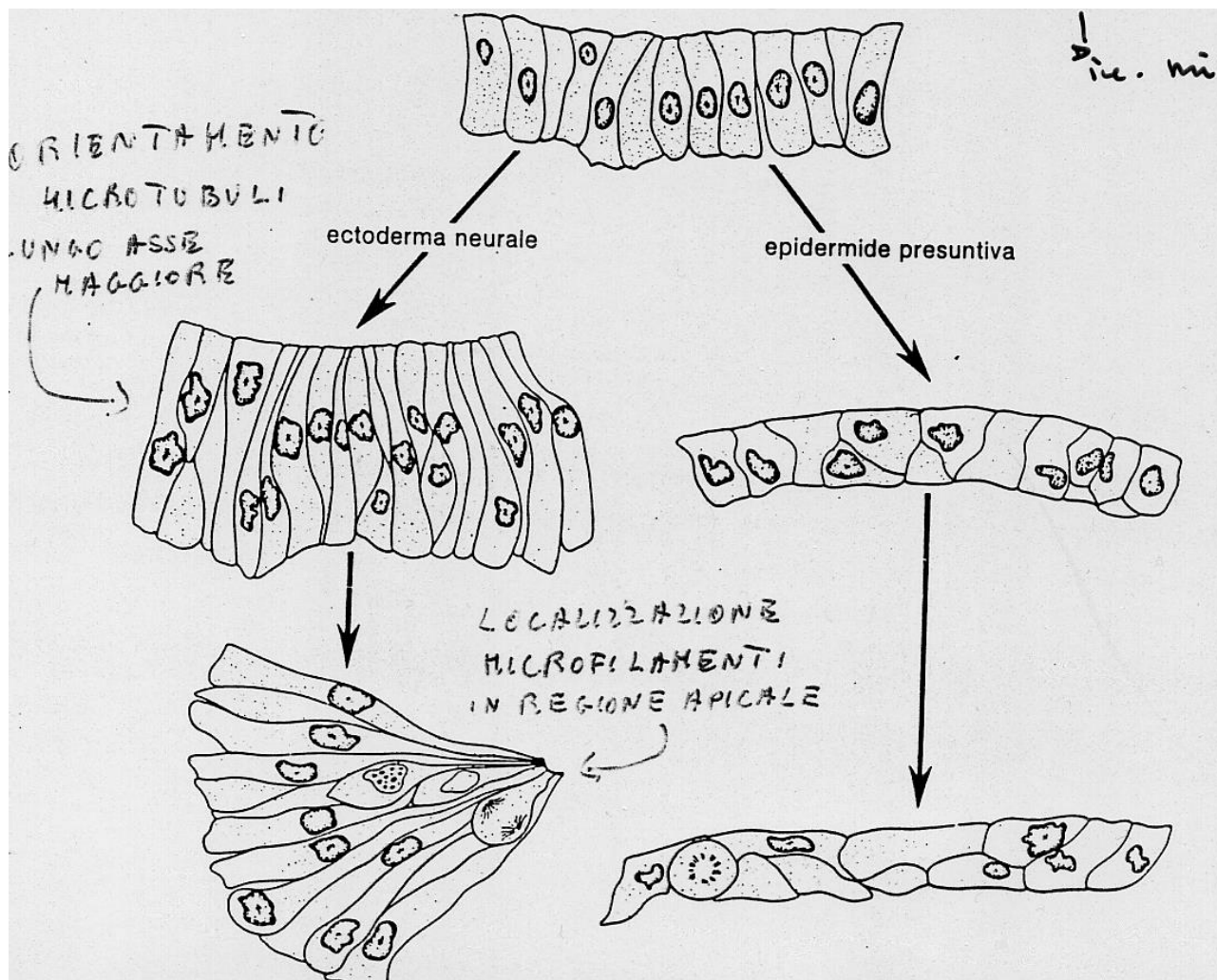
Il ripiegamento della piastra neurale avviene mediante formazione di cardini in cui il neuroectoderma contatta i tessuti circostanti che inducono cambiamenti morfologici cellulari e tissutali.

**Notare i cambiamenti di forma delle cellule al livello dei cardini!**

- **Cardine mediale:** contatto neuroectoderma-notocorda
- **Cardini dorso-laterali:** contatti neuroectoderma-epidermide

I cardini agiscono come perni che dirigono i movimenti di rotazione del tessuto





Polimerizzazione dei microtubuli  
 Costrizione di un anello apicale di microfilamenti actina

**Forze intrinseche:** modificazioni del citoscheletro →

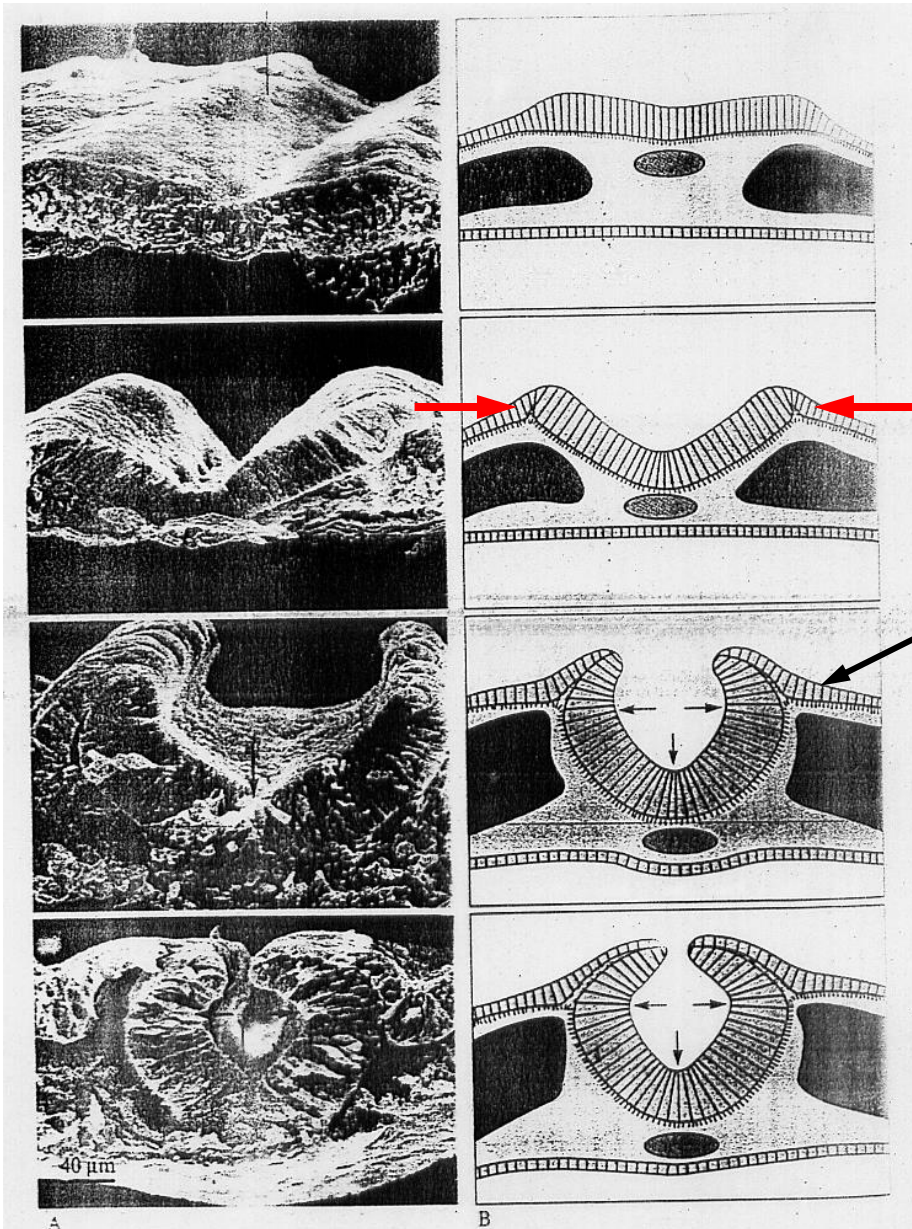
Le cellule dei cardini si allungano e assumono una **forma a cuneo**, inducendo una curvatura nel tessuto in modo simile al movimento di invaginazione nella gastrulazione



## Forze estrinseche:

Spinta dell'ectoderma non neurale porta all'avvicinamento delle pliche verso la linea mediana

Ectoderma non neurale (epidermide)



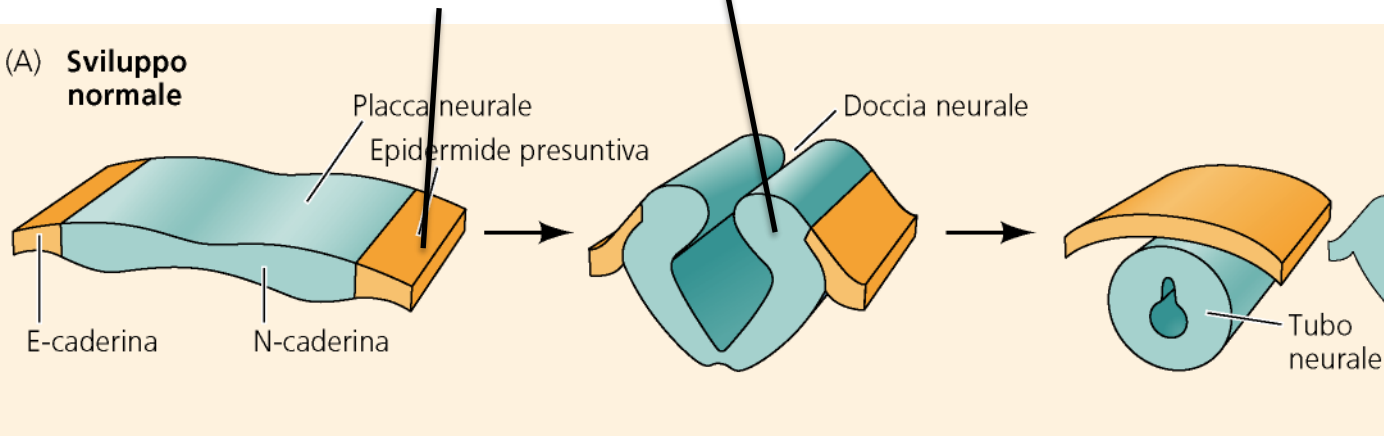
Il **distacco** del tubo neurale dall'ectoderma superficiale è mediato da modificazioni nell'espressione di molecole di adesione.

Le cellule del tubo neurale sostituiscono **caderina E** con **caderina N**, quelle dell'epidermide continuano a presentare caderina E.

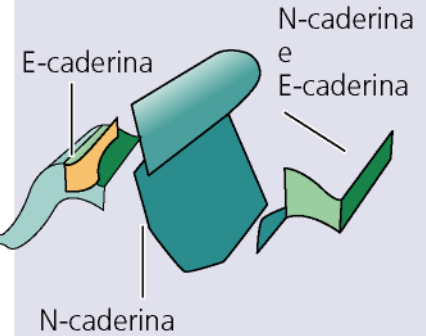
## E-Caderina

## N-Caderina

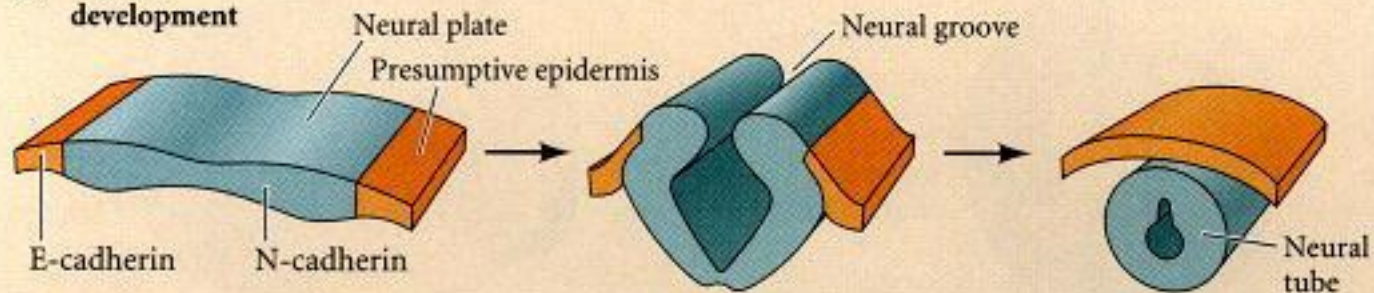
(A) Sviluppo normale



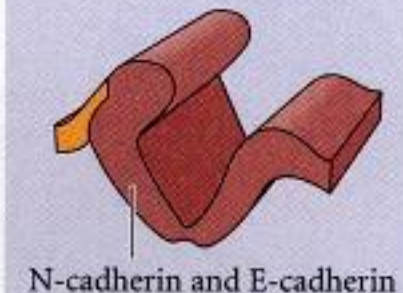
(B) Esperimento



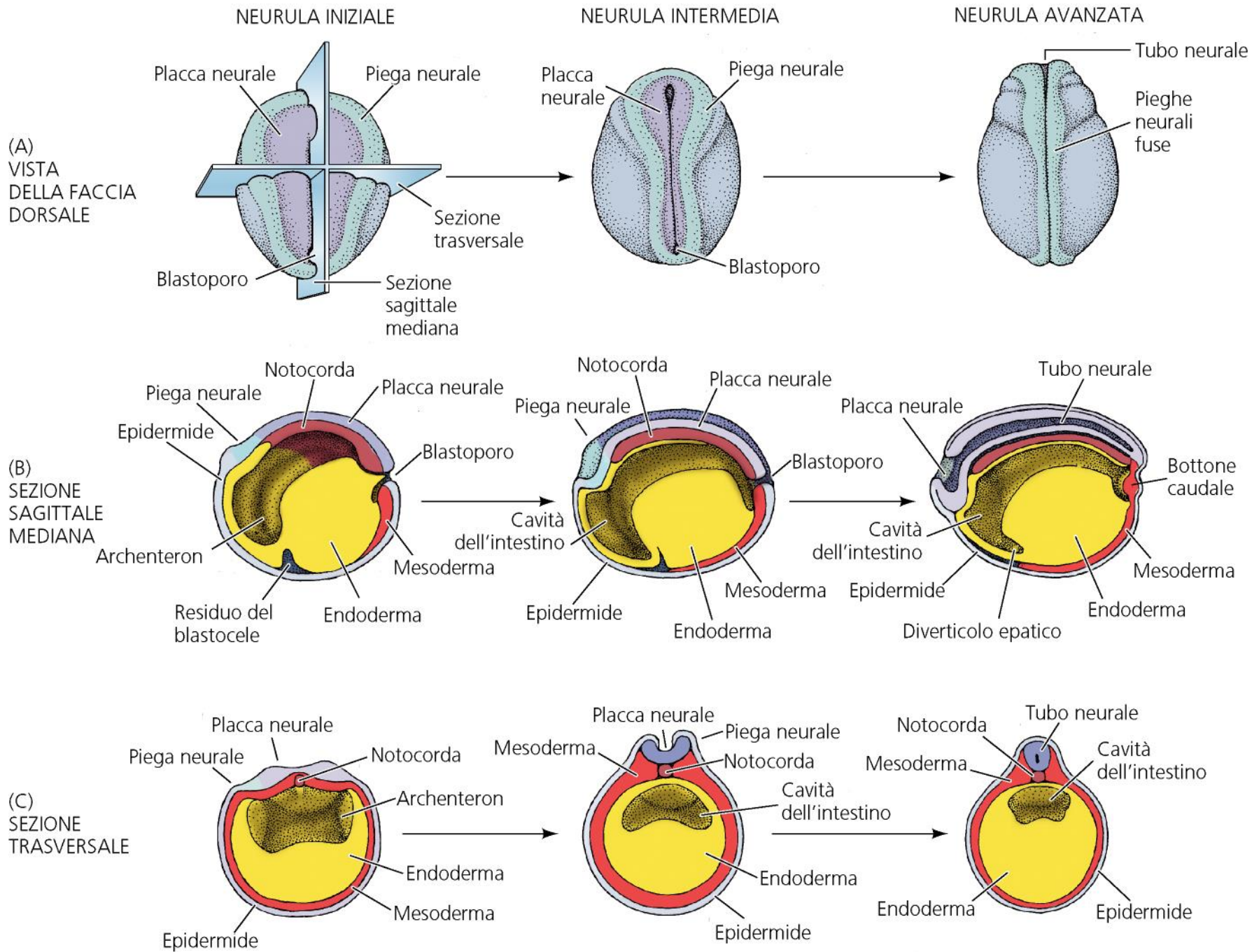
(A) Normal development

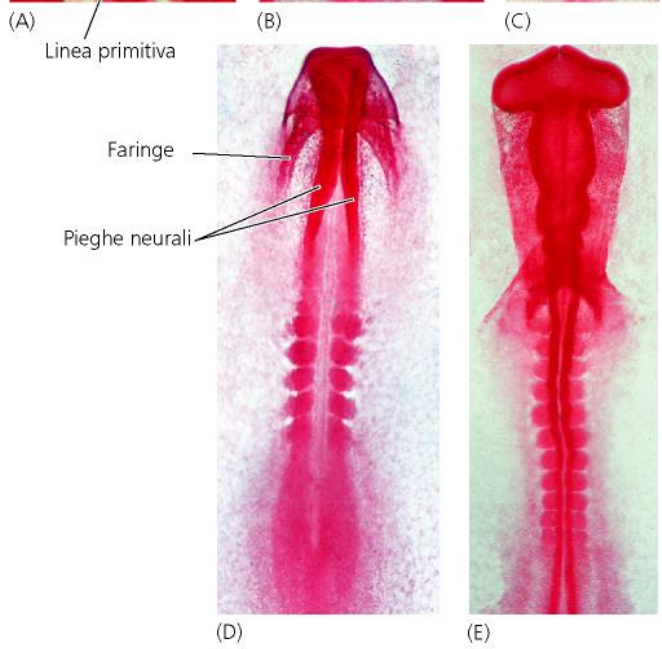
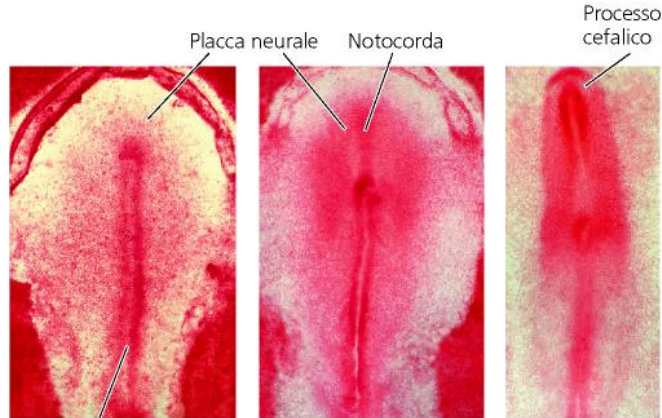


(B) Experimental

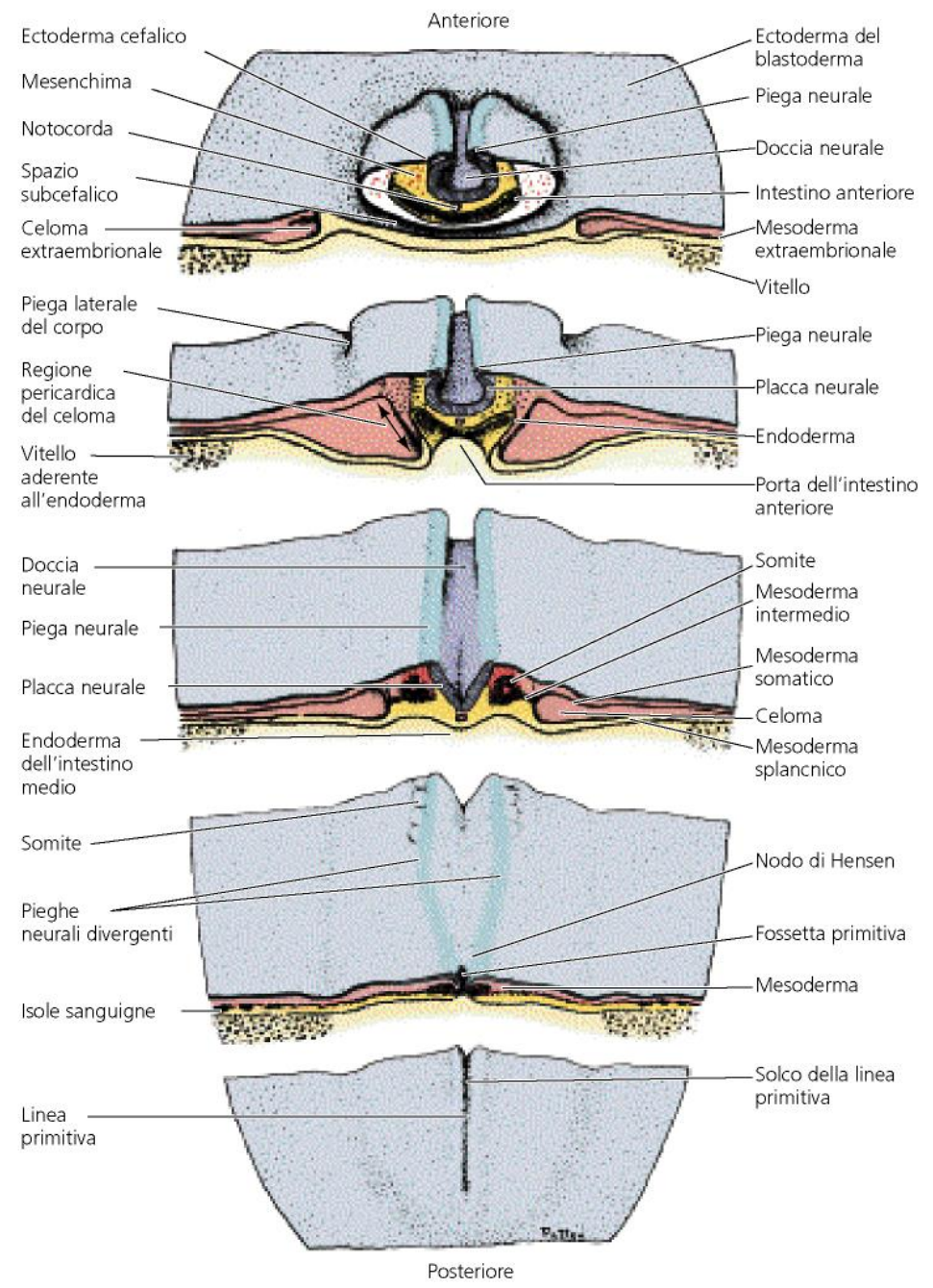




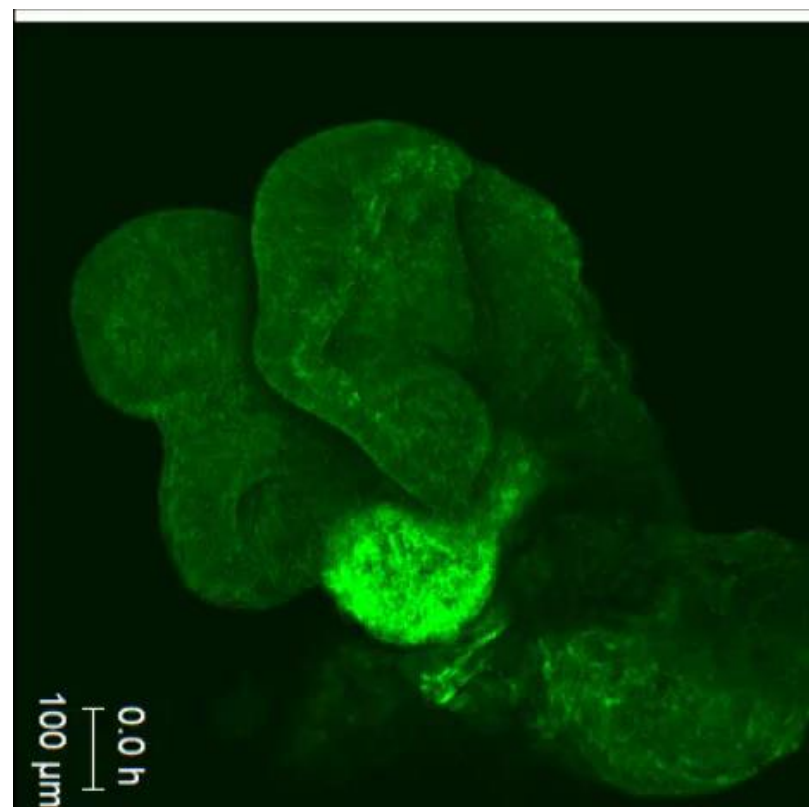
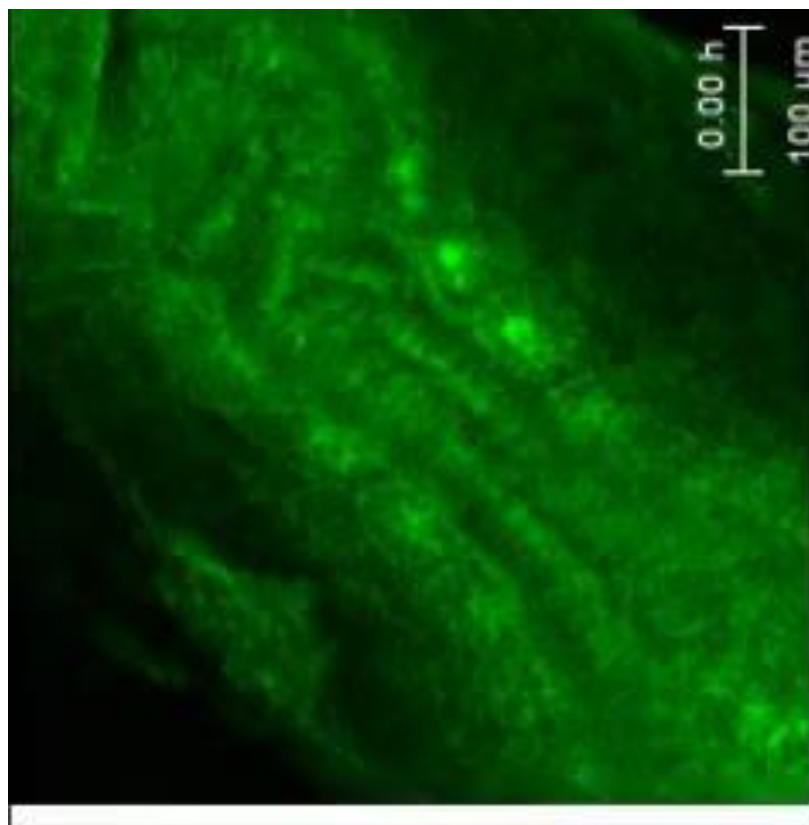
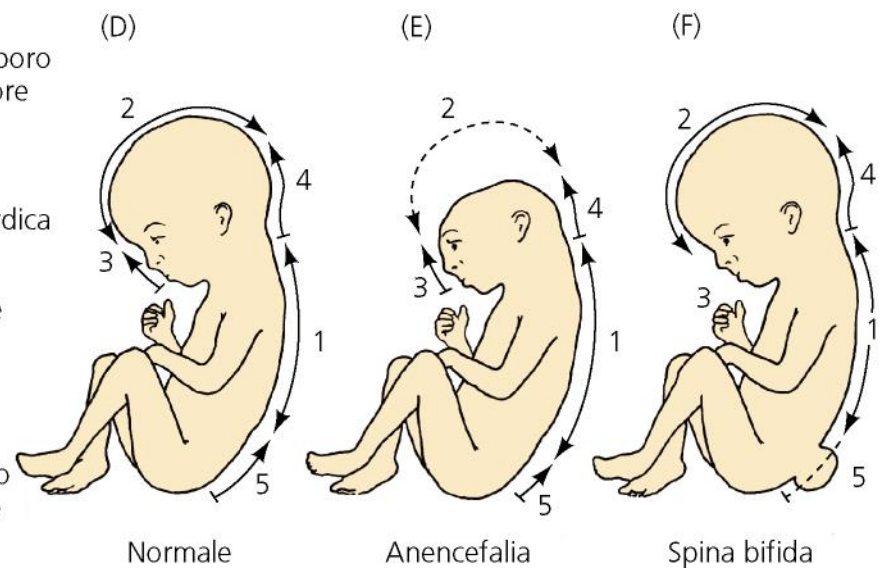
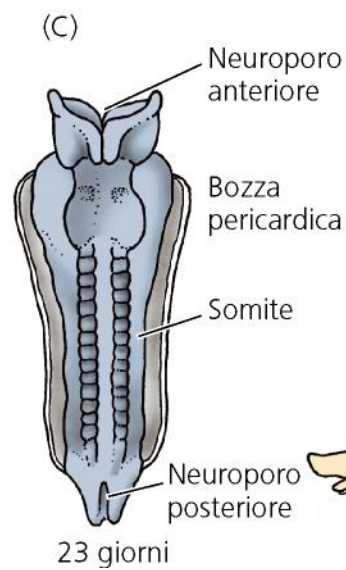
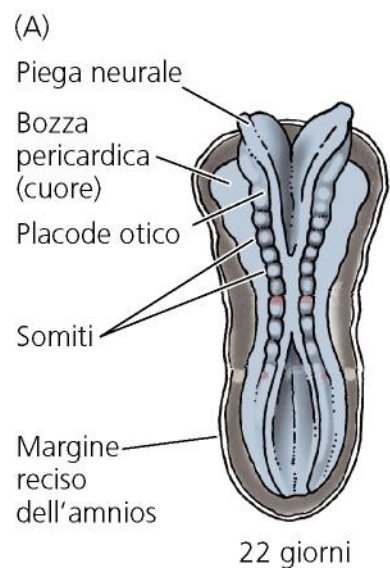




(F)







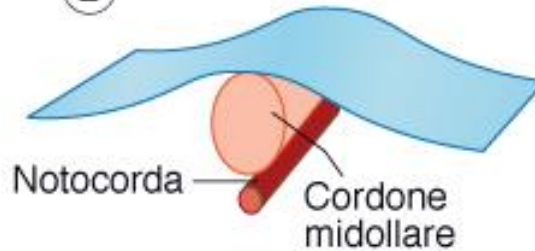
# Neurulazione secondaria

Si verifica nelle regioni caudali dei vertebrati, ma è assente nei cefalocordati e negli urocordati. E' caratterizzata dall'aggregazione, epitelizzazione e successiva cavitazione di un cordone di cellule mesenchimatiche.

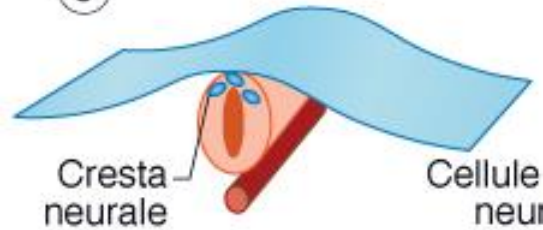
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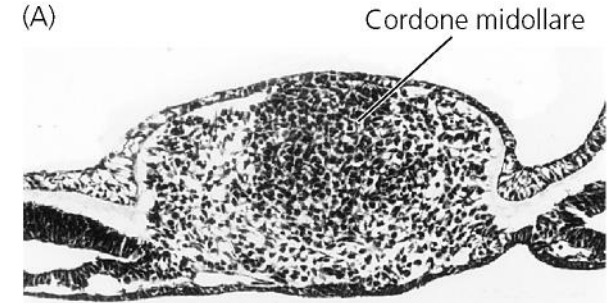
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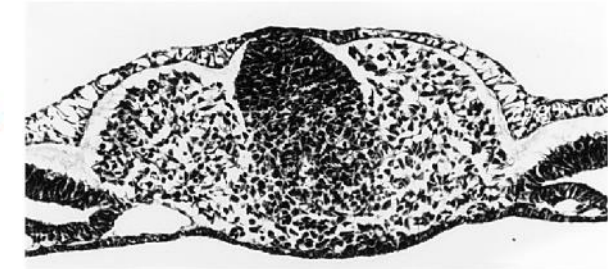
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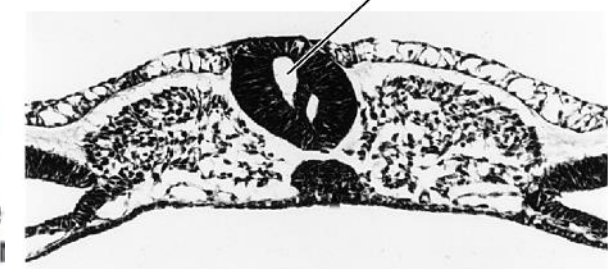
(A)



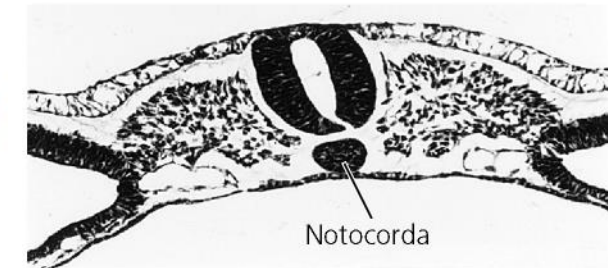
(B)



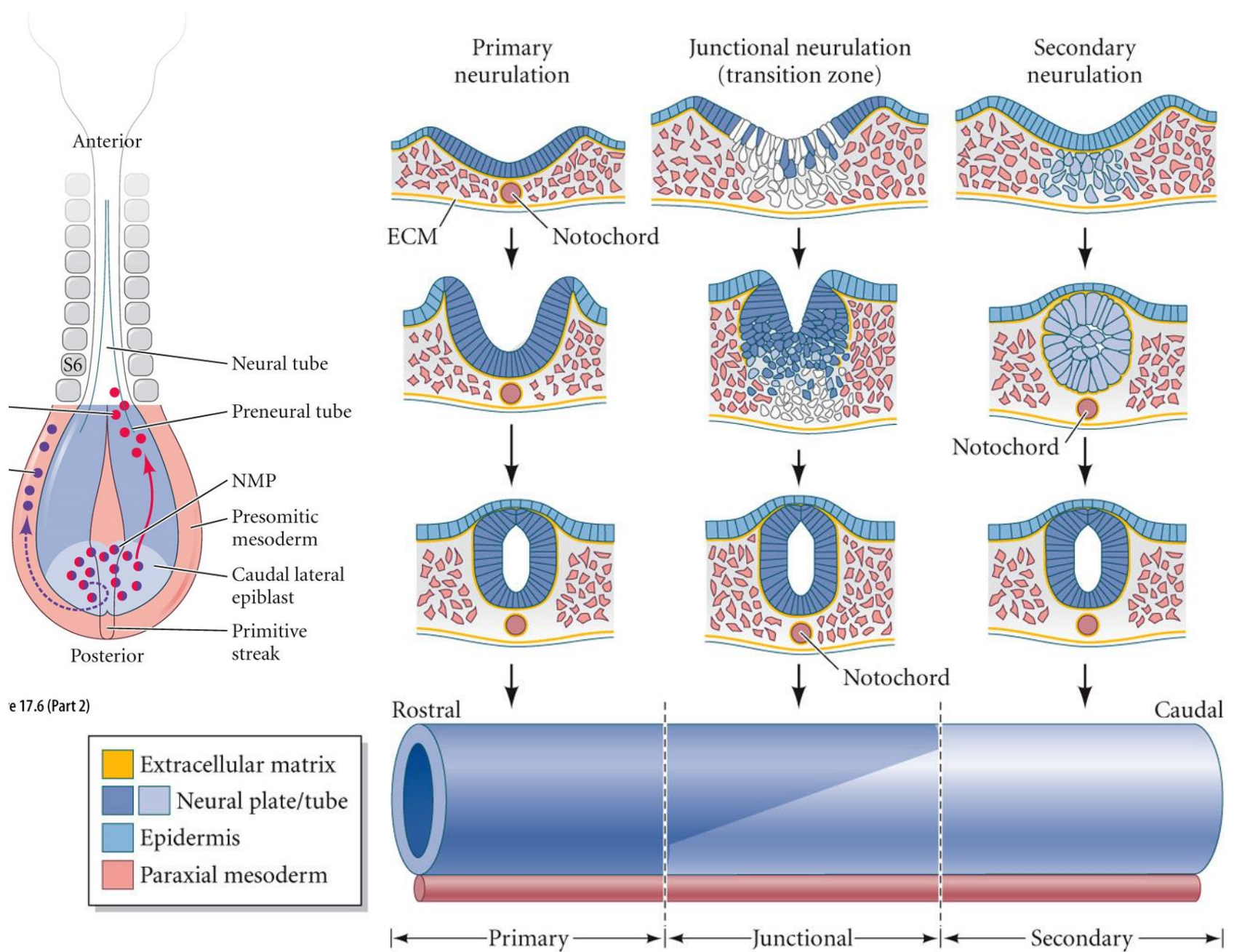
(C)



(D)







e 17.6 (Part 2)



# FORMAZIONE DELLE VESCICOLE ENCEFALICHE

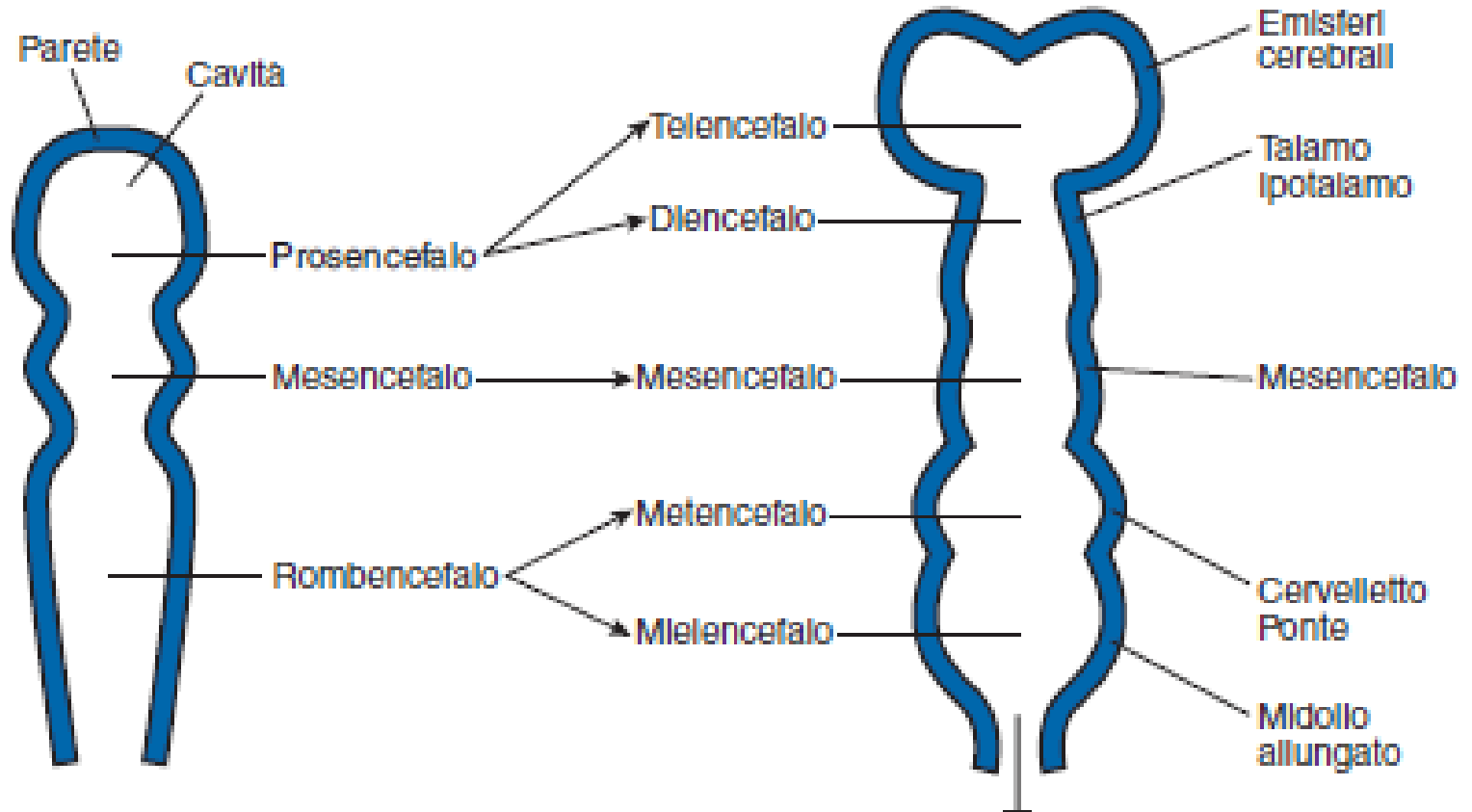


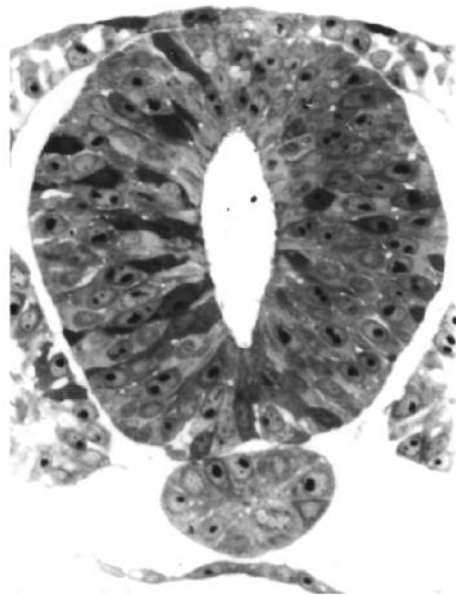
Figura 9

**L'aumento del volume cerebrale e la formazione delle vescicole encefaliche sono dovuti alla pressione esercitata dai fluidi interni al tubo neurale**

(A)



(B)



(D)

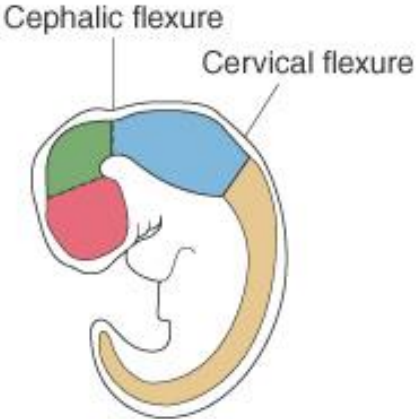


(C)

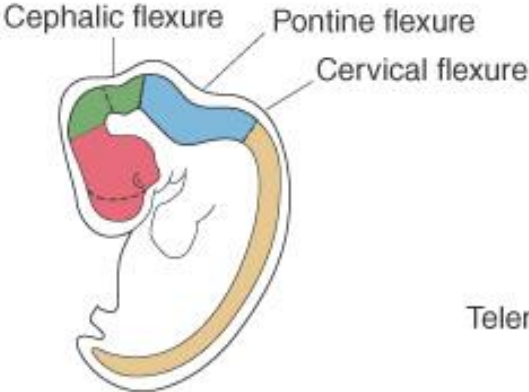


# REGIONALIZZAZIONE ANTERO-POSTERIORE DEL SISTEMA NERVOSO

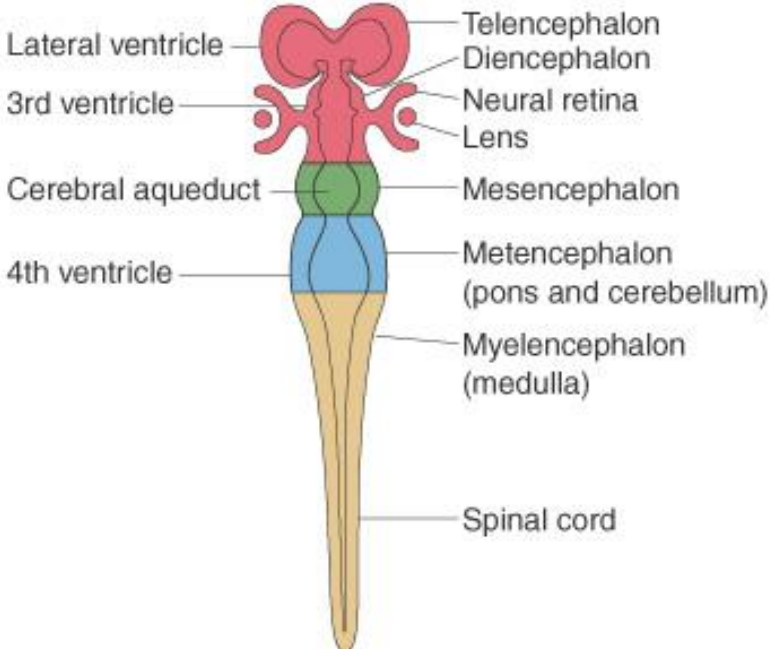
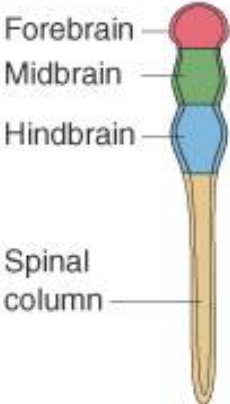
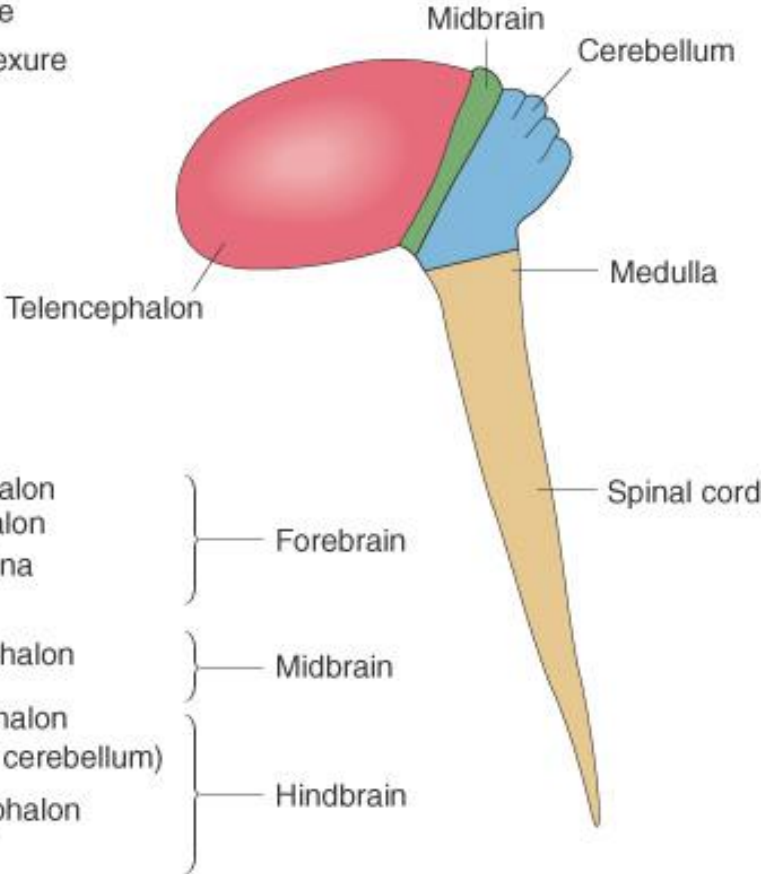
**A**



**B**

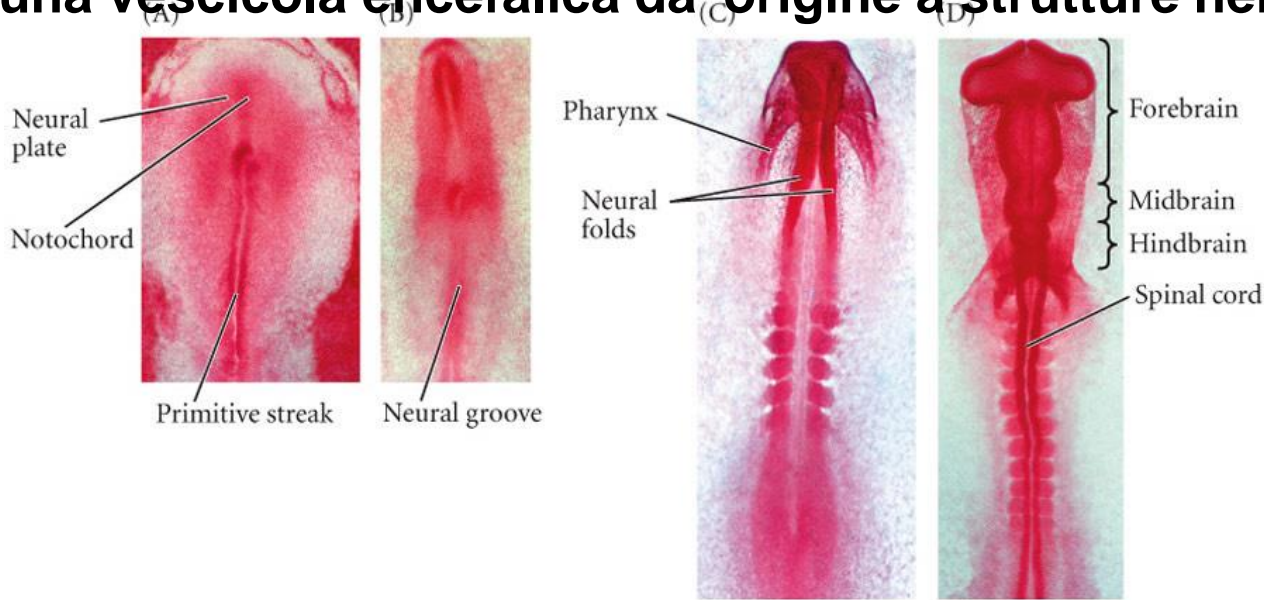


**C Adult brain**

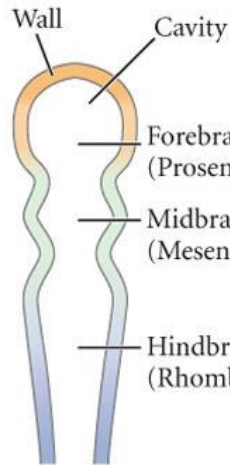




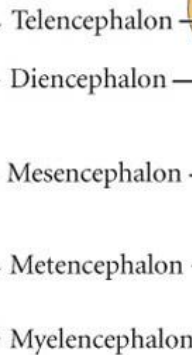
# Ciascuna vescicola encefalica da' origine a strutture nervose specifiche



(E) Primary vesicles



Secondary vesicles



Spinal cord

## Adult derivatives

Olfactory lobes	- Smell
Hippocampus	- Memory storage
Cerebrum	- Association ("intelligence")
Optic vesicle	- Vision (retina)
Epithalamus	- Pineal gland
Thalamus	- Relay center for optic and auditory neurons
Hypothalamus	- Temperature, sleep, and breathing regulation
Midbrain	- Temperature regulation, motor control, motivation, and emotional control
Cerebellum	- Coordination of complex muscular movements
Pons	- Fiber tracts between cerebrum and cerebellum
Medulla	- Reflex center of involuntary activities

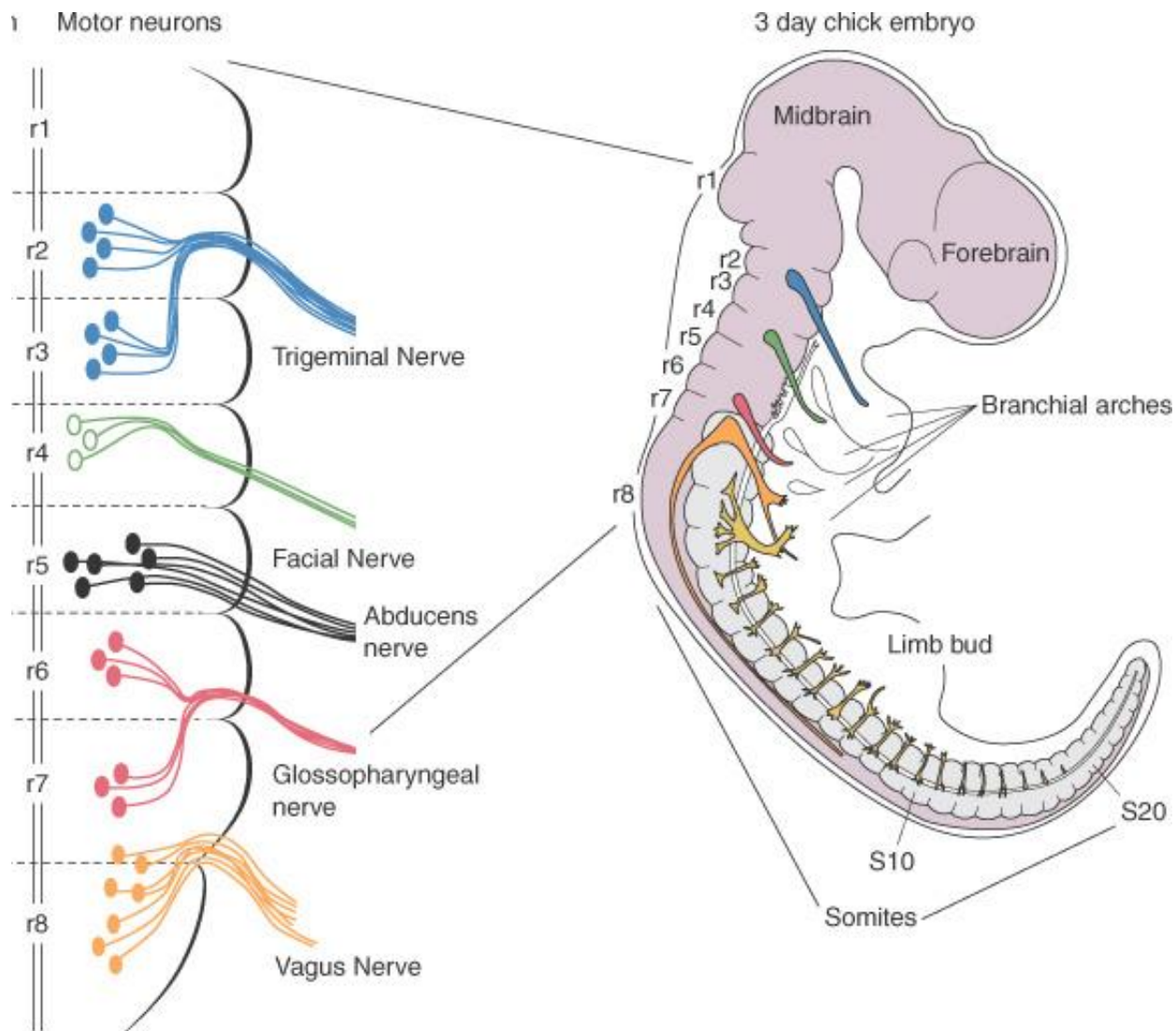


Rombomero 2

Rombomero 4

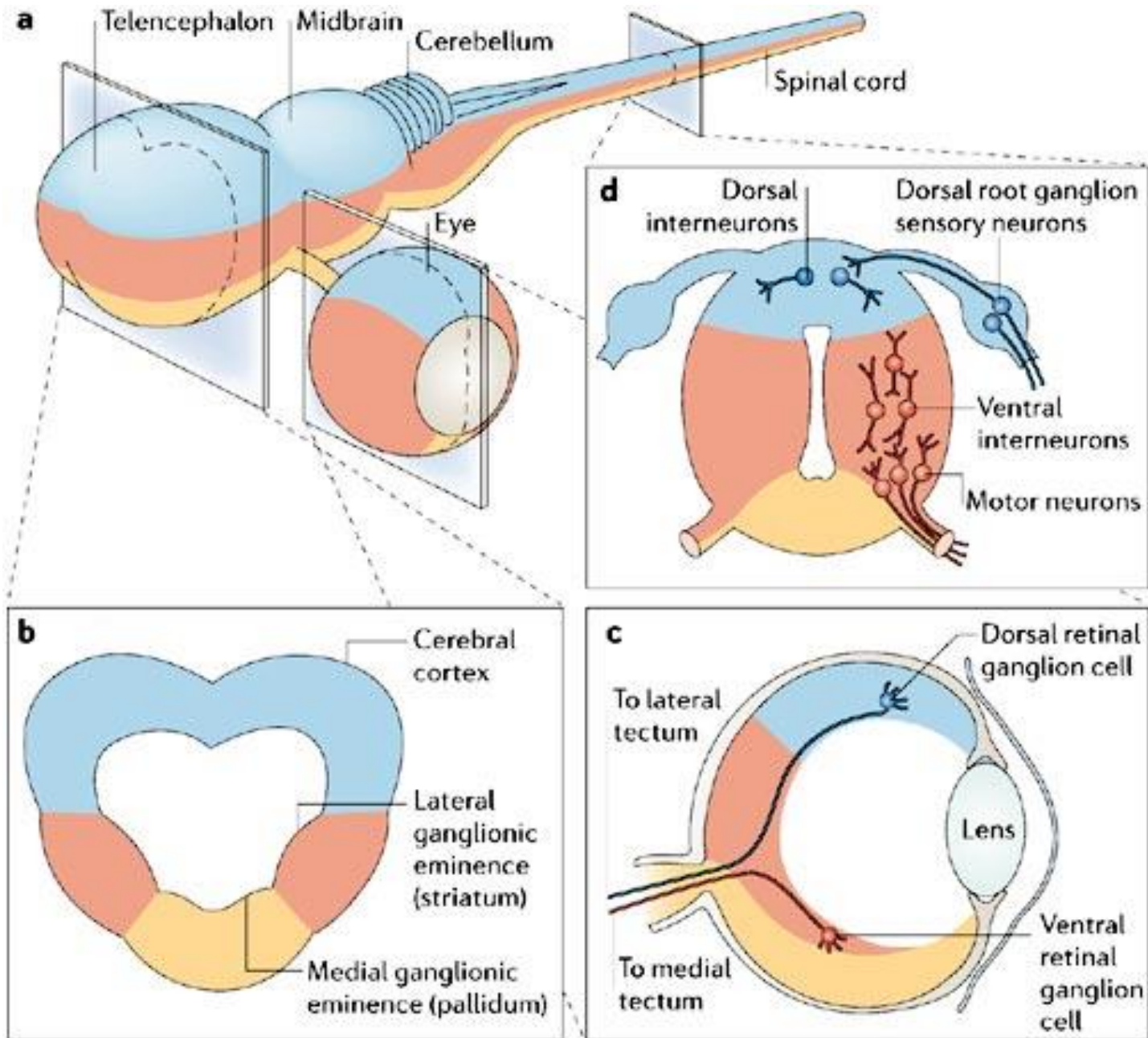
Rombomero 6

# ORGANIZZAZIONE SEGMENTALE DEL ROMBOENCEFALO

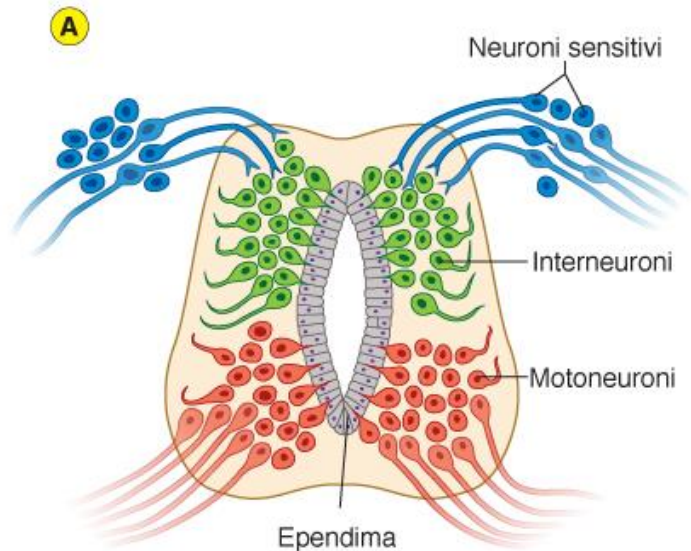
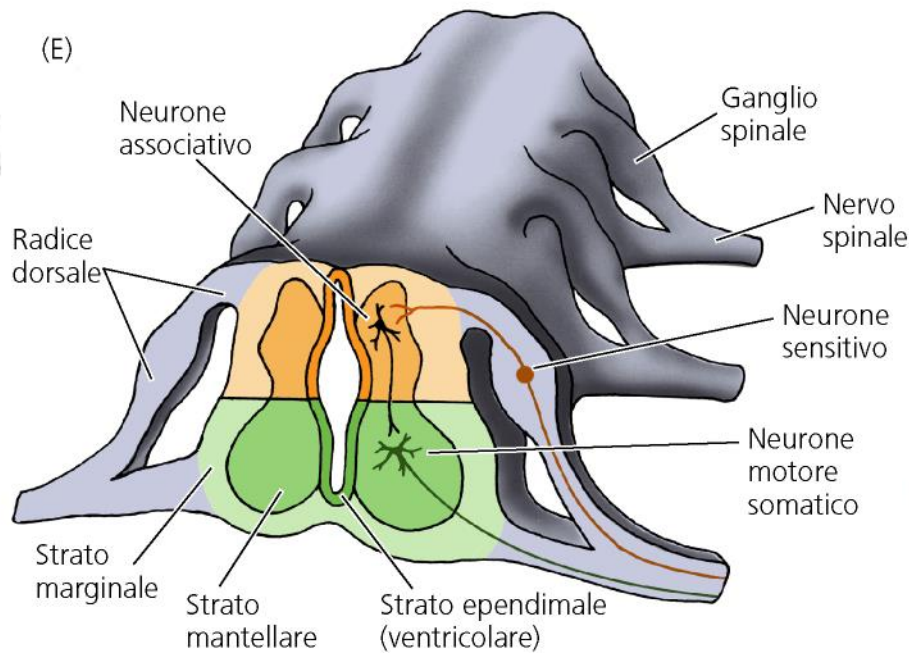
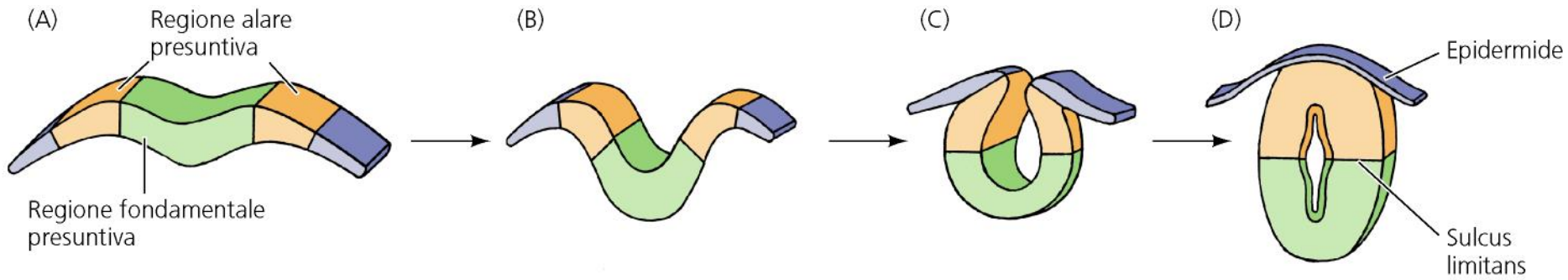




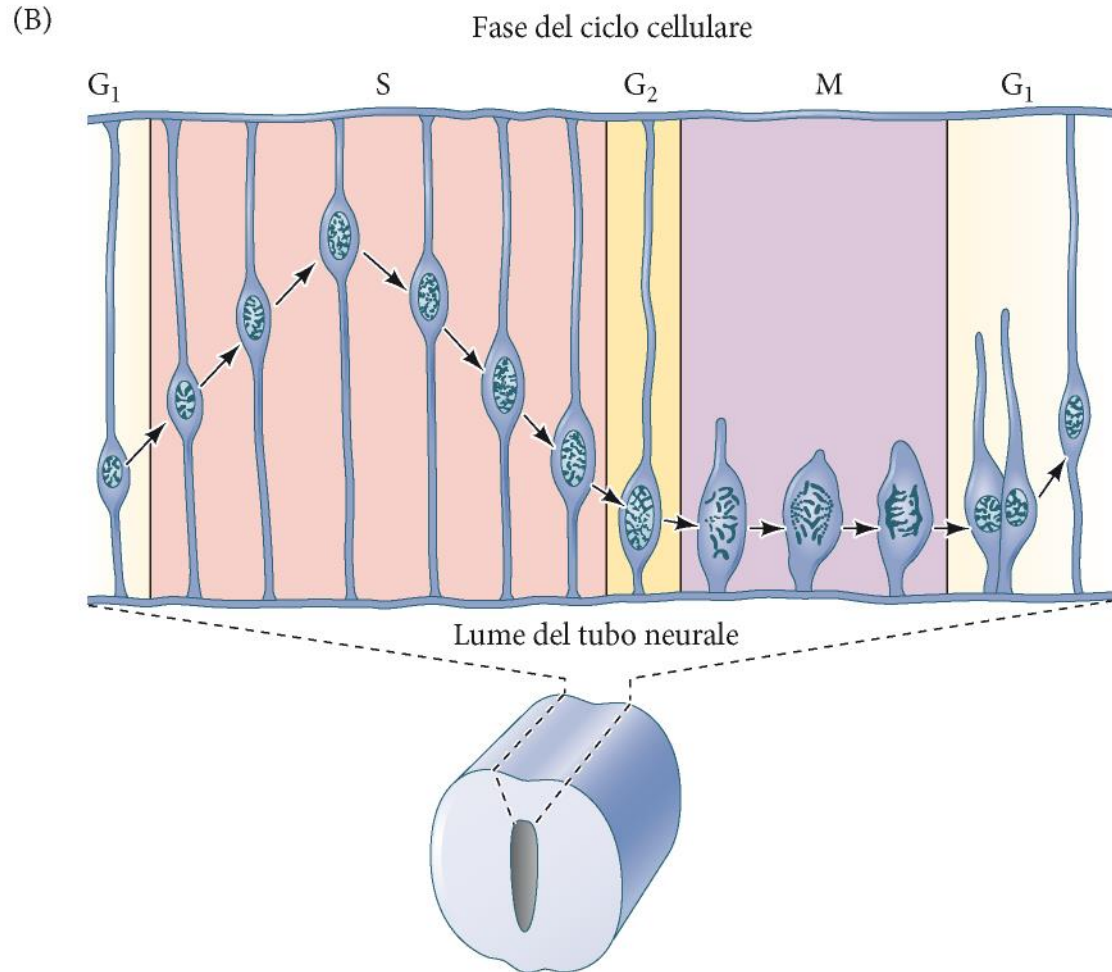
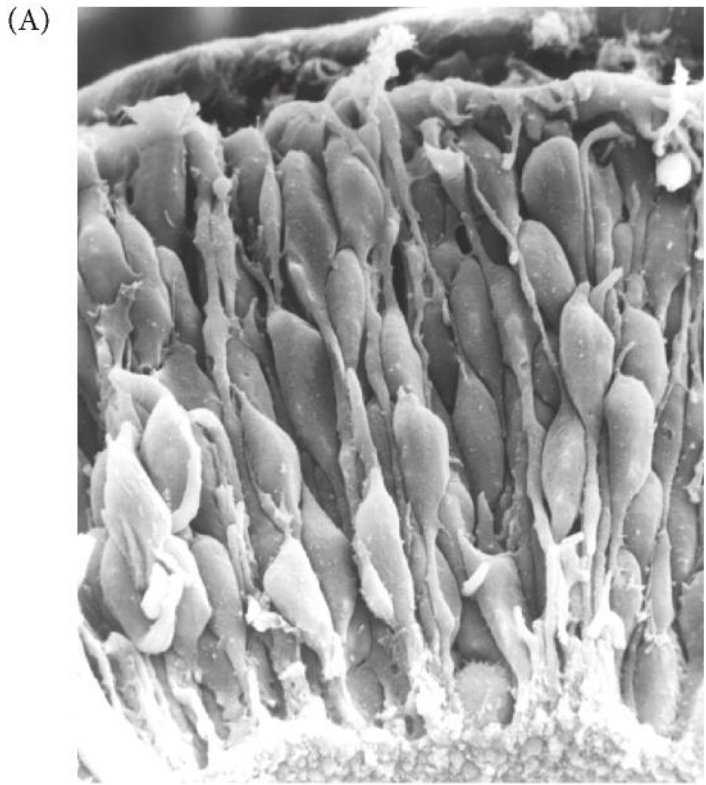
# ORGANIZZAZIONE DORSO-VENTRALE DEL SISTEMA NERVOSO



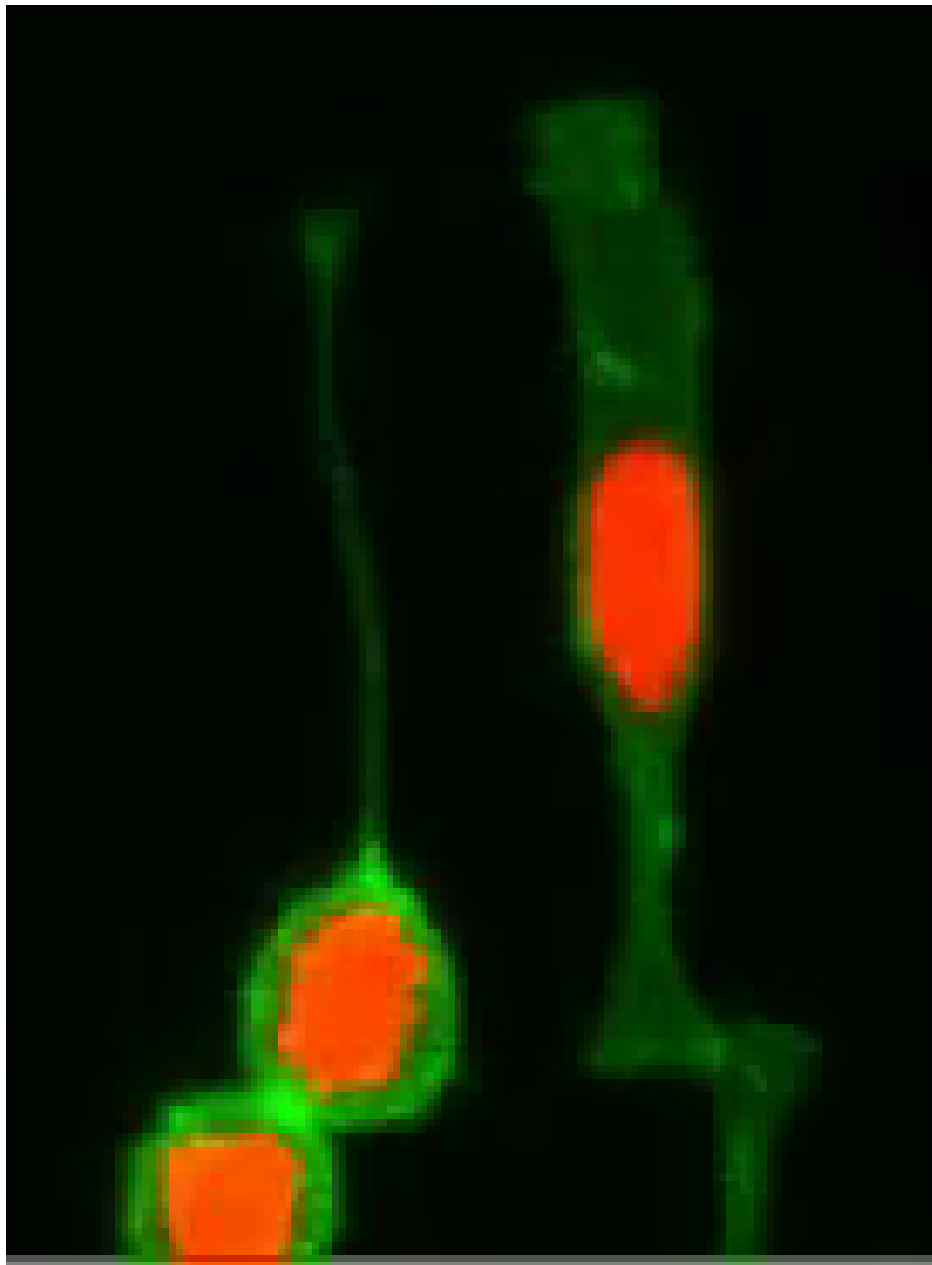
# ORGANIZZAZIONE DORSO-VENTRALE DEL MIDOLLO SPINALE

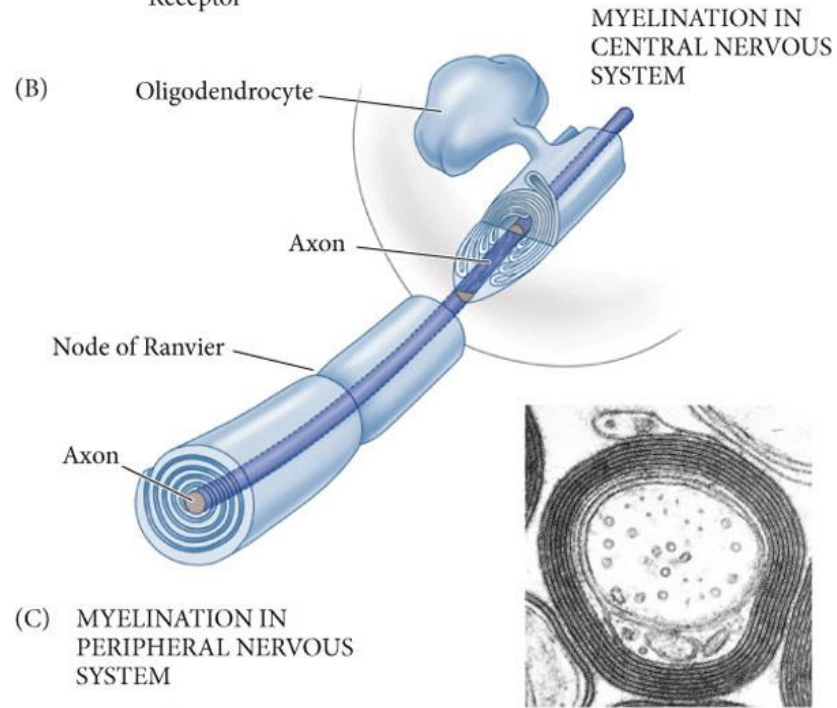
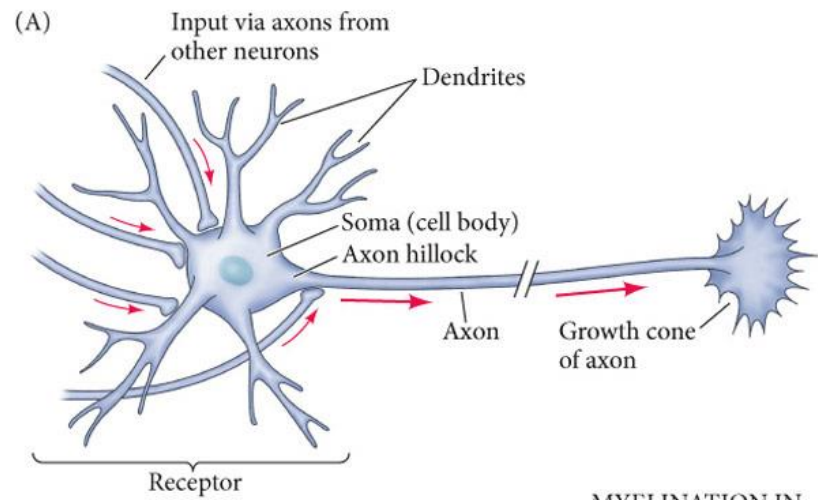


Le pareti del tubo neurale sono costituite da un **epitelio pseudo-stratificato**. Le cellule neuroepiteliali sono dotate di un processo apicale e di un processo basale che attraversano tutta la parete del tubo. I nuclei si trovano ad altezze diverse in base alla fase del ciclo cellulare delle cellule. La mitosi si svolge in posizione apicale (vicino al lume), la fase S in posizione basale.

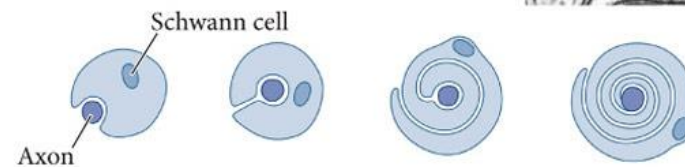


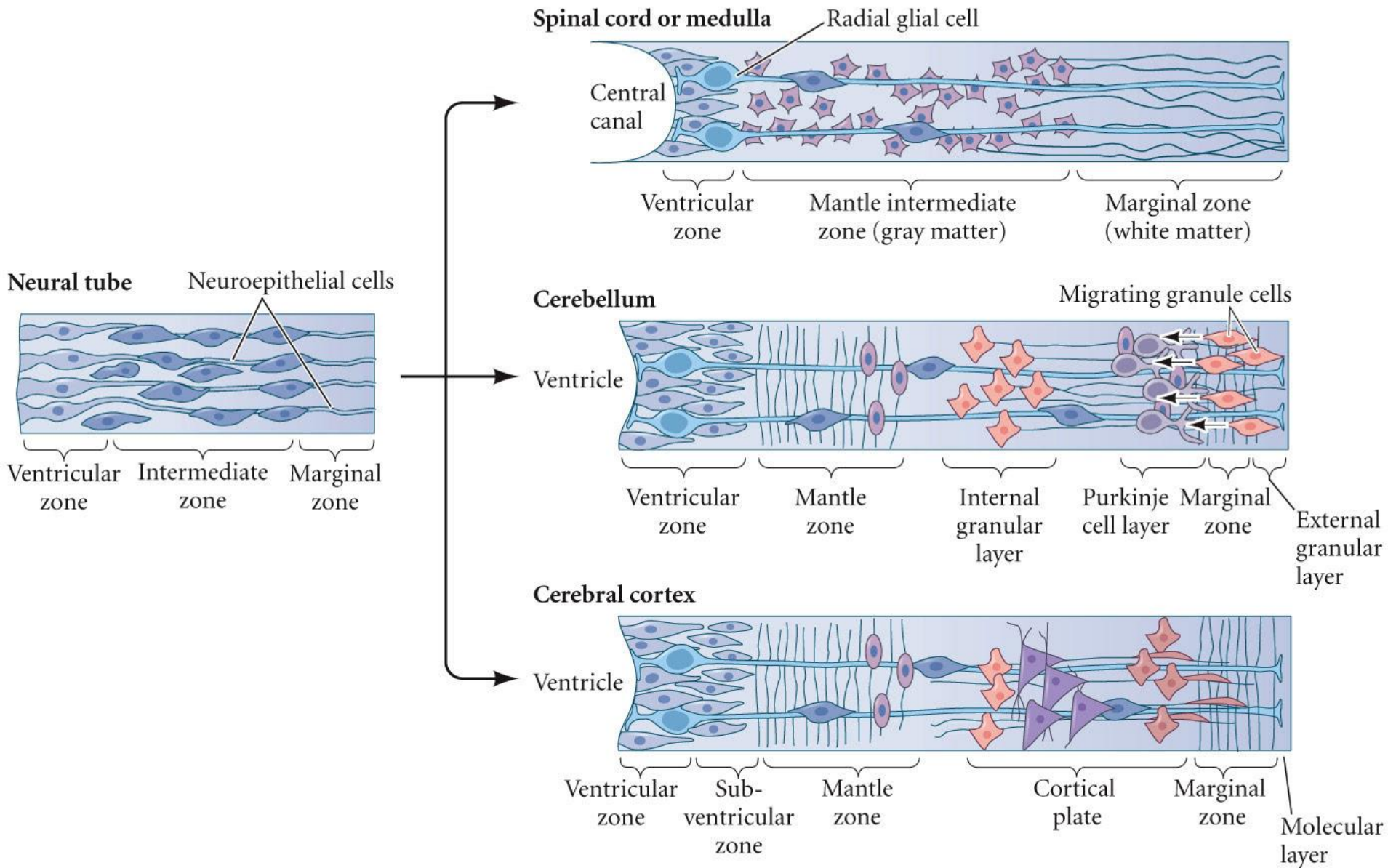






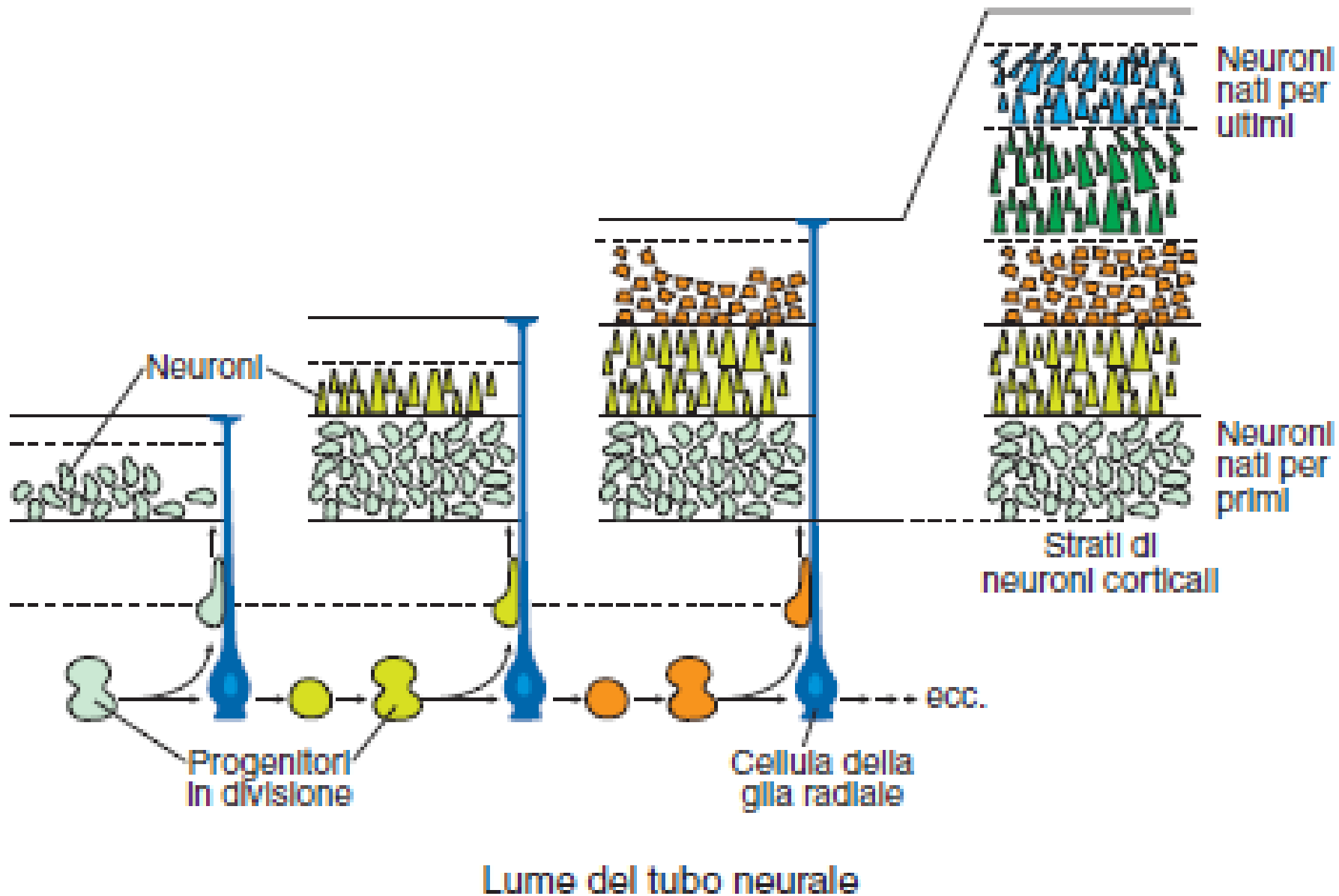
(C) MYELINATION IN PERIPHERAL NERVOUS SYSTEM



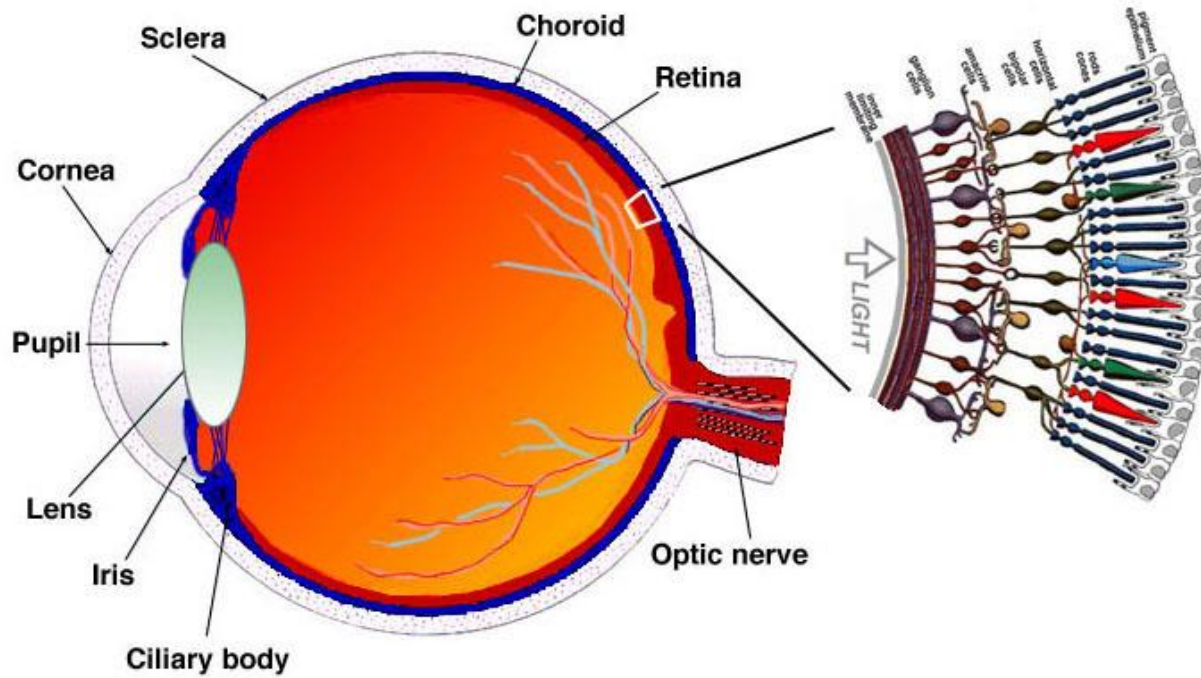


DEVELOPMENTAL BIOLOGY 11e, Figure 14.3



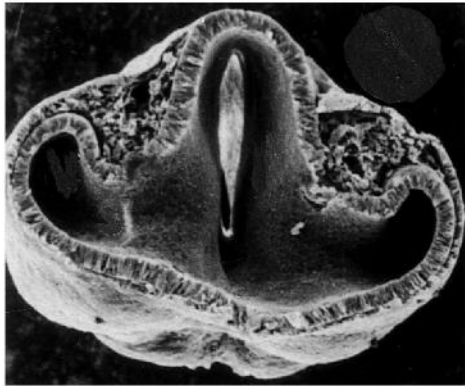


# STRUTTURA ANATOMICA DELL'OCCHIO UMANO

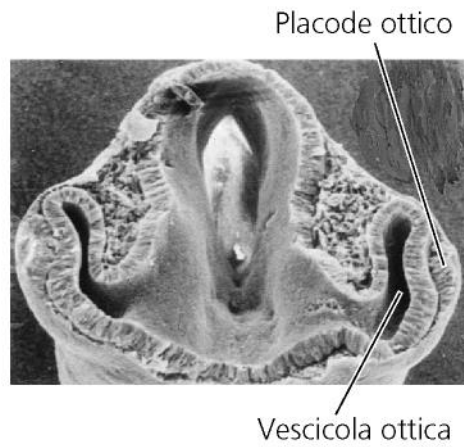


# SVILUPPO DELL'OCCHIO

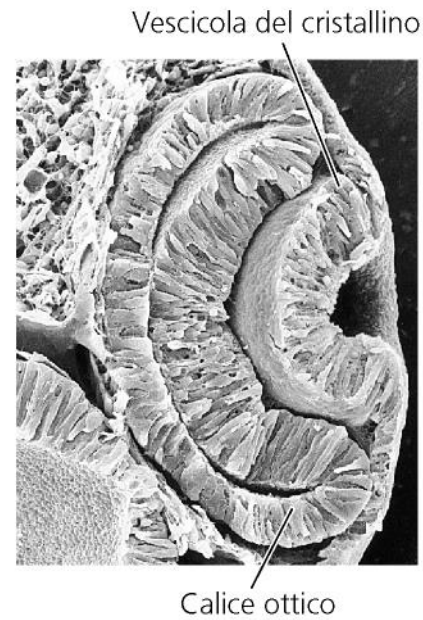
(A) Embrione di 4 mm



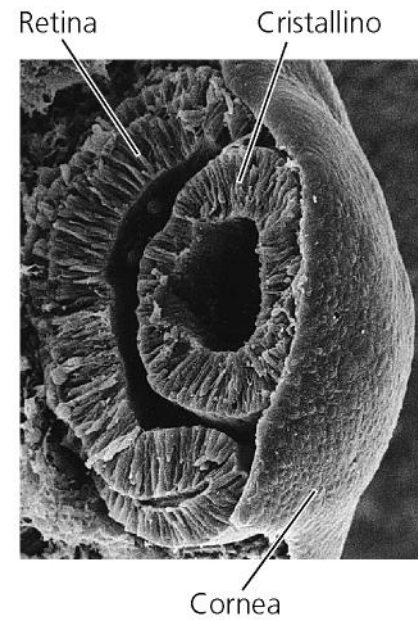
(B) Embrione di 4,5 mm



(C) Embrione di 5 mm

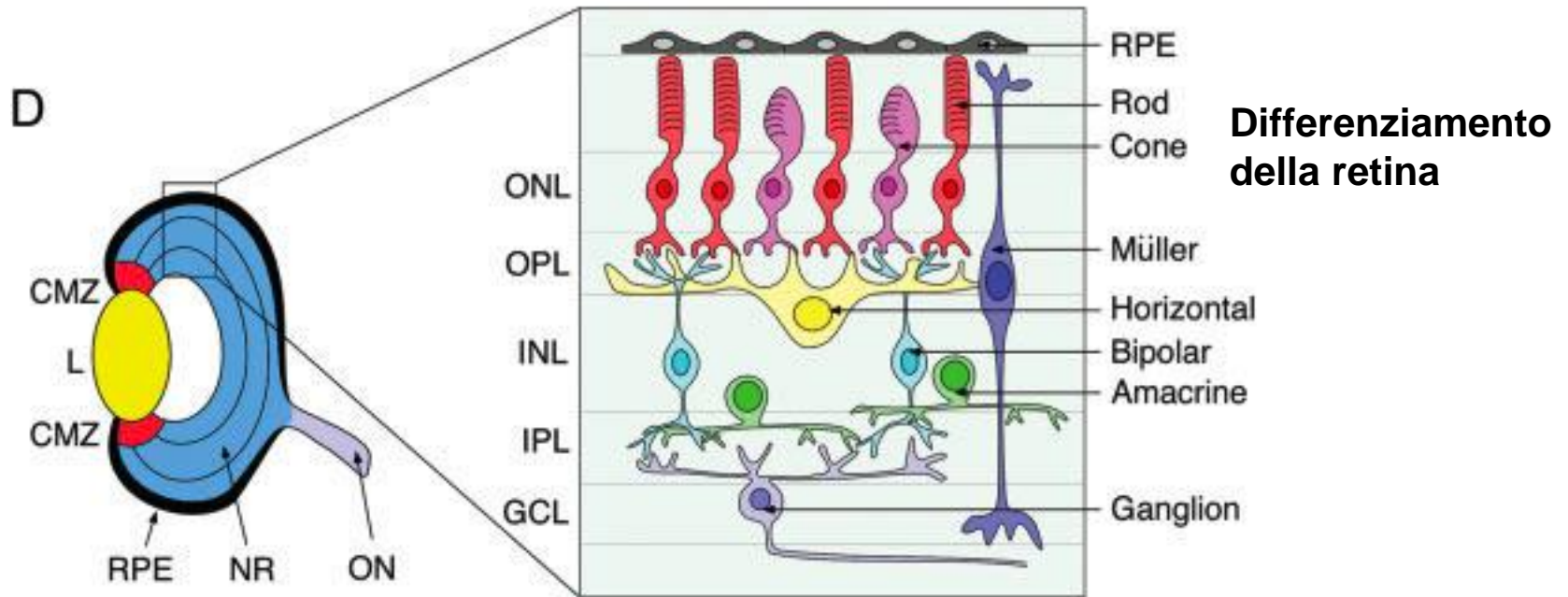
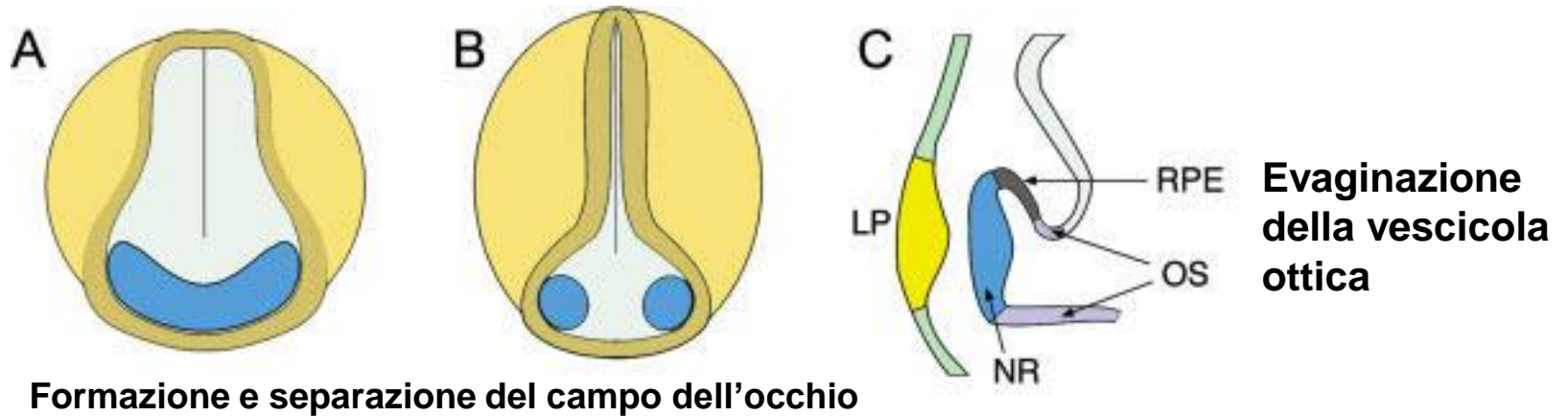


(D) Embrione di 7 mm

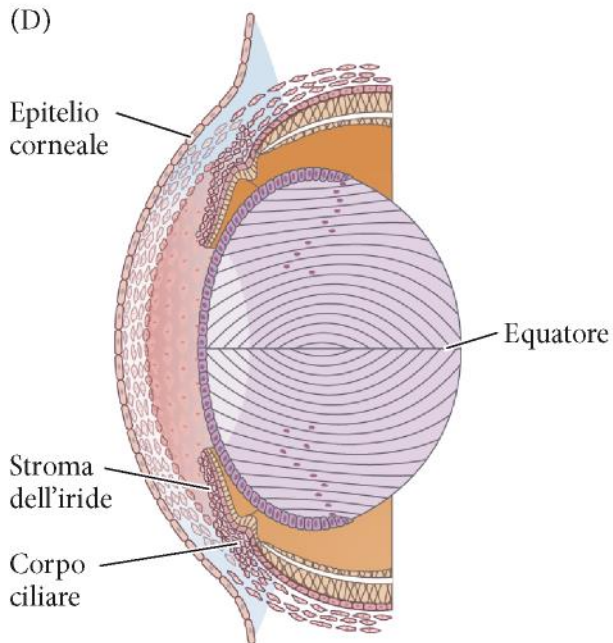
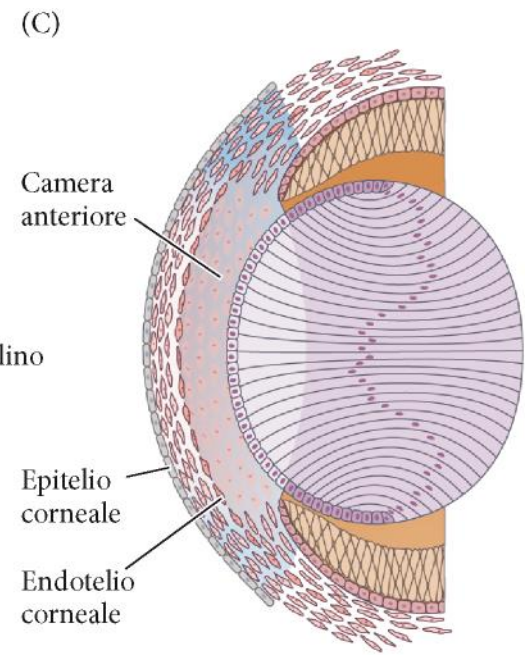
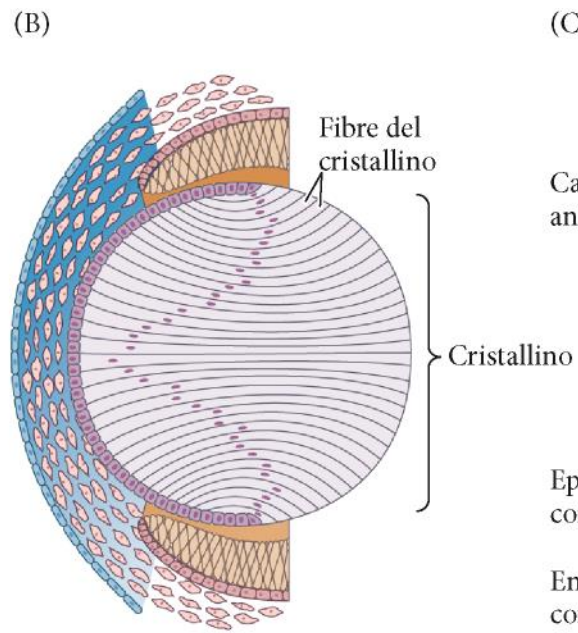
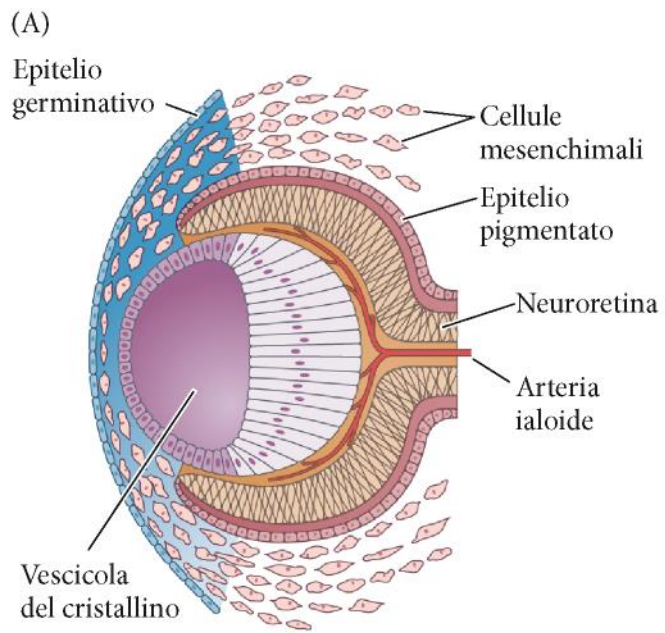


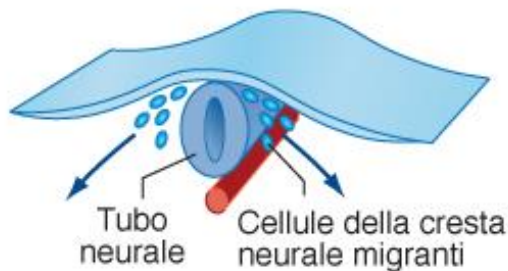
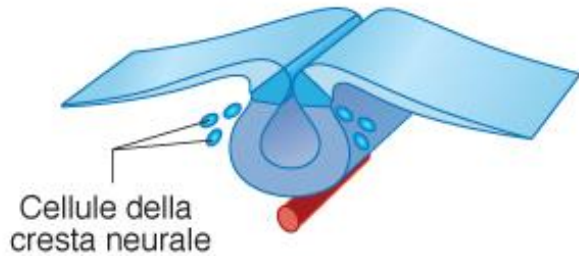
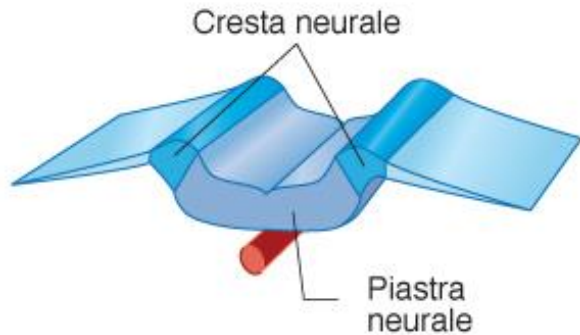
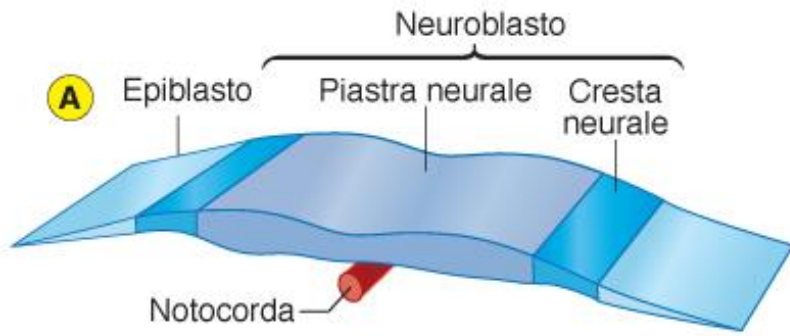


# TAPPE FONDAMENTALI NELLO SVILUPPO DELL'OCCHIO



Invaginazione della coppa ottica

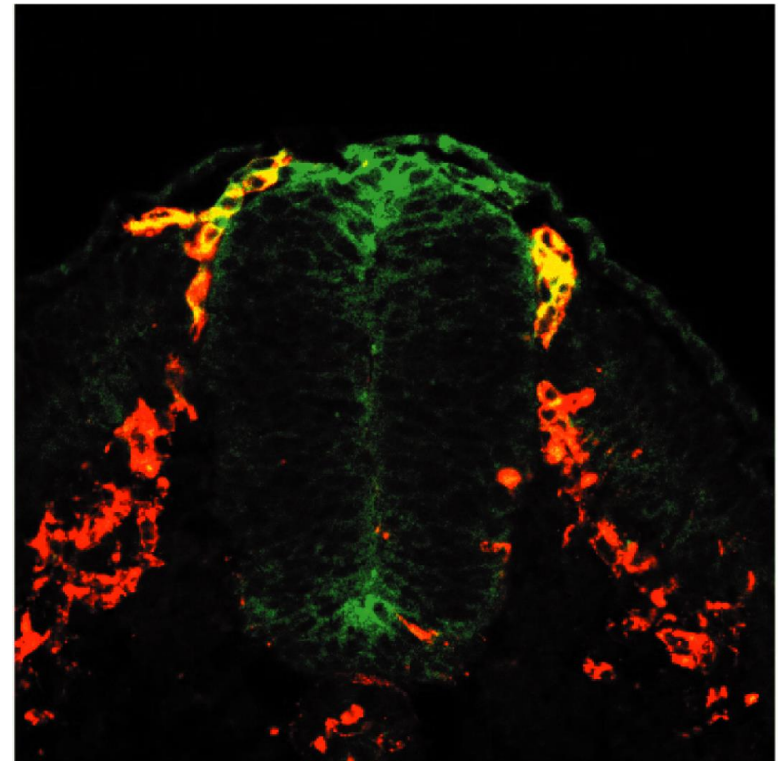




## Cellule delle creste neurali

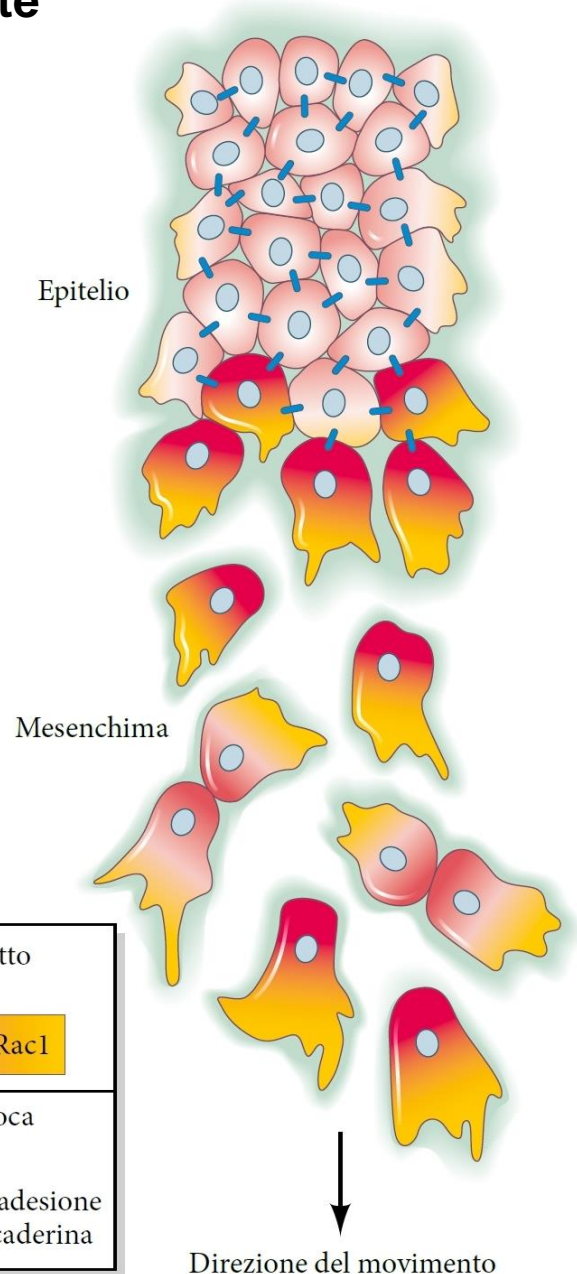
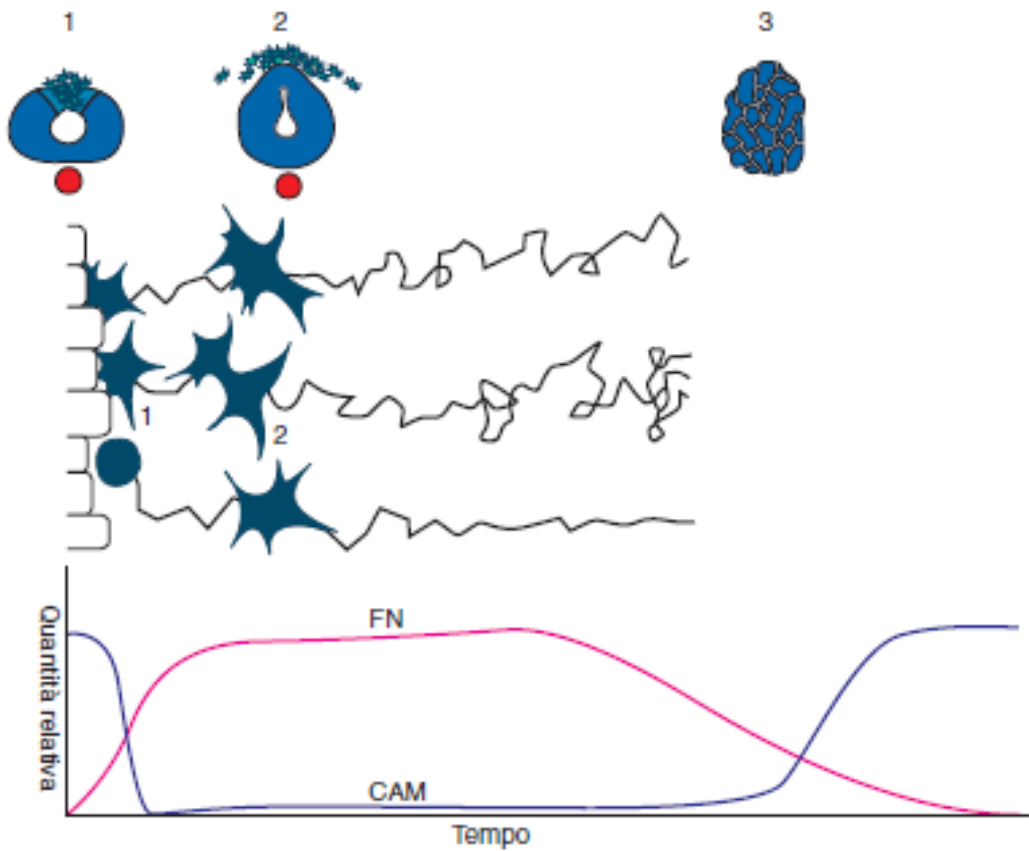
Si formano nella parte più dorsale del tubo neurale.

Dopo la chiusura del tubo, effettuano **tranizione epitelio-mesenchimatica** e migrano, differenziandosi in vario modo a seconda delle posizioni raggiunte.





# La migrazione delle creste neurali e' modulata da cambiamenti nell'espressione di molecole di adesione, da segnali chemiotattici, dalla matrice extra-cellulare e da interazioni fra le cellule delle creste



Inibizione da contatto del movimento	
RhoA	Rac1
Attrazione reciproca da Ca <sup>2+</sup>	
— Modesti livelli di adesione mediata dalla N-caderina	



## I derivati cellulari delle creste neurali

### TABELLA 1

#### Principali derivati della cresta neurale

Gangli spinali	Neuroni sensoriali peptidergici
Gangli simpatici	Neuroni adrenergici,
Gangli parasimpatici	Neuroni colinergici
Cellule gliali	Satelliti e cellule di Schwann
Strutture endocrine	Cellule cromaffini della midollare del surrene Cellule secernenti calcitonina
Tegumento	Melanociti
Scheletro craniofacciale	Condroblasti ed osteoblasti
Derivati connettivali	Connettivo di timo, tiroide e paratiroide
Papille dentarie	Odontoblasti
Connettivo e muscolatura di grandi arterie	

- Sistema nervoso periferico:
  - gangli spinali
  - gangli simpatici
  - gangli parasimpatici
  - Cellule di Schwann
- Cellule pigmentate:
  - melanociti
- Derivati endocrini:
  - midollare del surrene
- Derivati mesenchimali:
  - cartilagine ed ossa della faccia
- Derivati connettivali:
  - connettivo e muscolatura delle arterie
  - connettivo della cornea

# SISTEMA NERVOSO PERIFERICO

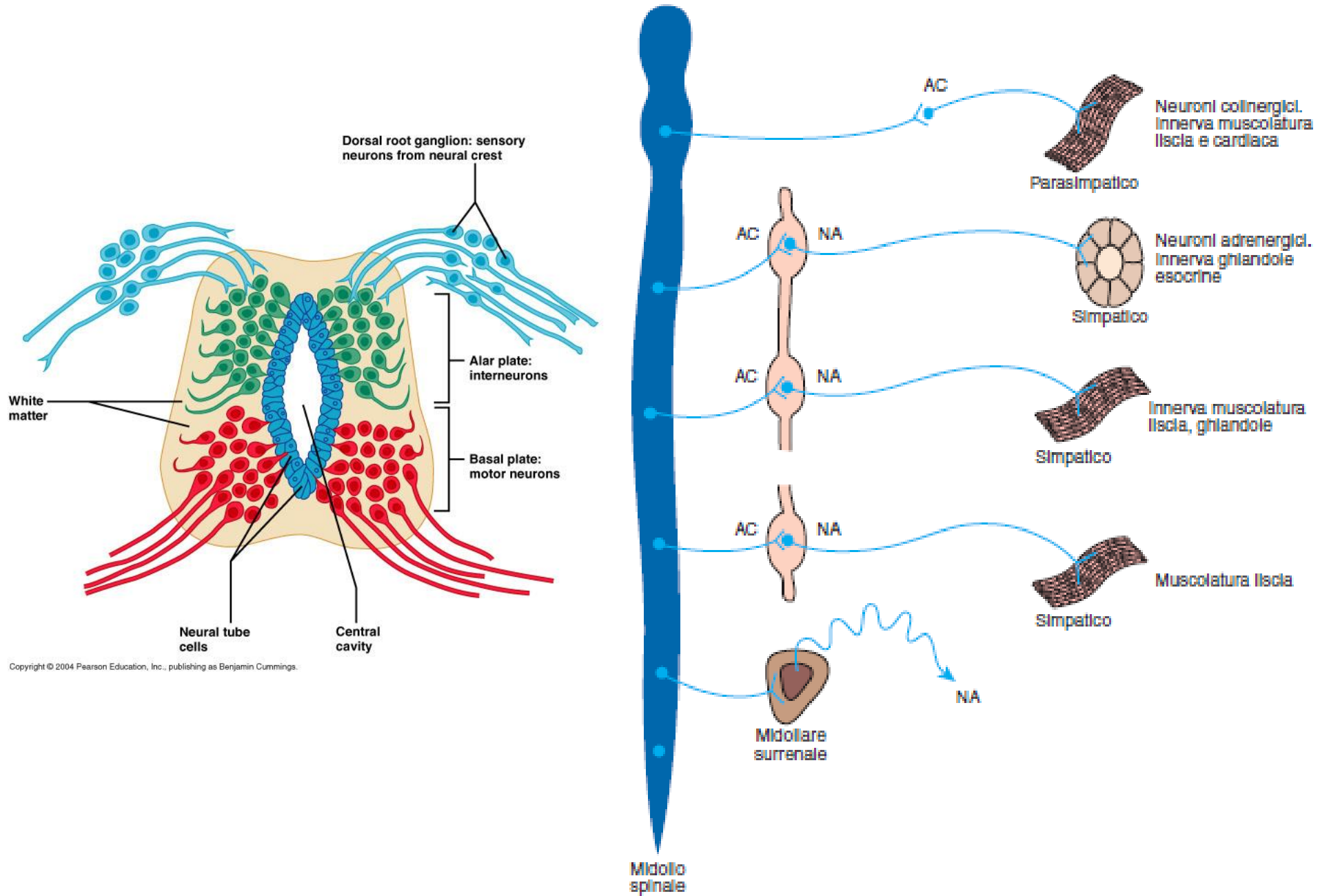
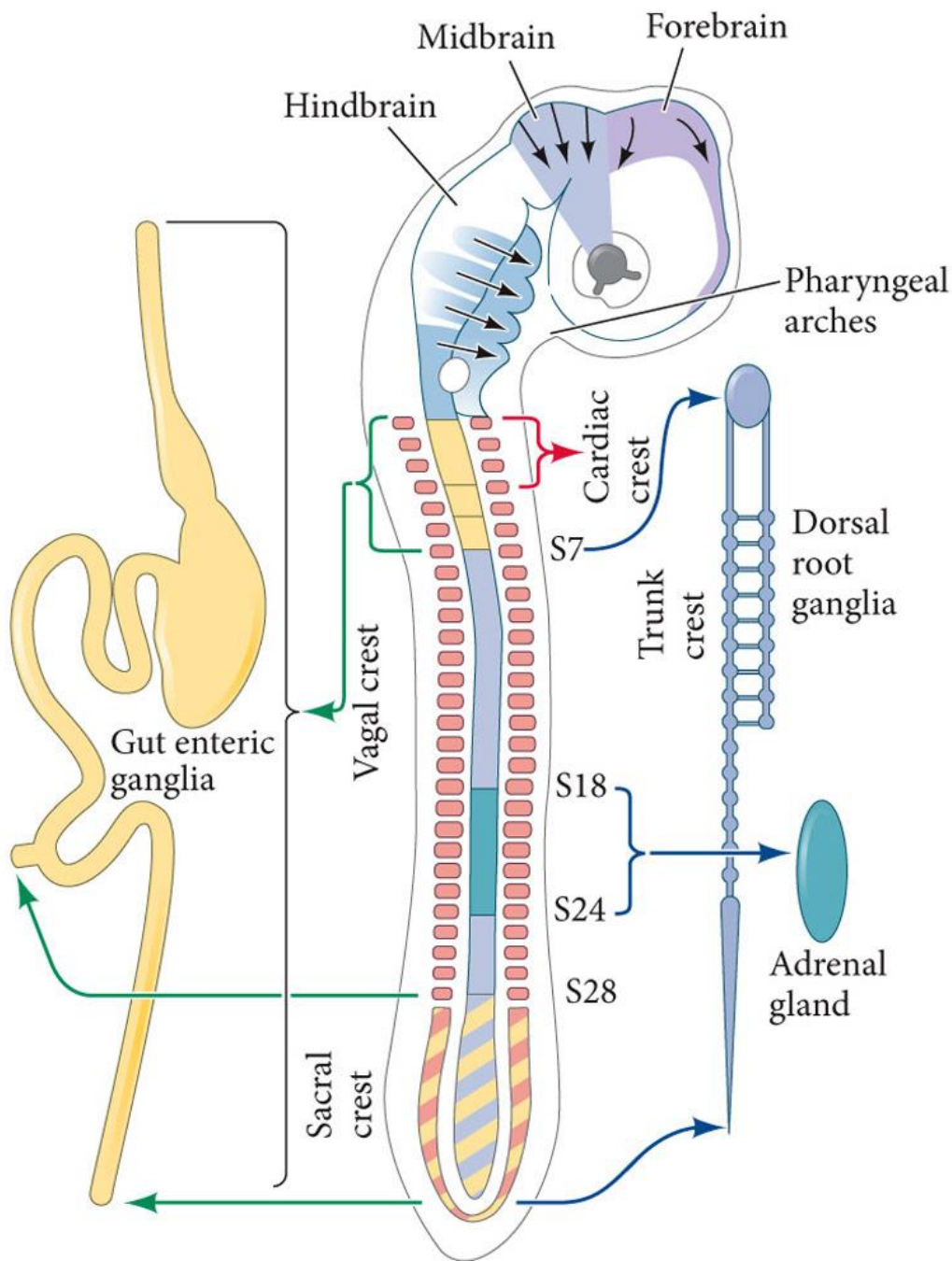


Figura 1



**Cresta cefalica – mesenchima craniofacciale, gangli dei nervi cranici**

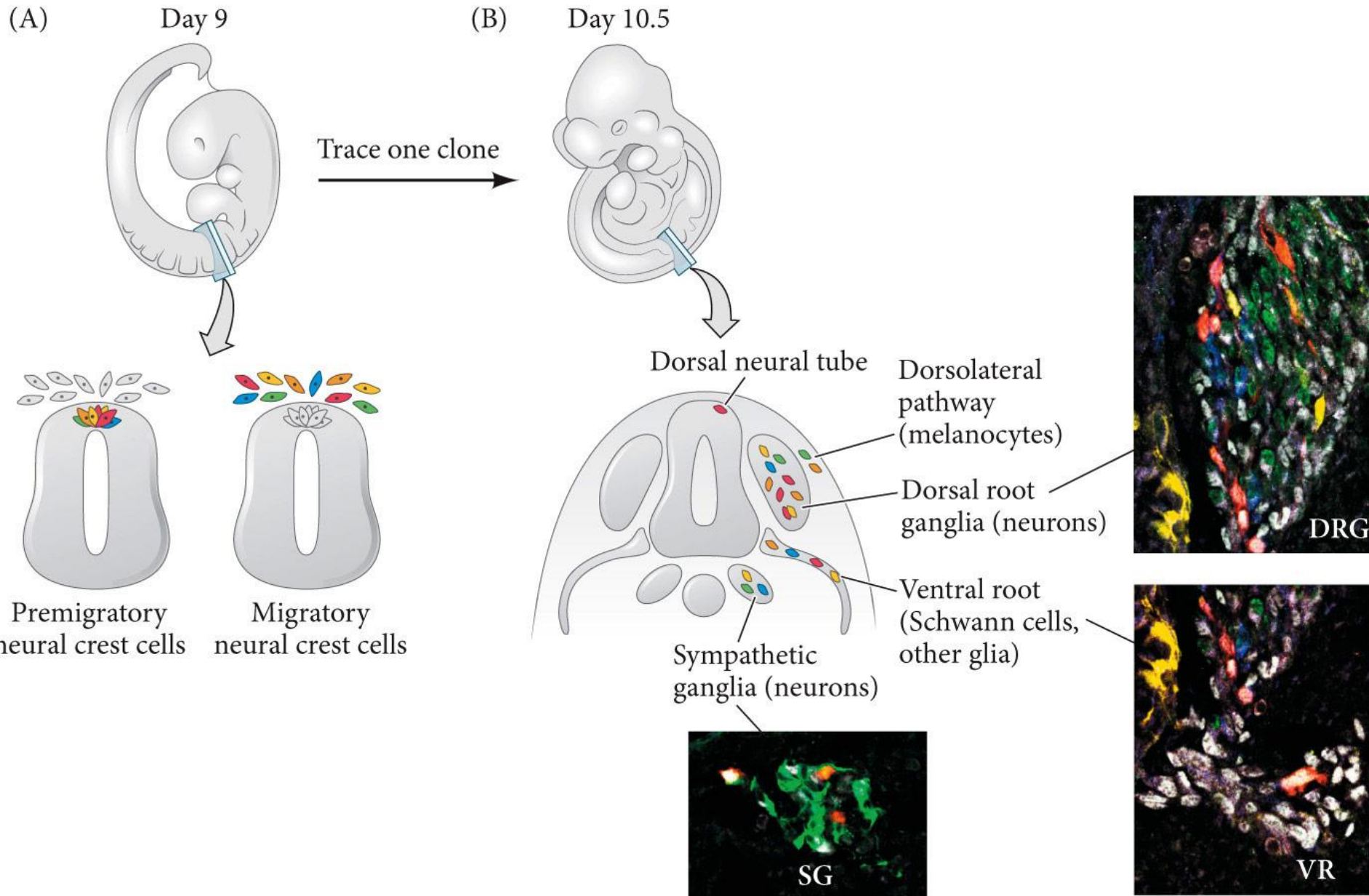
**Cresta vagale – gangli parasimpatici**

**Cresta cardiaca – melanociti, tessuto muscolo-connettivale delle grandi arterie**

**Cresta del tronco – melanociti, gangli simpatici e spinali**

**Cresta sacrale – gangli parasimpatici**

# MULTIPOTENZA DELLE CELLULE DELLE CRESTE NEURALI

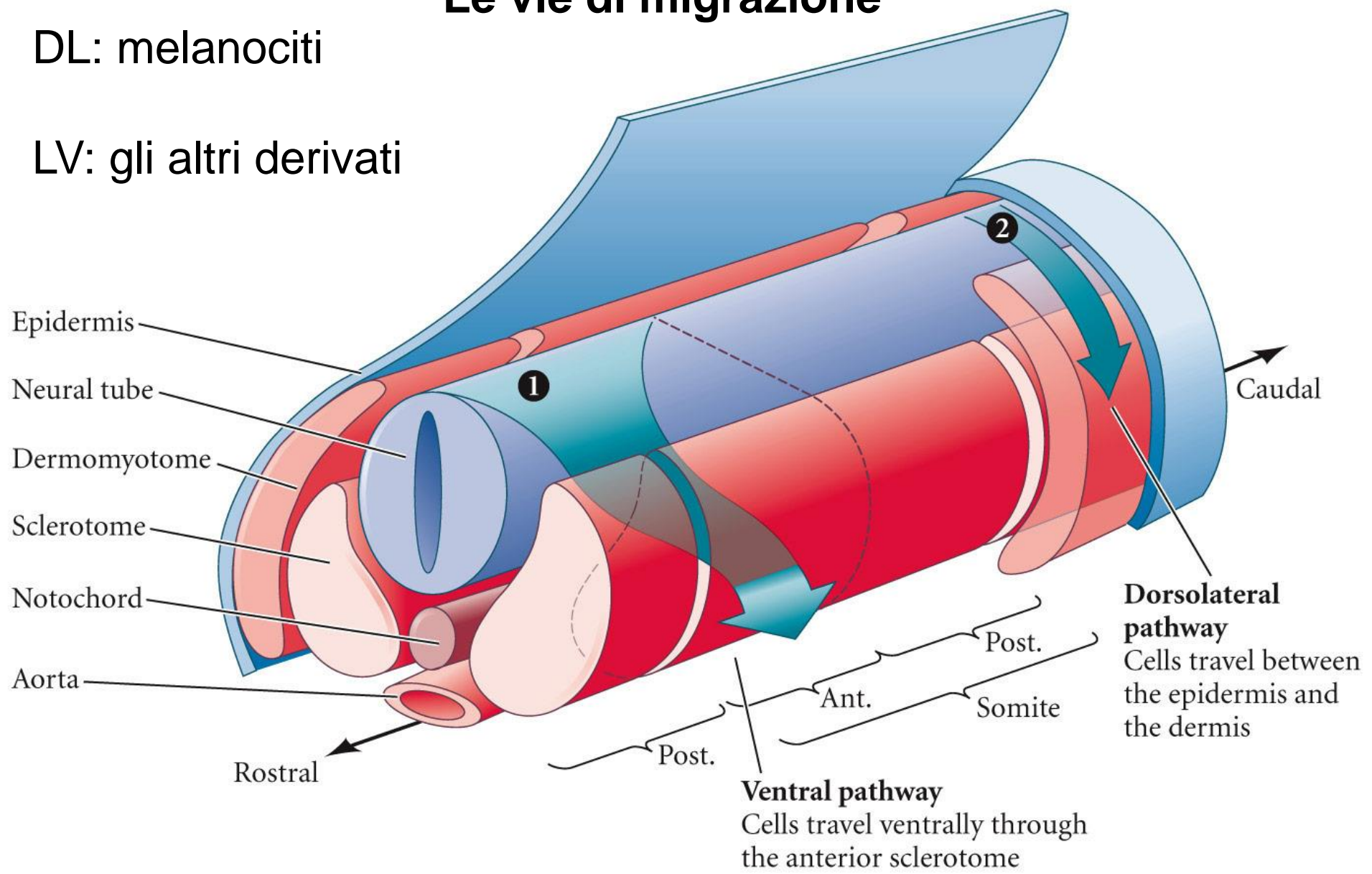


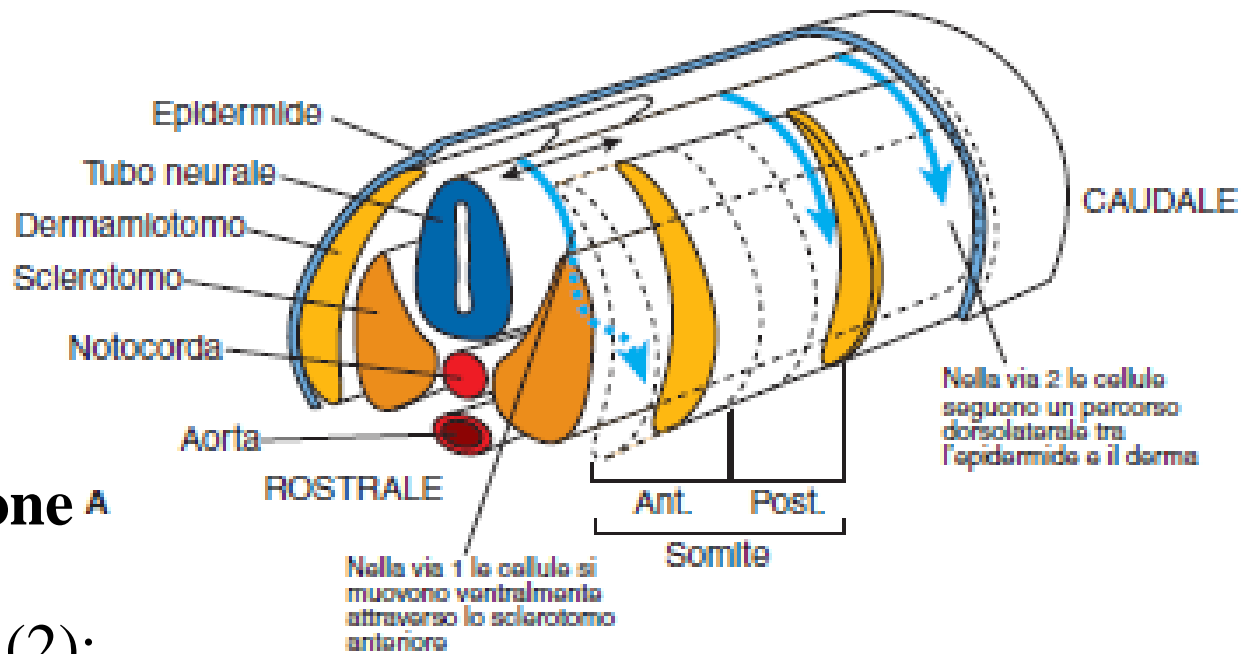


# Le vie di migrazione

DL: melanociti

LV: gli altri derivati





## Le vie di migrazione A

Via dorso-laterale (2):  
melanociti

Via latero-ventrale (1):  
gli altri derivati

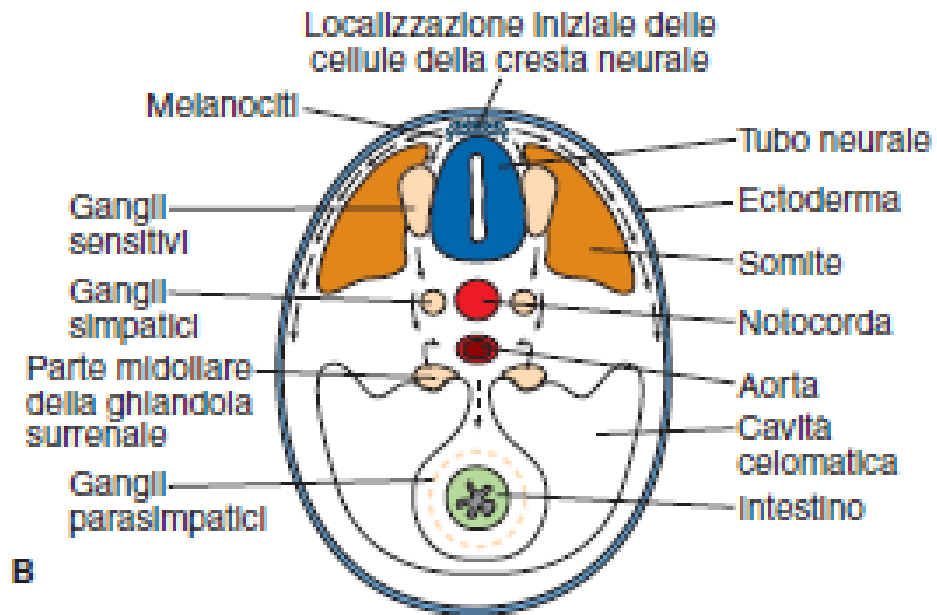


Figura 14