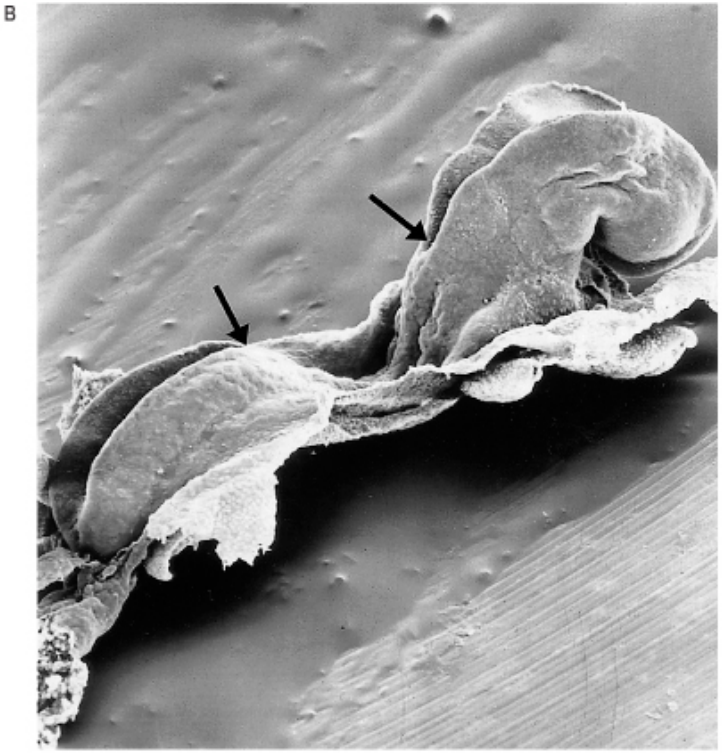
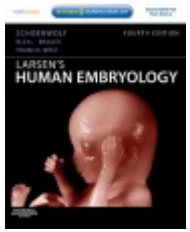
Early Development of the Ectoderm





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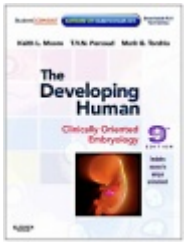


Dr Annemiek Beverdam – School of Medical Sciences, UNSW
Wallace Wurth Building Room 234 – A.Beverdam@unsw.edu.au

Lecture overview
Early Development of the Ectoderm

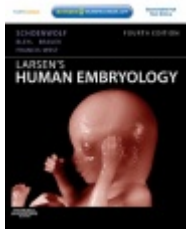
Gastrulation

Neurulation

Neural Crest

Epidermis Development

Ectodermal placodes



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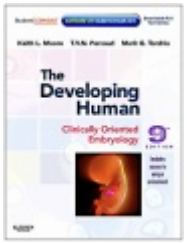

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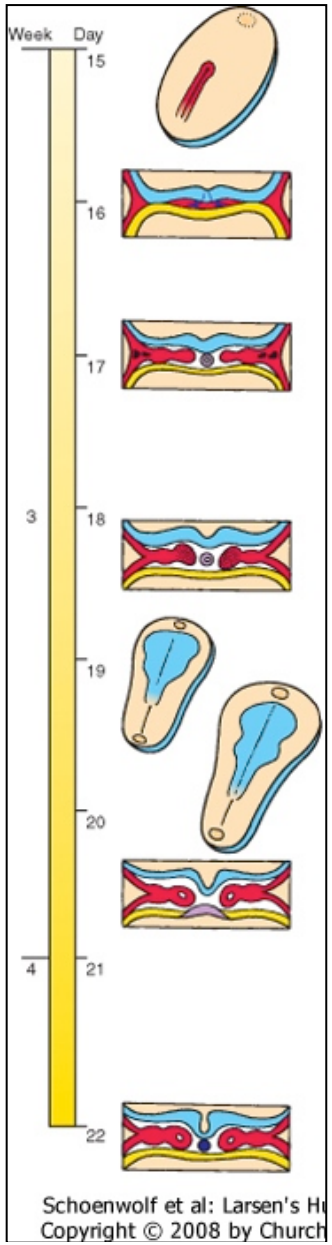
Week 3: Gastrulation

Epiblast forms 3 germ layers:
- Ectoderm: epithelium (previous epiblast)
- Mesoderm: mesenchymal layer (embryonic connective tissue)
- Endoderm: epithelium

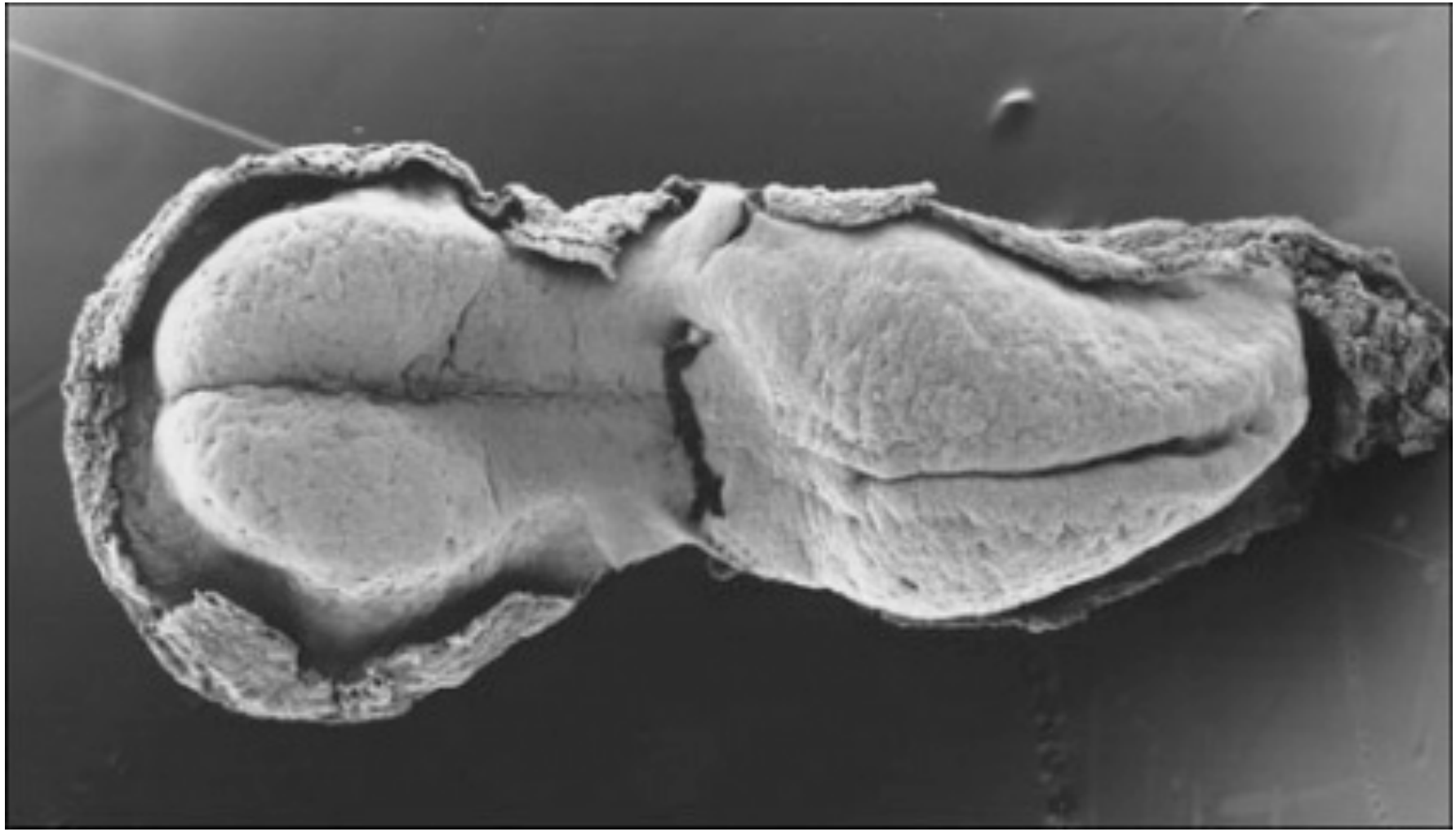
Hypoblast:
- replaced by definitive endoderm

3 body axes:
- Anteroposterior body axis
- Dorosventral body axis
- Left-Right body axis

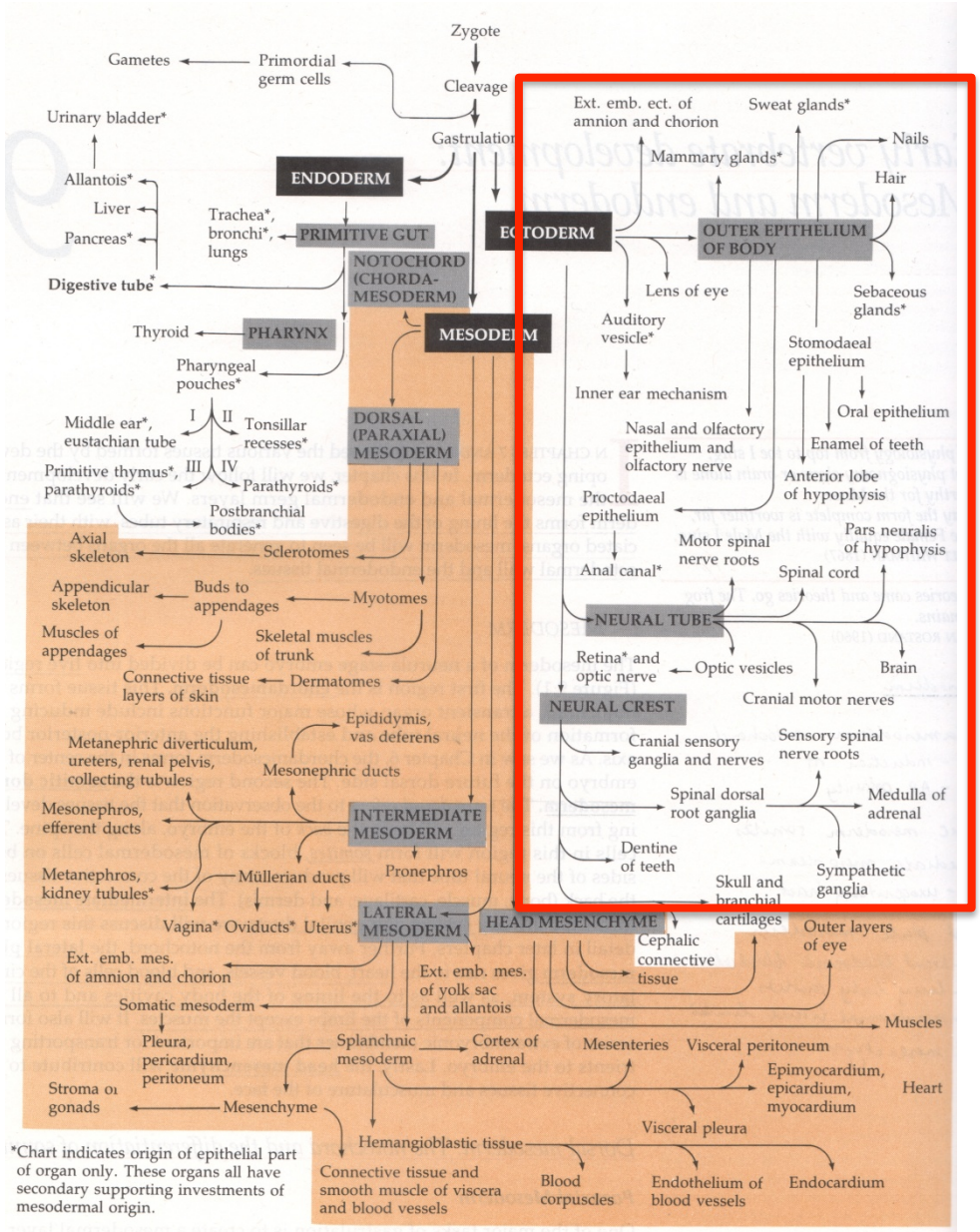
Week 3: gastrulation:



≈ 3 week old embryo



Embryonic development:



Page 342
S.F. Gilbert
Developmental Biology
5th edition

End product gastrulation:

Trilaminar embryo

Ectoderm *(Neural crest)*
brain, spinal cord, eyes, *peripheral nervous system*
epidermis of skin and associated structures,
melanocytes, cranial connective tissues (dermis)

Mesoderm
musculo-skeletal system, limbs,
connective tissue of skin and organs,
urogenital system, heart, blood cells

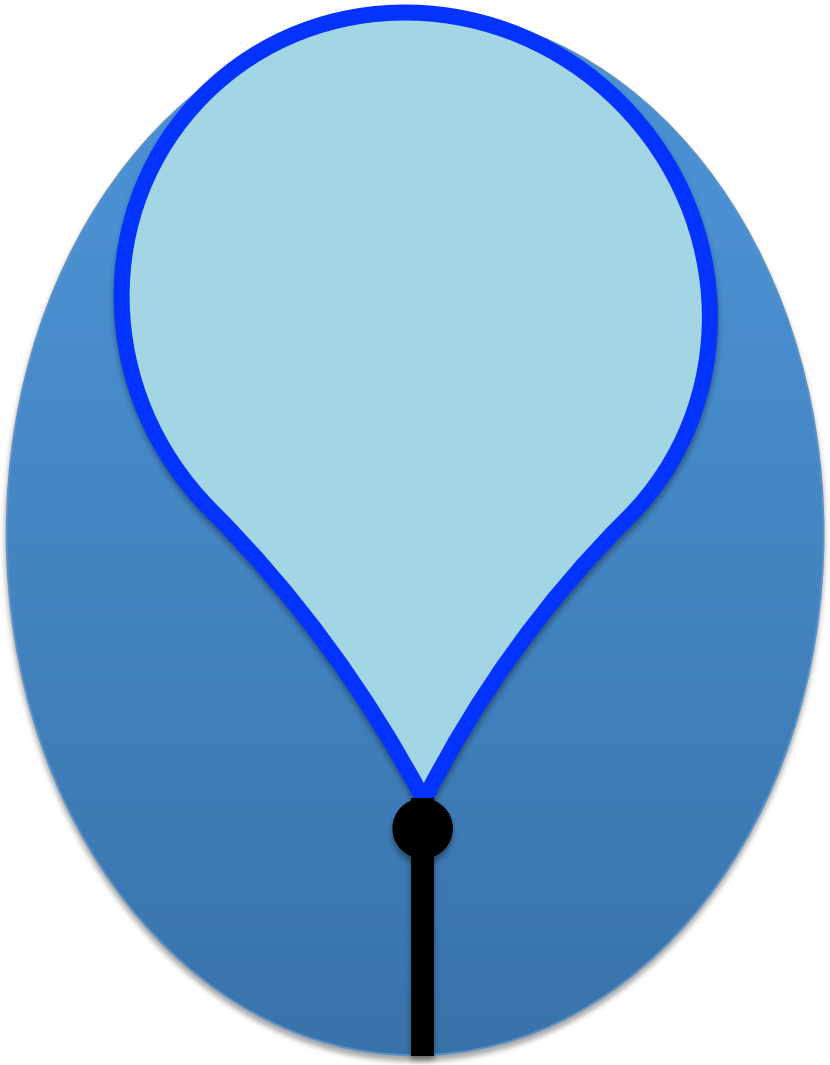
Endoderm
epithelial linings of gastrointestinal, liver, pancreas,
thyroid and respiratory tracts

Ectoderm

Midplate ectoderm: nervous system and neural crest

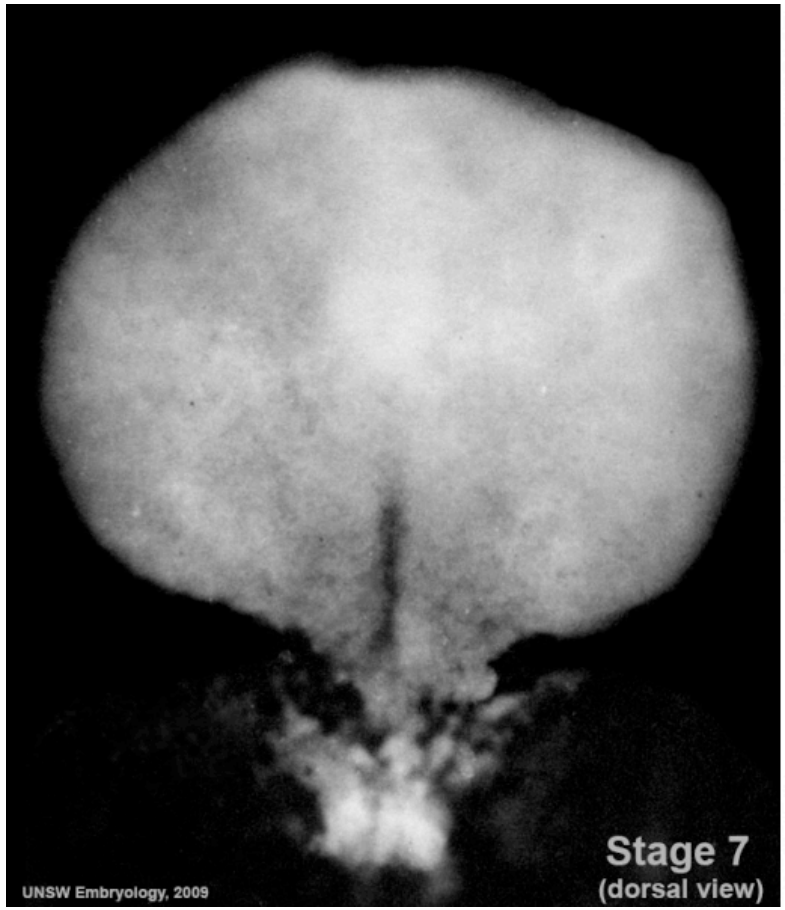
Lateral ectoderm: surface epidermis

Ectodermal placodes



Ectoderm

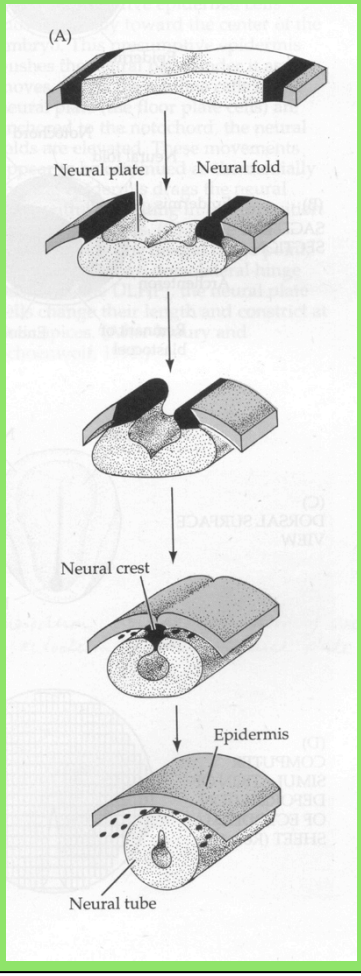
Midplate ectoderm: nervous system and neural crest
Lateral ectoderm: surface epidermis
Ectodermal placodes



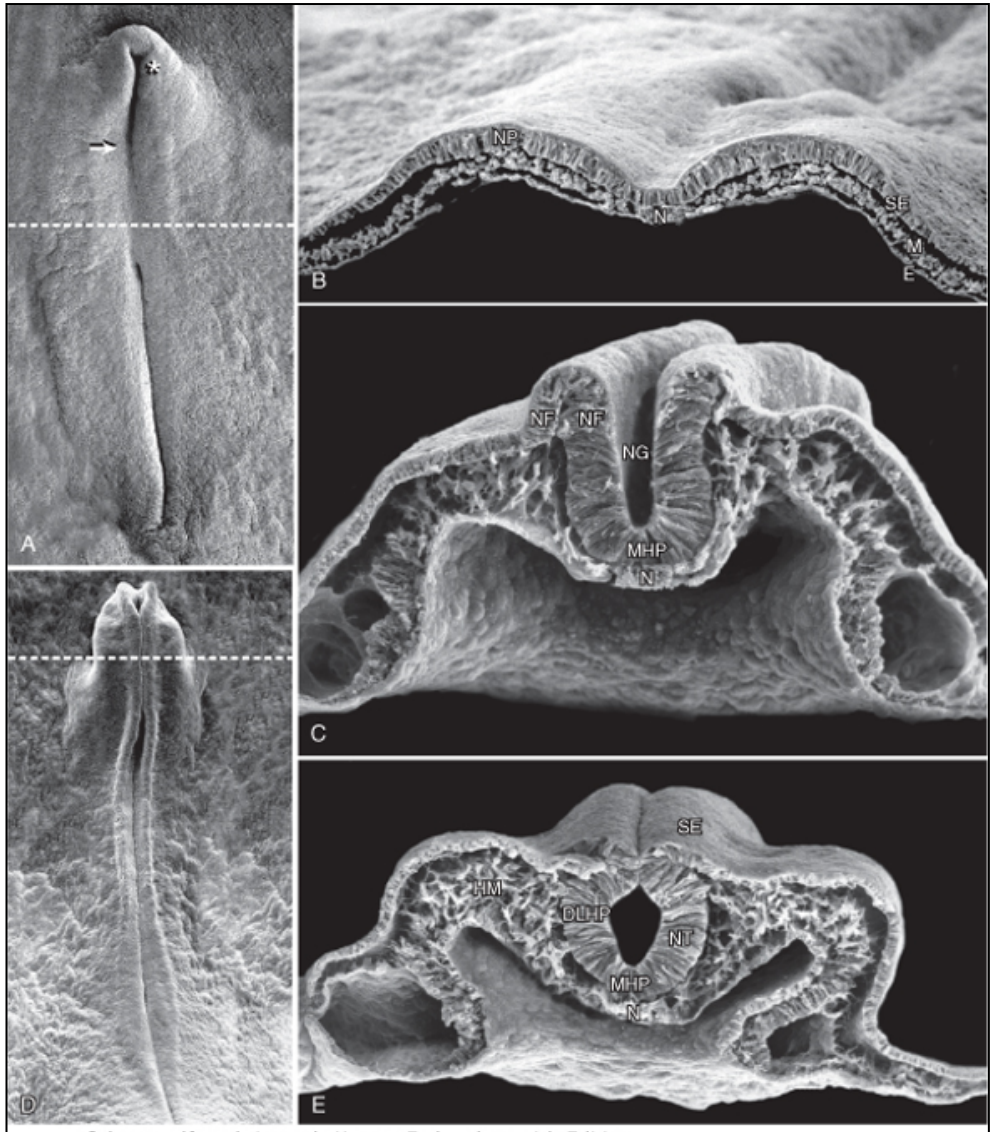
Neurulation

Midplate ectoderm

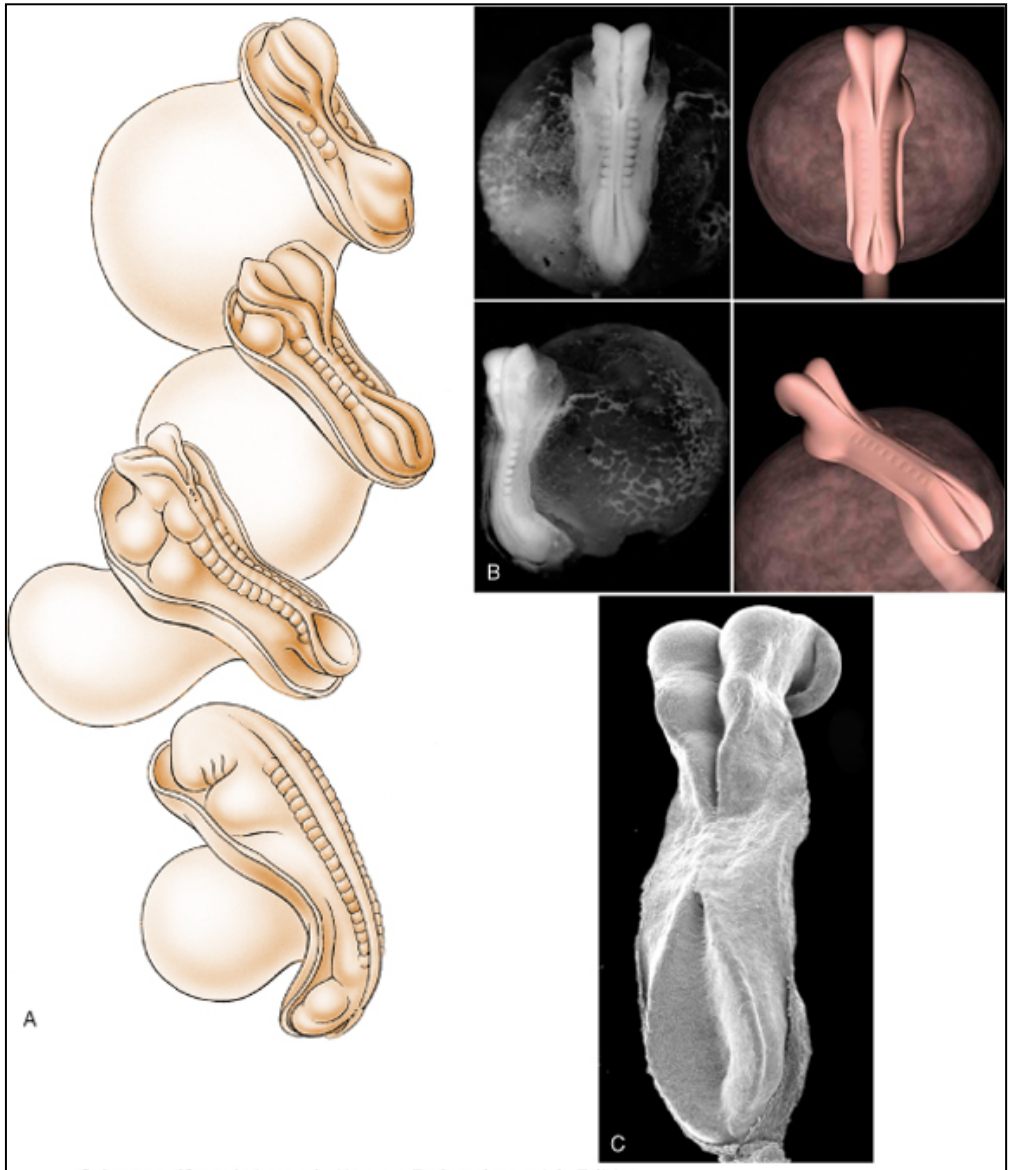
Transverse section



Neurulation



Neurulation

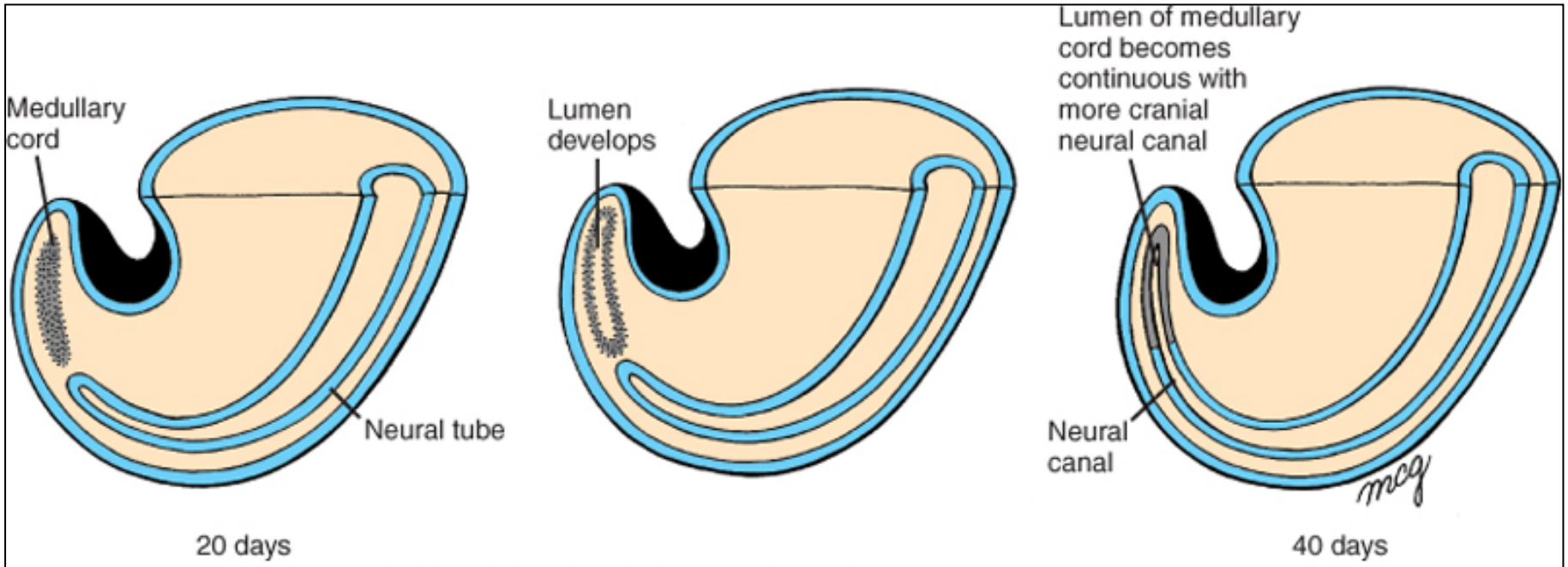


Schoenwolf et al: Larsen's Human Embryology, 4th Edition.

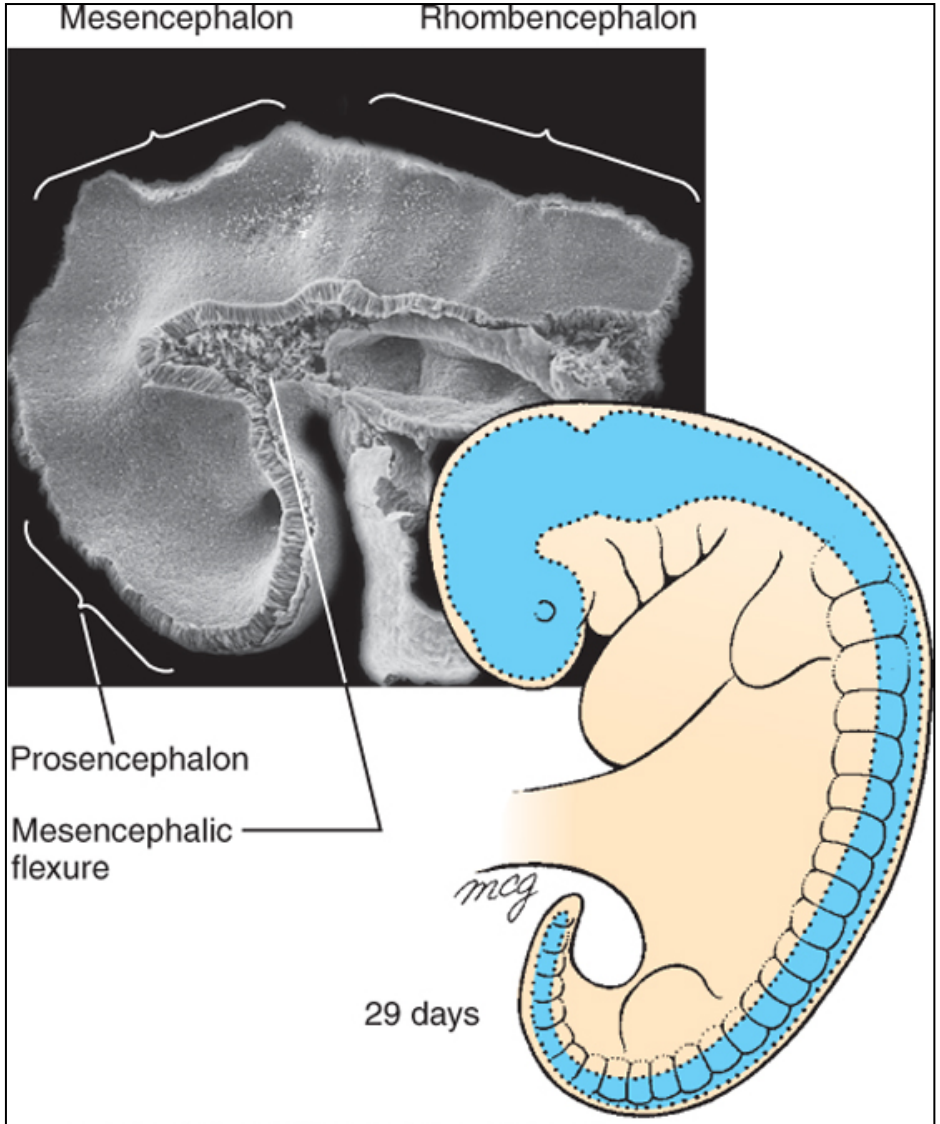
Neurulation

Neurulation

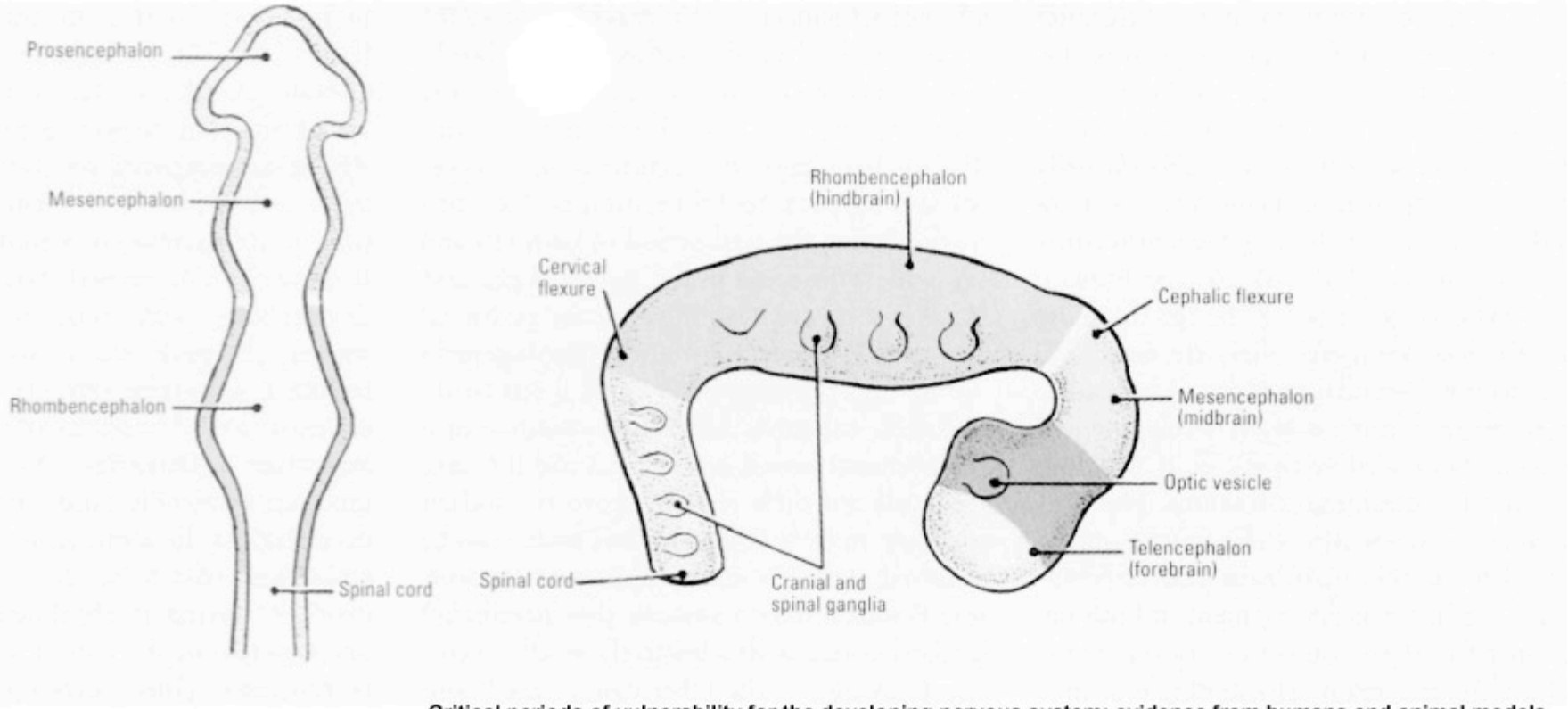
Secondary neurulation



Neurulation

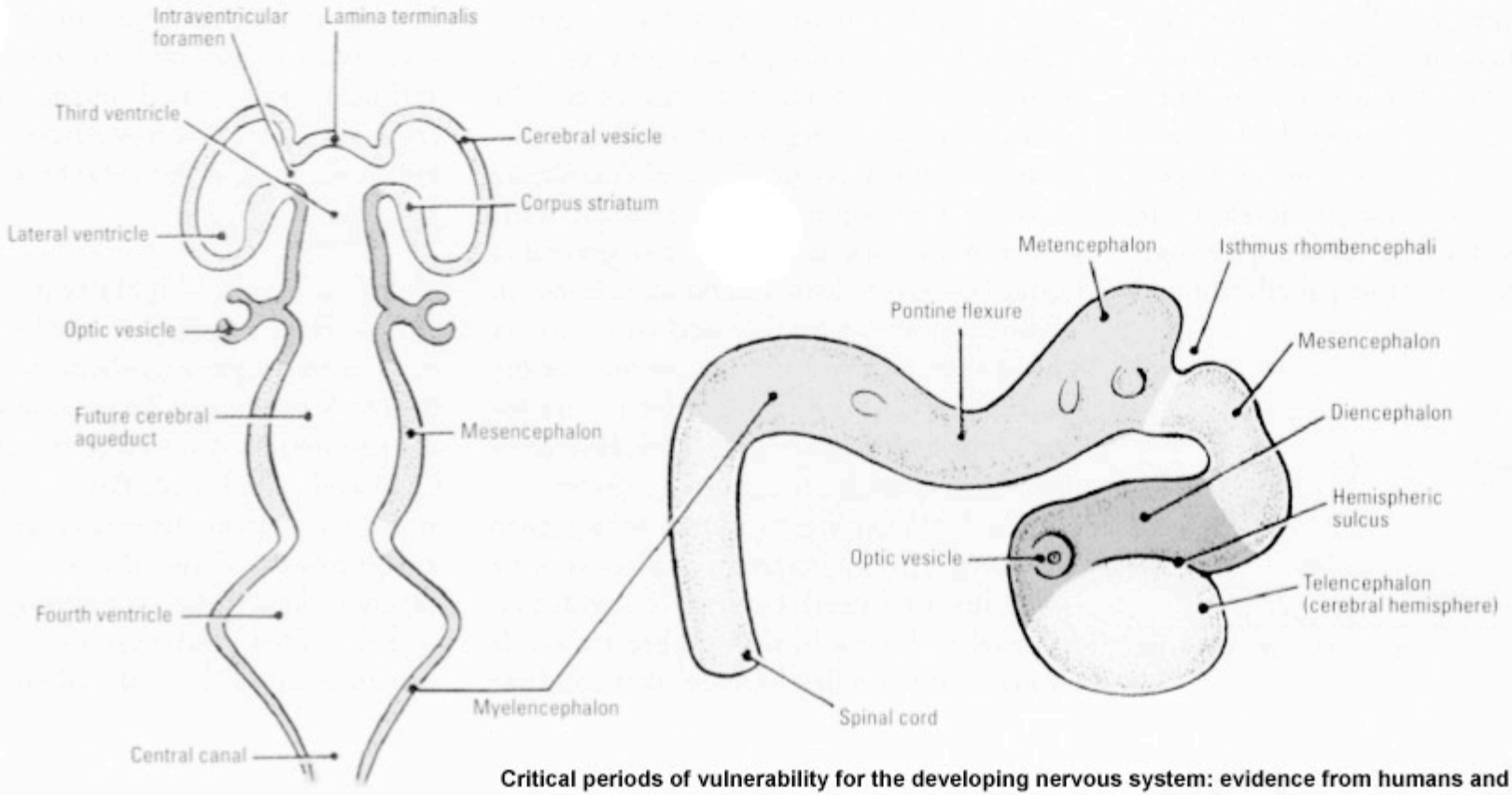


Neurulation



Critical periods of vulnerability for the developing nervous system: evidence from humans and animal models.
Rice D, Barone S Jr. Environ Health Perspect. 2000 Jun;108 Suppl 3:511-33. Review. PMID: 10852851

Neurulation



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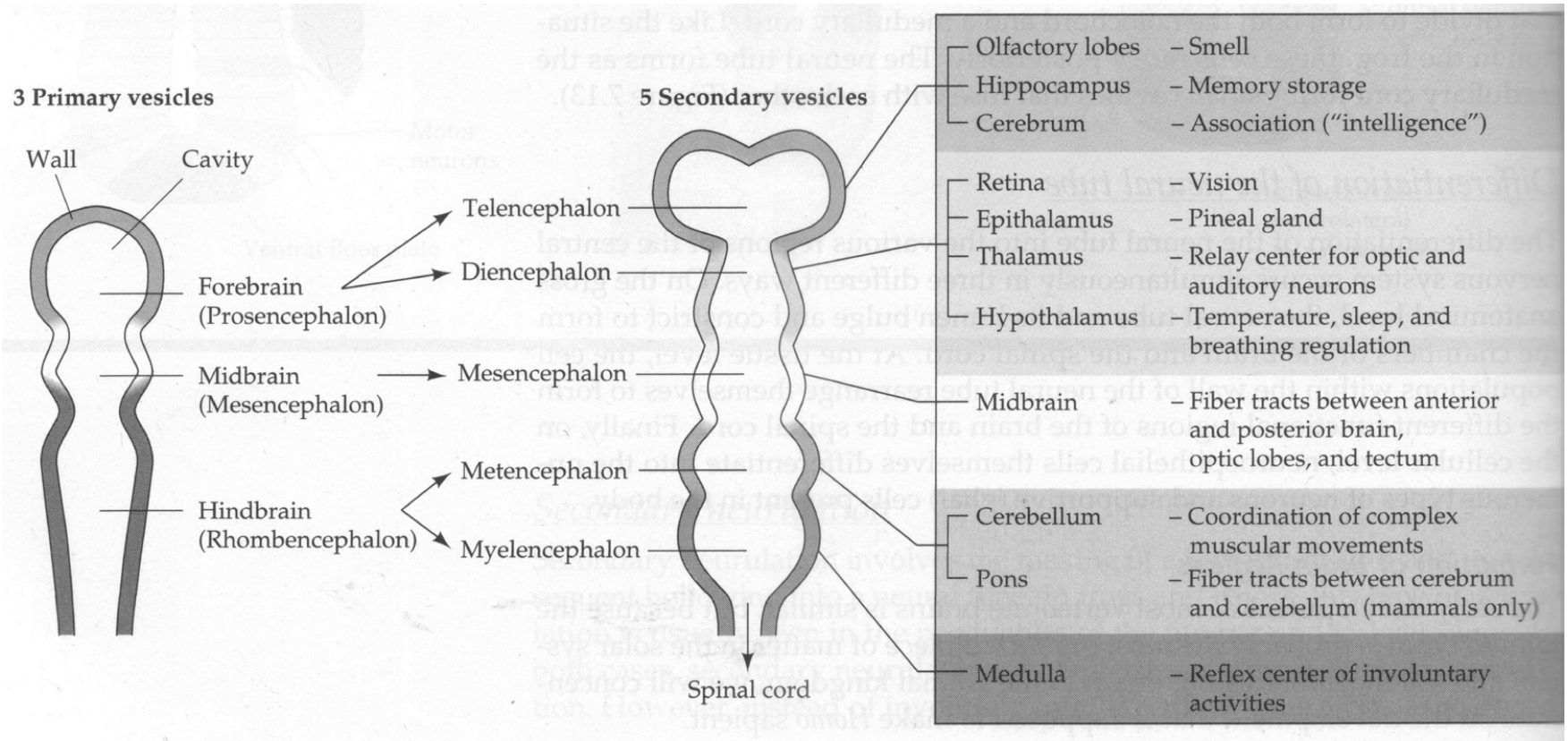
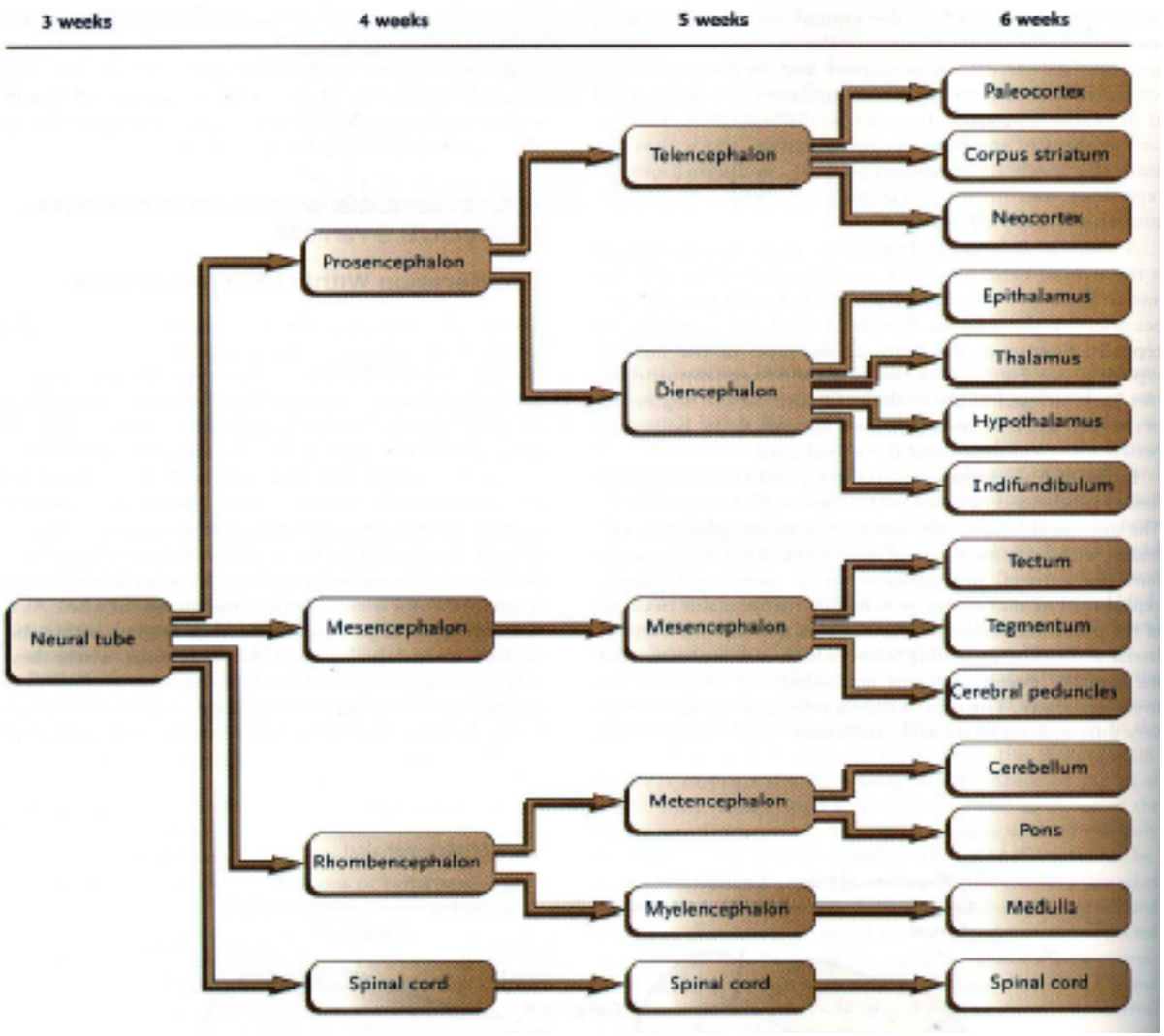
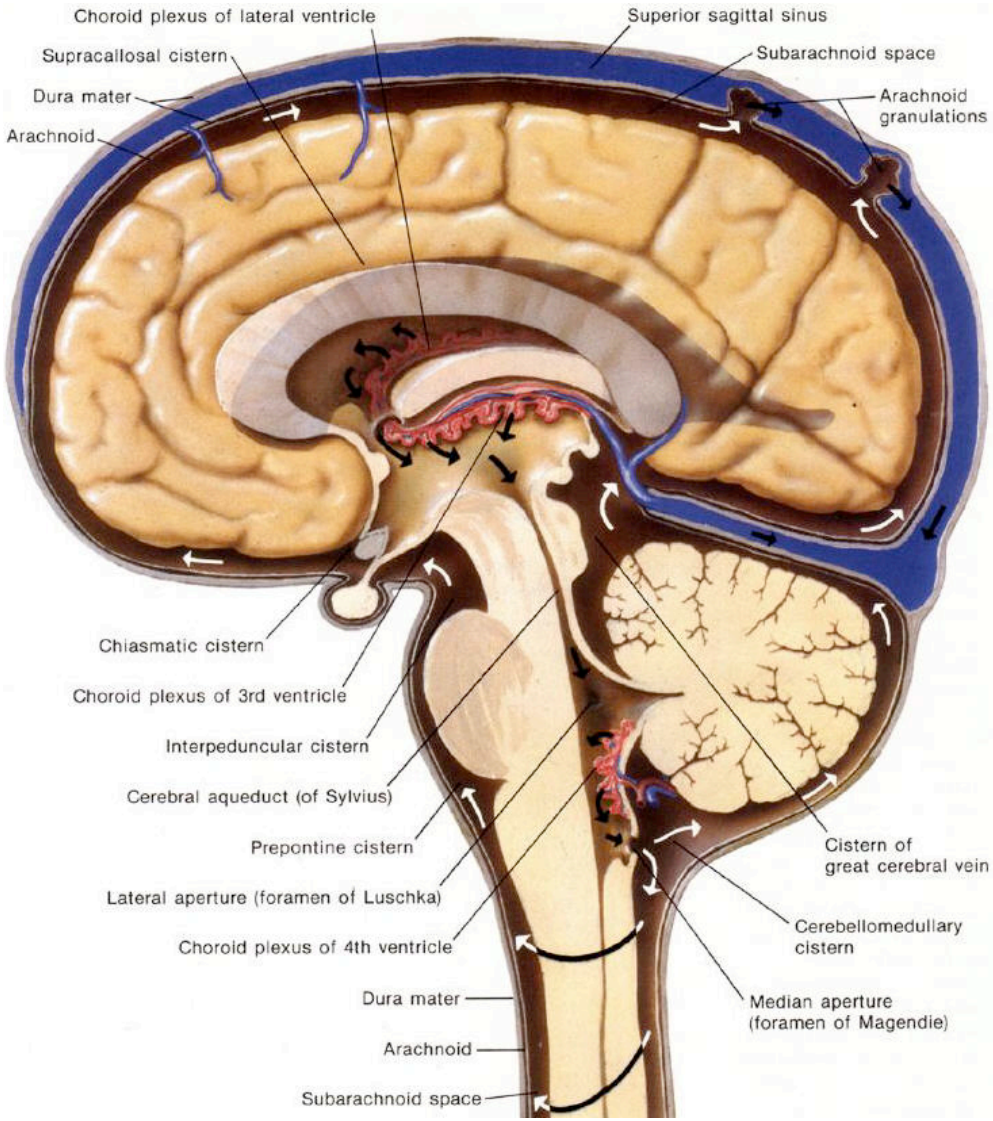


Neurulation



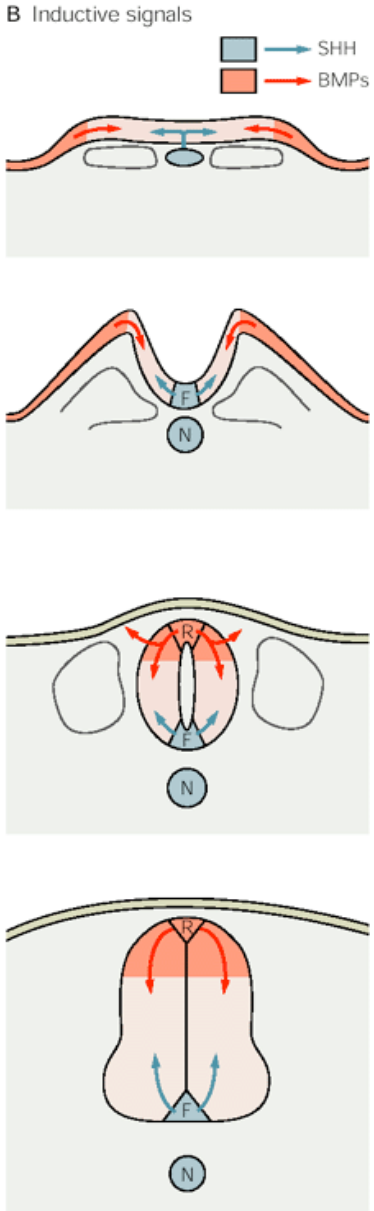
Neurulation

Cerebrospinal Fluid



Spinal Cord Axes

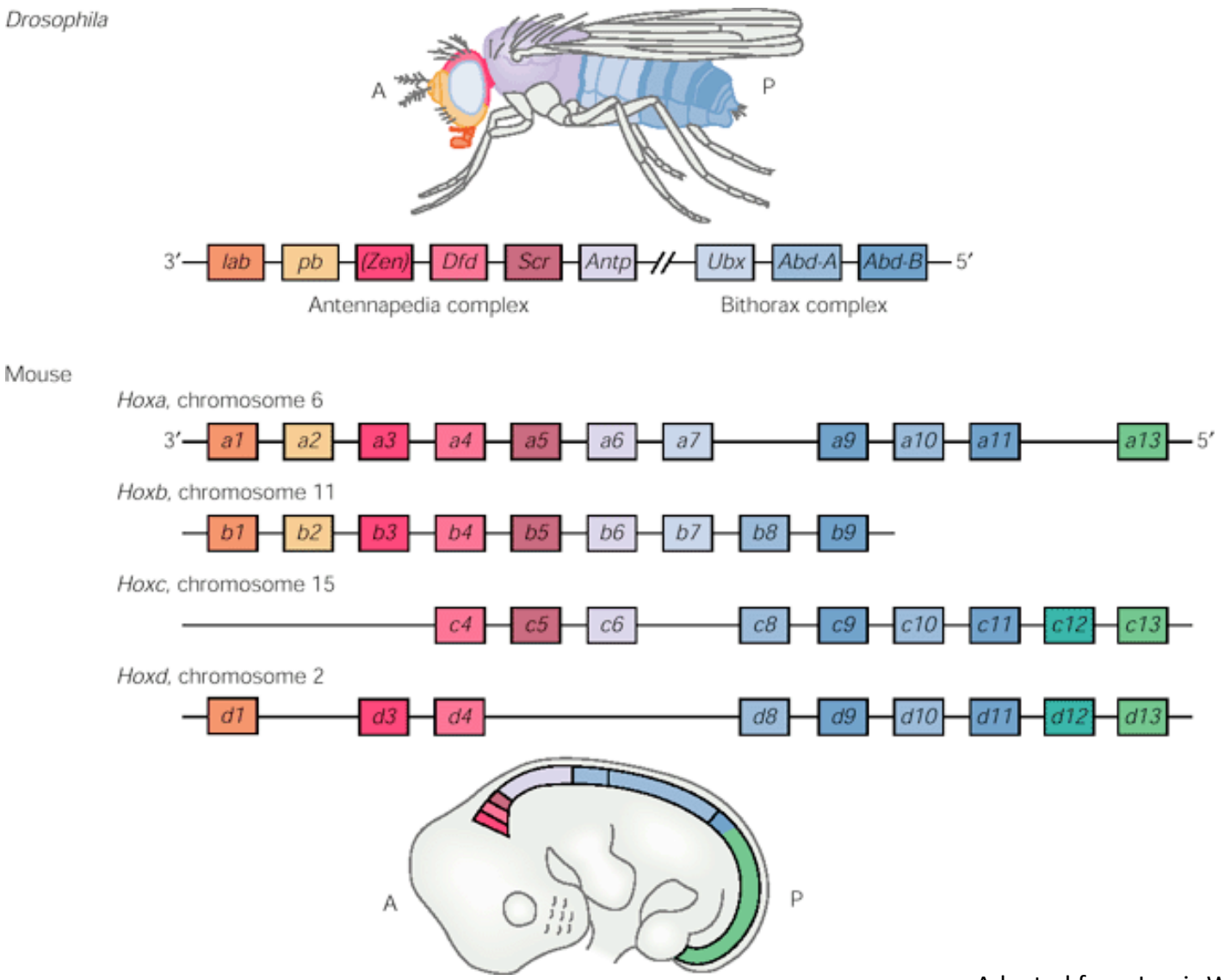
Dorsoventral axis



Modified from Tanabe and Jessell et al., 1996

Spinal Cord Axes

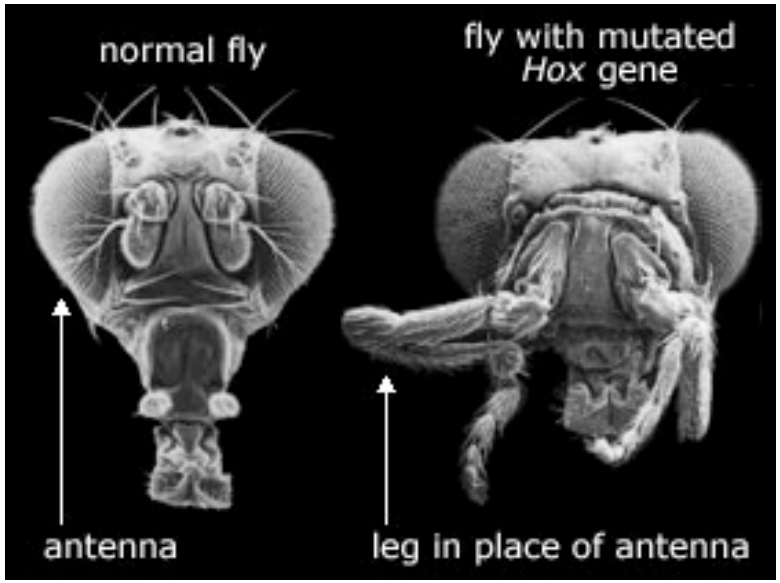
Anteroposterior axis

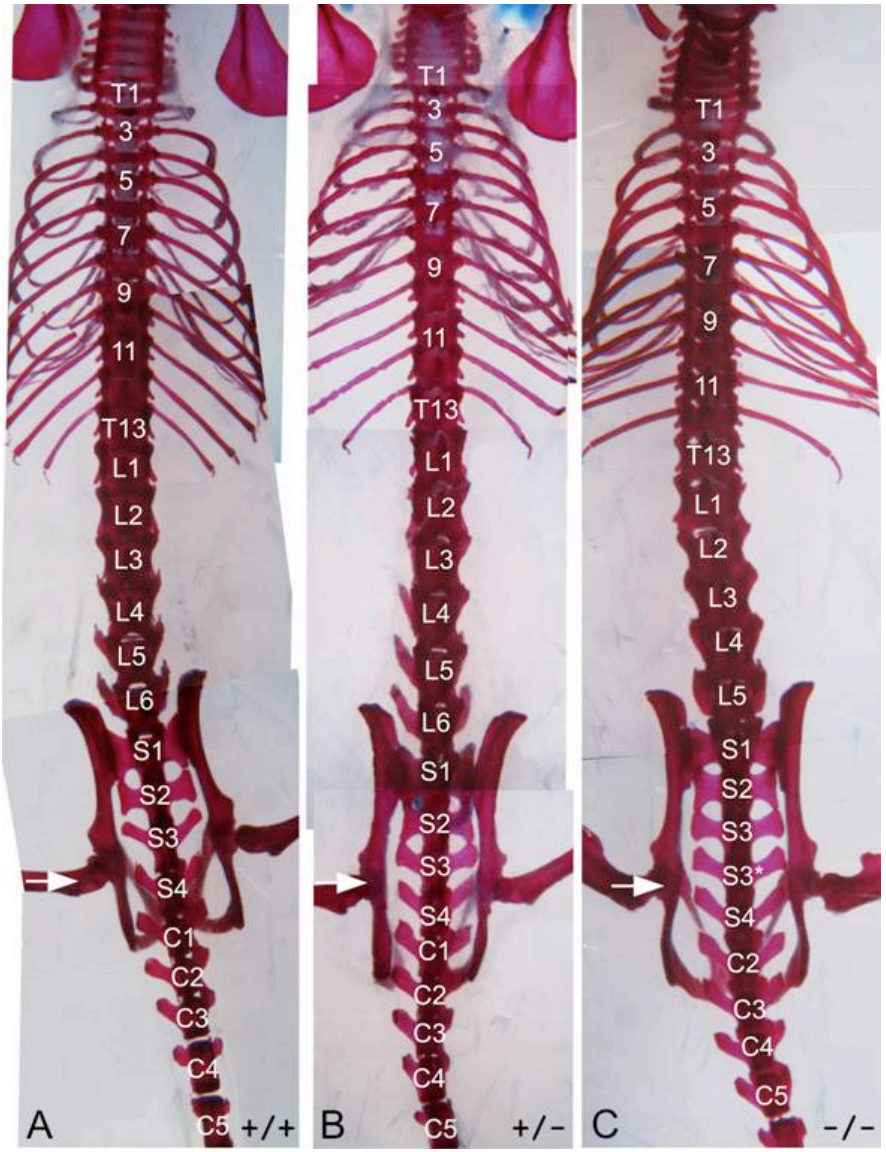


Adapted from Lewis Wolpert et al., 1998

Spinal Cord Axes

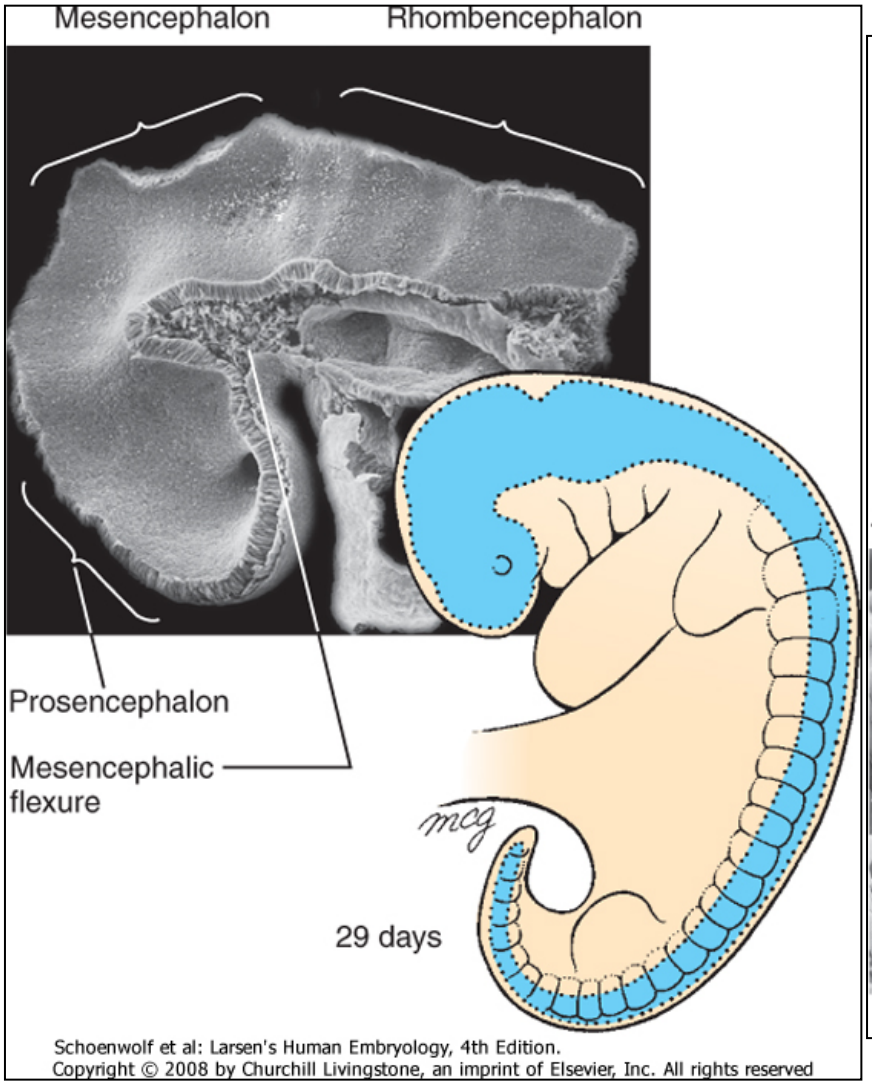
Anteroposterior axis





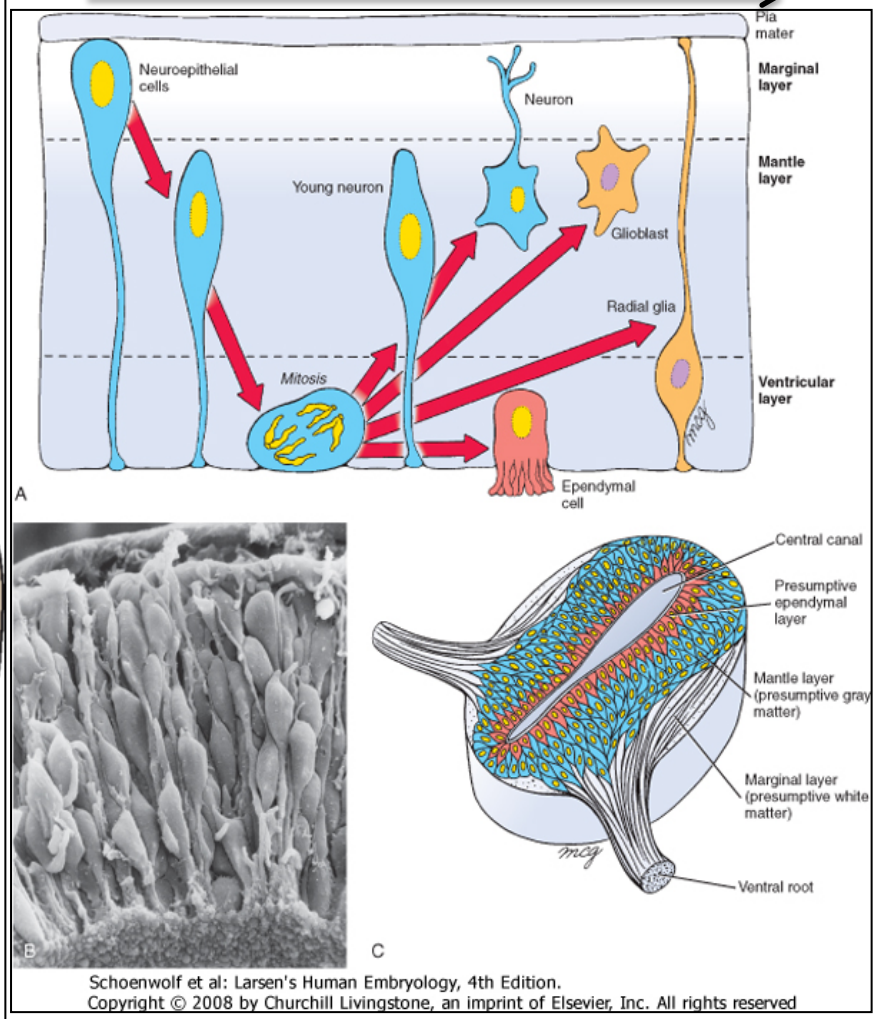
Hostikka et al., 2009

Cytodifferentation of the Neural Tube



Schoenwolf et al: Larsen's Human Embryology, 4th Edition.

Time



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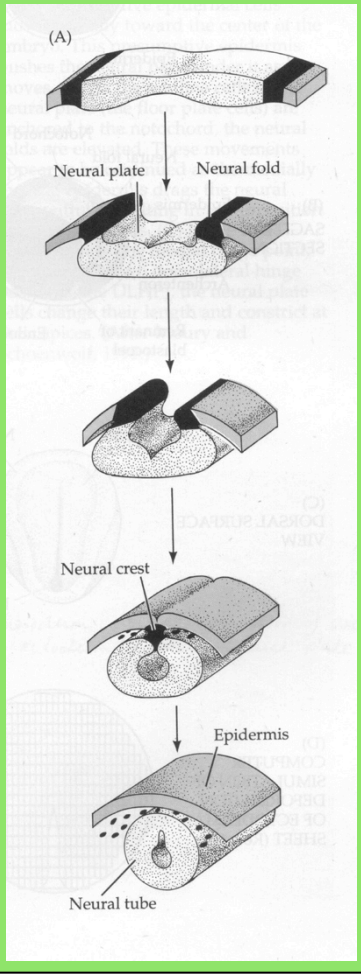
Neural Crest Development

Transverse section



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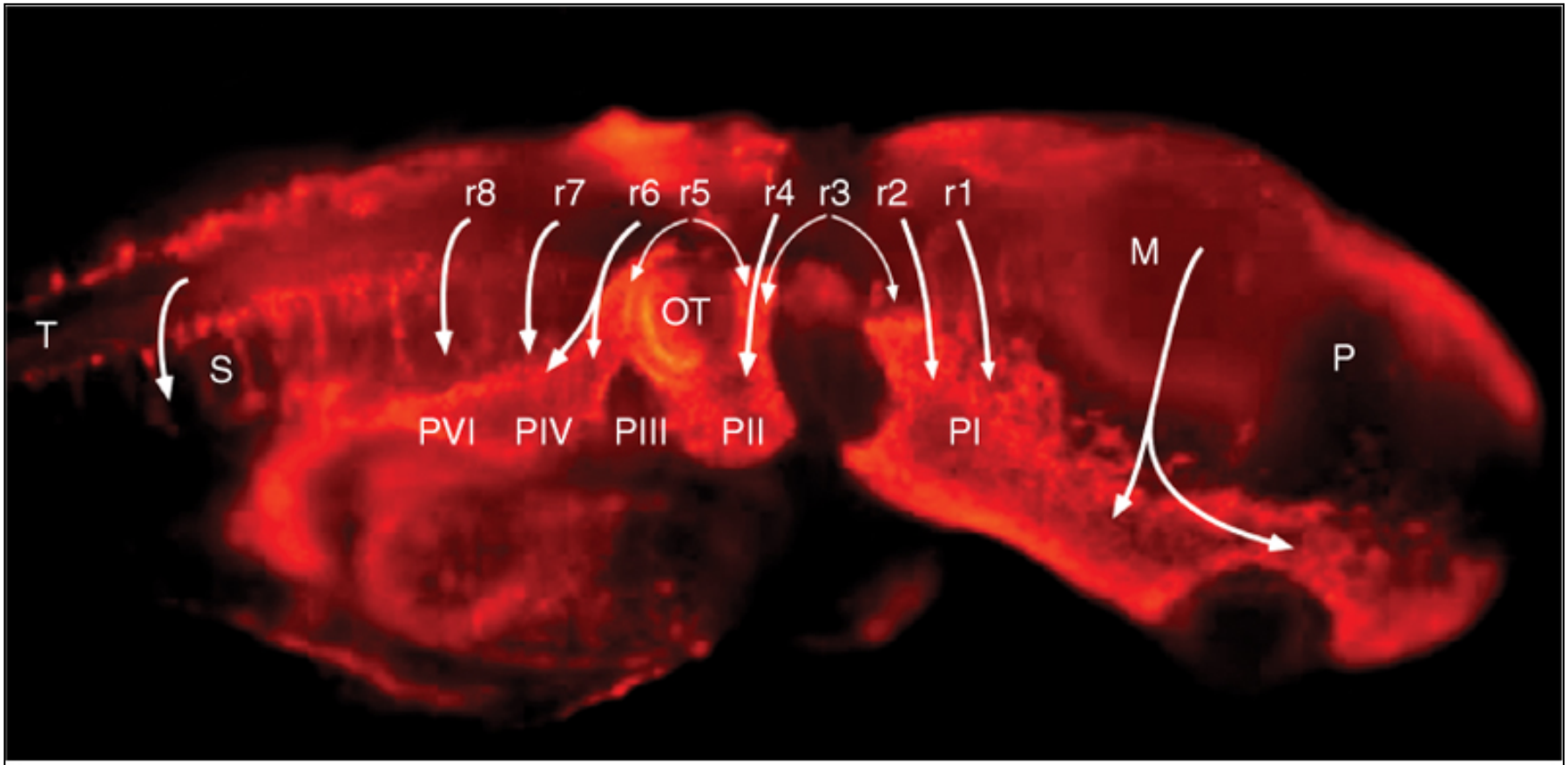

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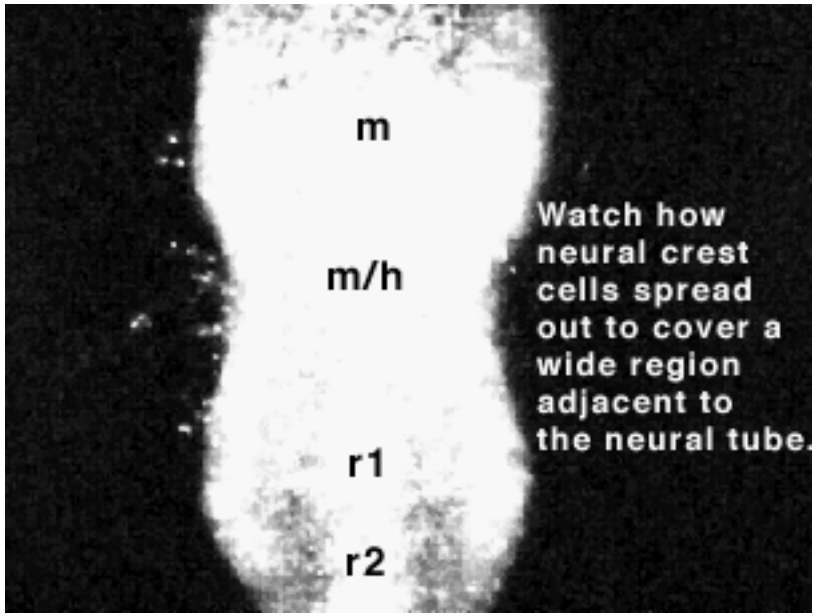

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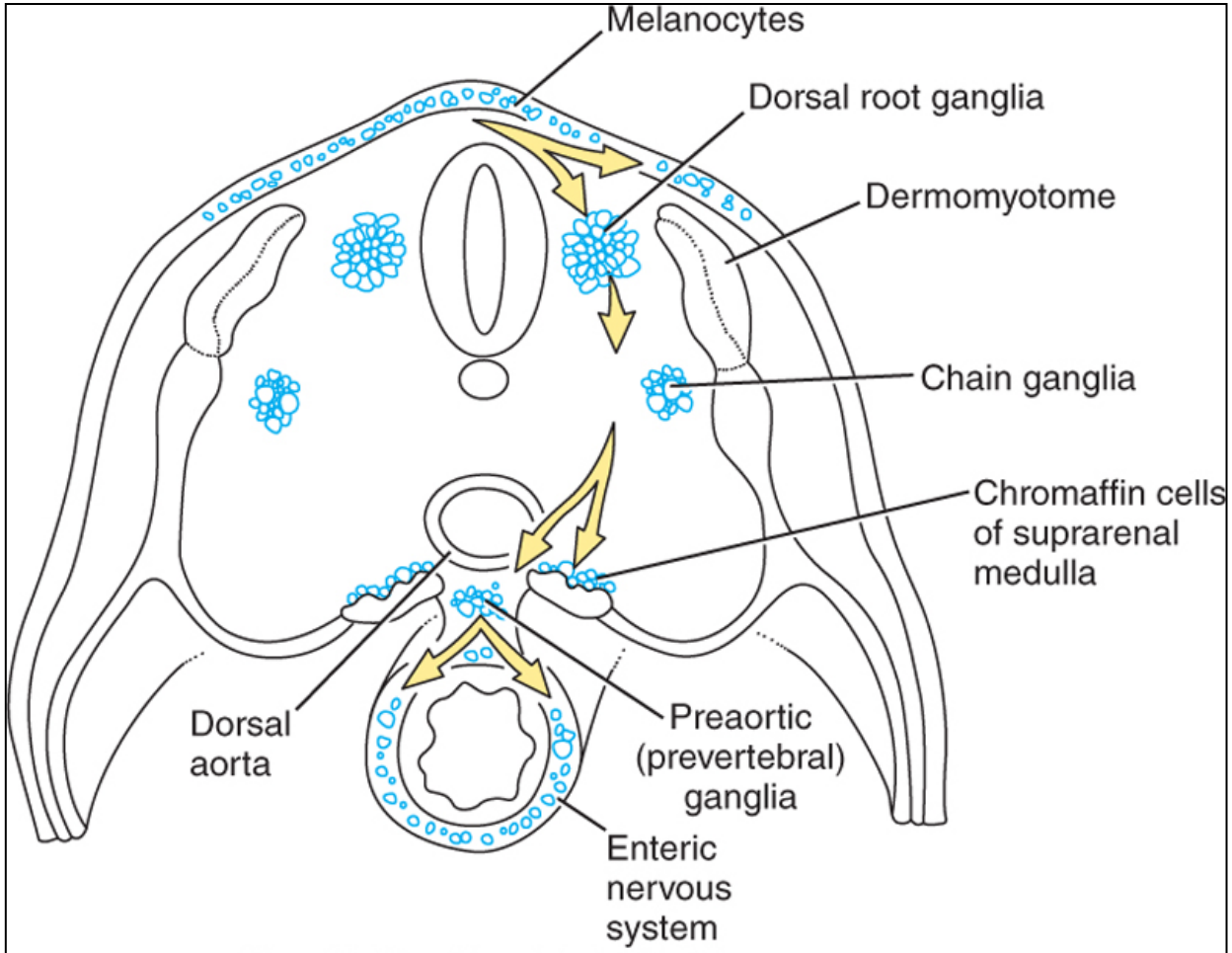


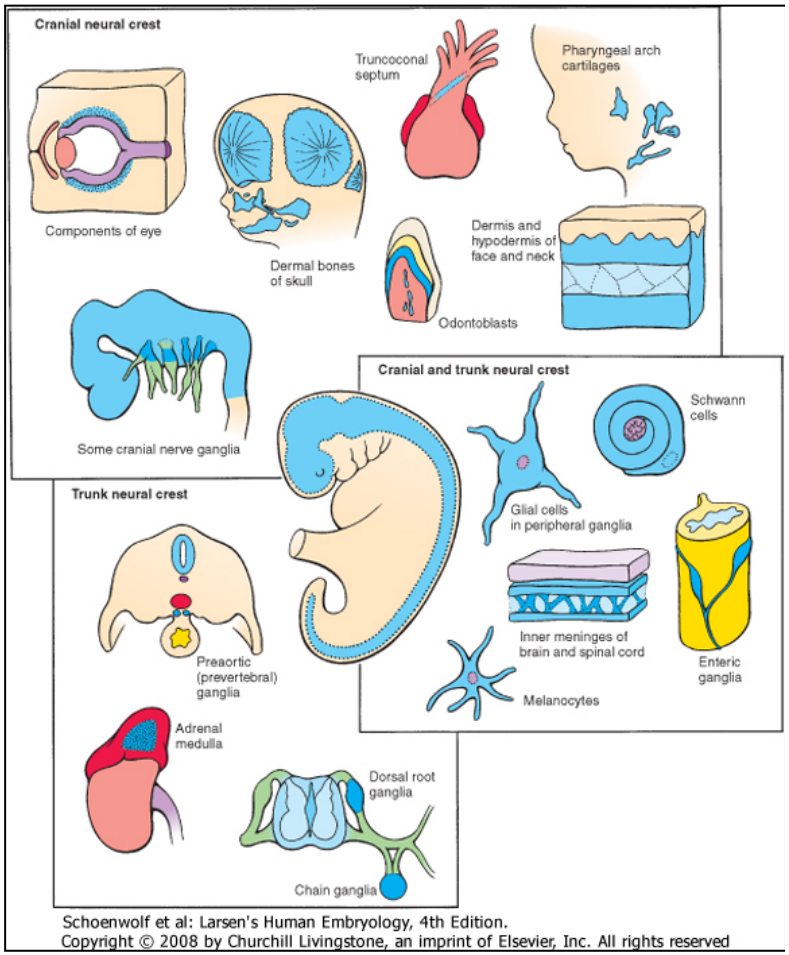
Neural Crest Development
4 functional domains and lineages

Cranial neural crest:
Cranial mesenchyme, facial skeleton,
cranial nerve ganglia

Cardiac neural crest:
Melanocytes, cartilage, connective tissue
and neurons of some pharyngeal arches,
Contributes to formation of regions of the heart

Trunk neural crest:
Melanocytes, dorsal root ganglia, sympathetic ganglia,
adrenal medulla,
nerves surrounding aorta

Vagal and Sacral neural crest:
Melanocytes, ganglia of the enteric nervous system
Parasympathetic ganglia



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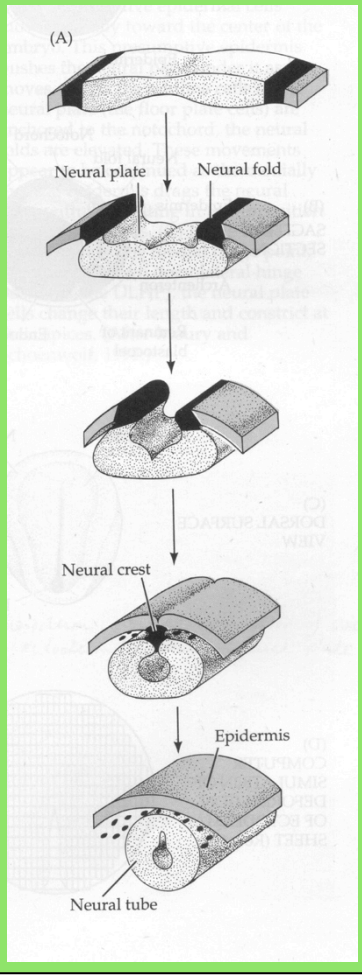
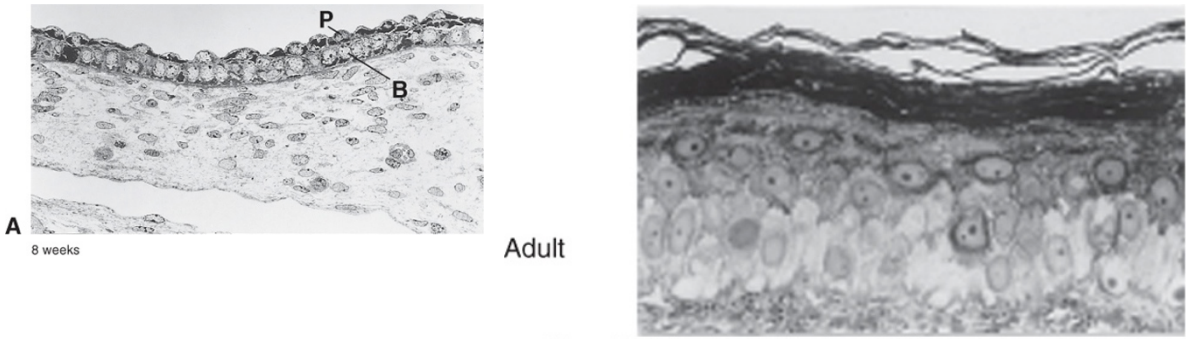
Epidermal development
Lateral surface ectoderm

Transverse section



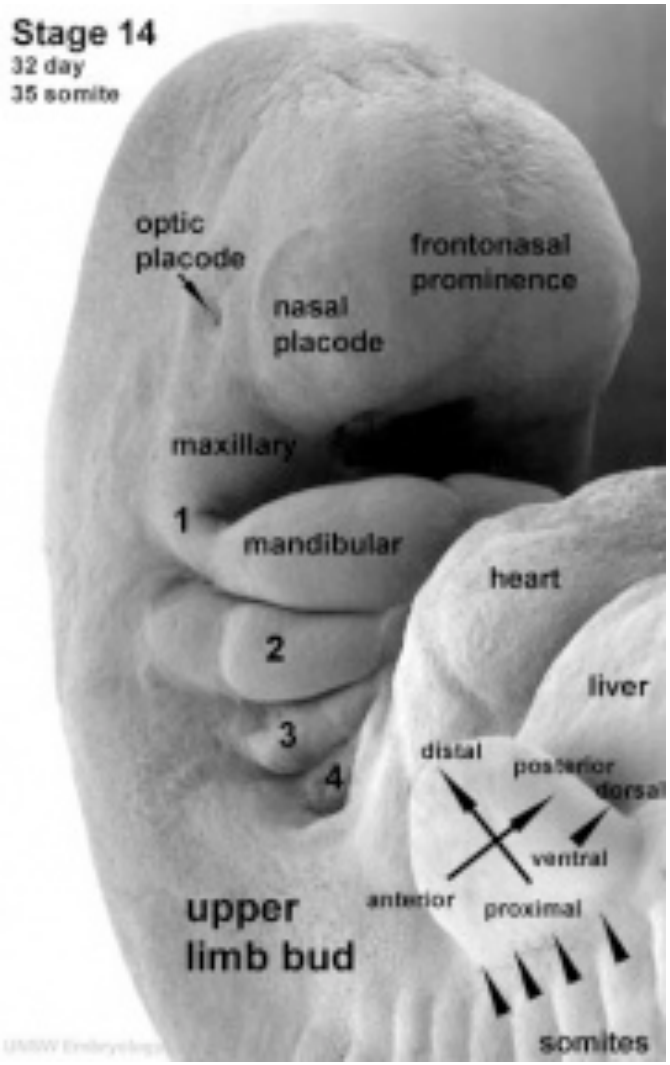


Interfollicular epidermis (surface epithelium)

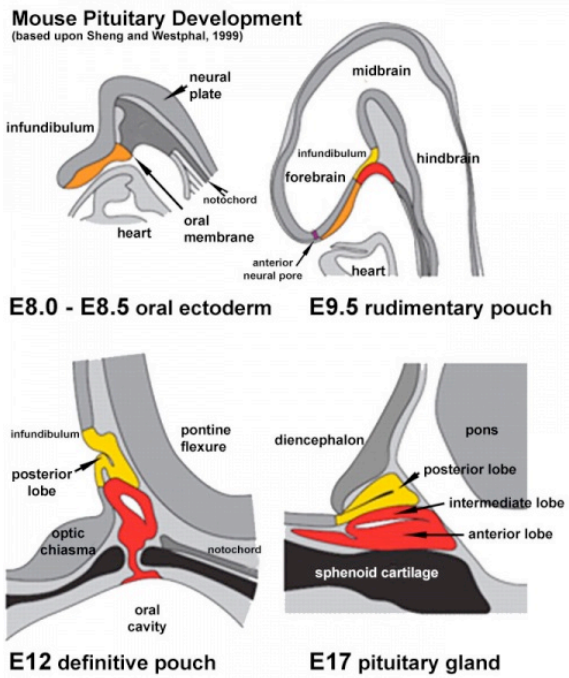
Epidermal Appendages:

- Hair follicles
- Glands (sebaceous, sweat, apocrine)
- Mammary glands
- Nails
- Teeth

Ectodermal placodes



Otic placodes
Olfactory (Nasal) placodes
Optic (Lens) placodes
Adenohypophyseal placode
Profundal/trigeminal placodes



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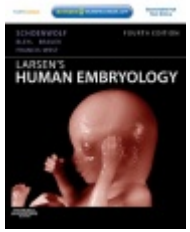

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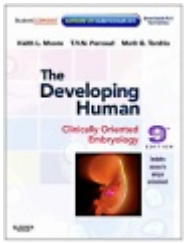

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