Chick Development

Talk 2

Ectoderm

Surface ectoderm (epidermis)

Ectoderm

Neural crest

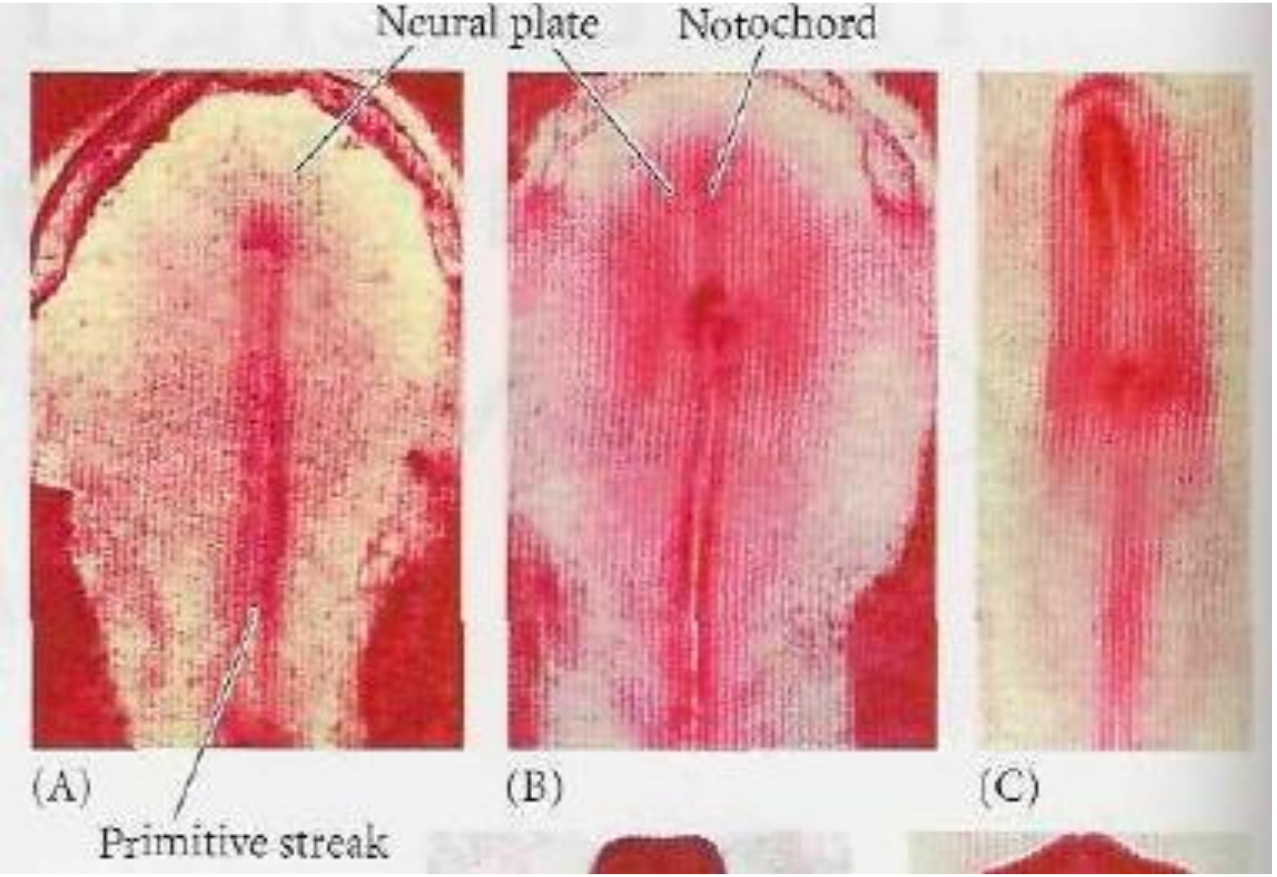
Neural tube

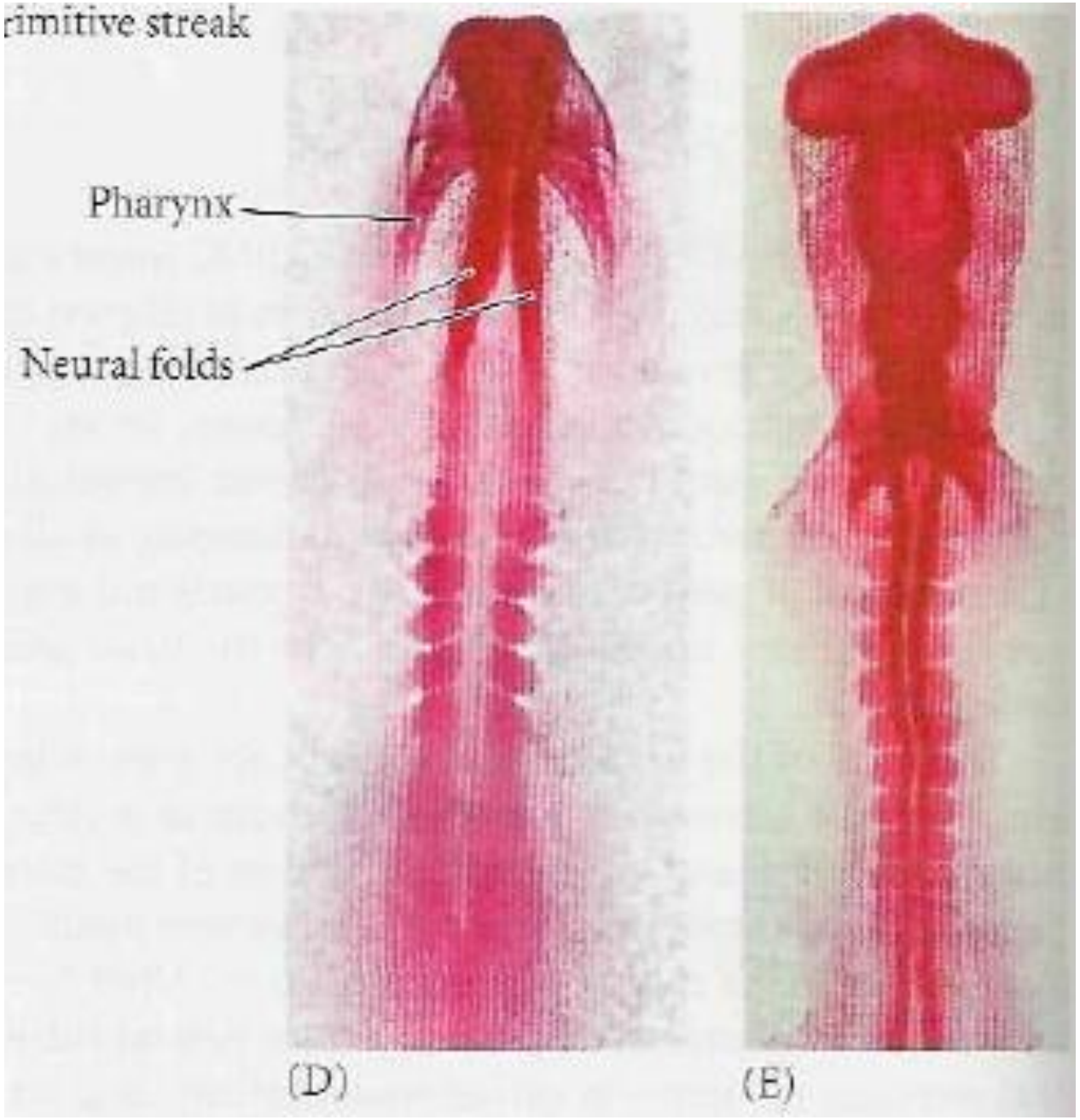
- Epidermis
- Hair
- Nails
- Sebaceous glands
- Olfactory epithelium
- Mouth epithelium
  - Anterior pituitary
  - Tooth enamel
  - Cheek epithelium
- Lens, cornea

- Brain
- Neural pituitary
- Spinal cord
- Motor neurons
- Retina

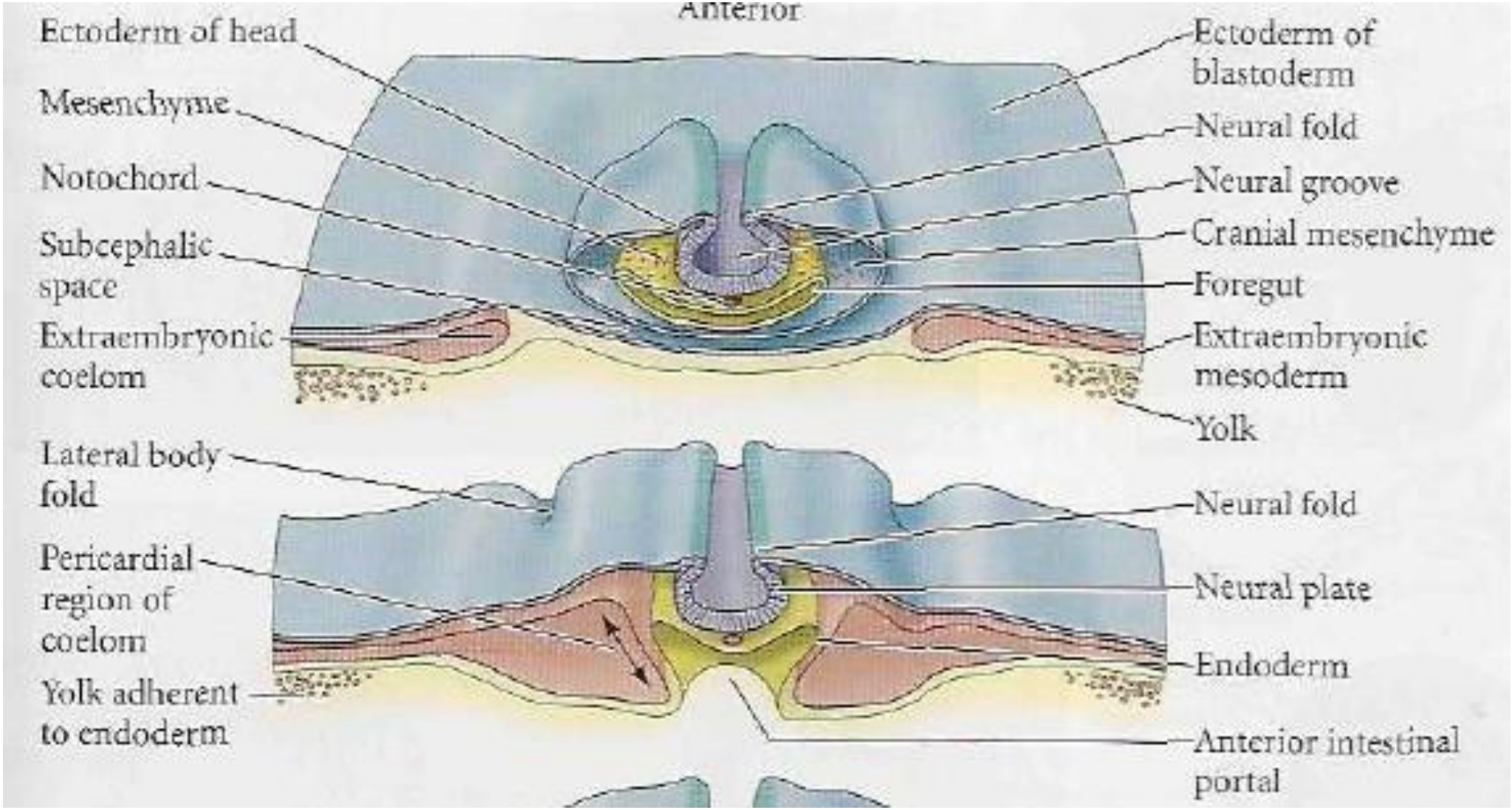
- Peripheral nervous system
  - Schwann cells
  - Neuroglial cells
  - Sympathetic nervous system
  - Parasympathetic nervous system
- Adrenal medulla
- Melanocytes
- Facial cartilage
- Dentine of teeth

Gastrulation

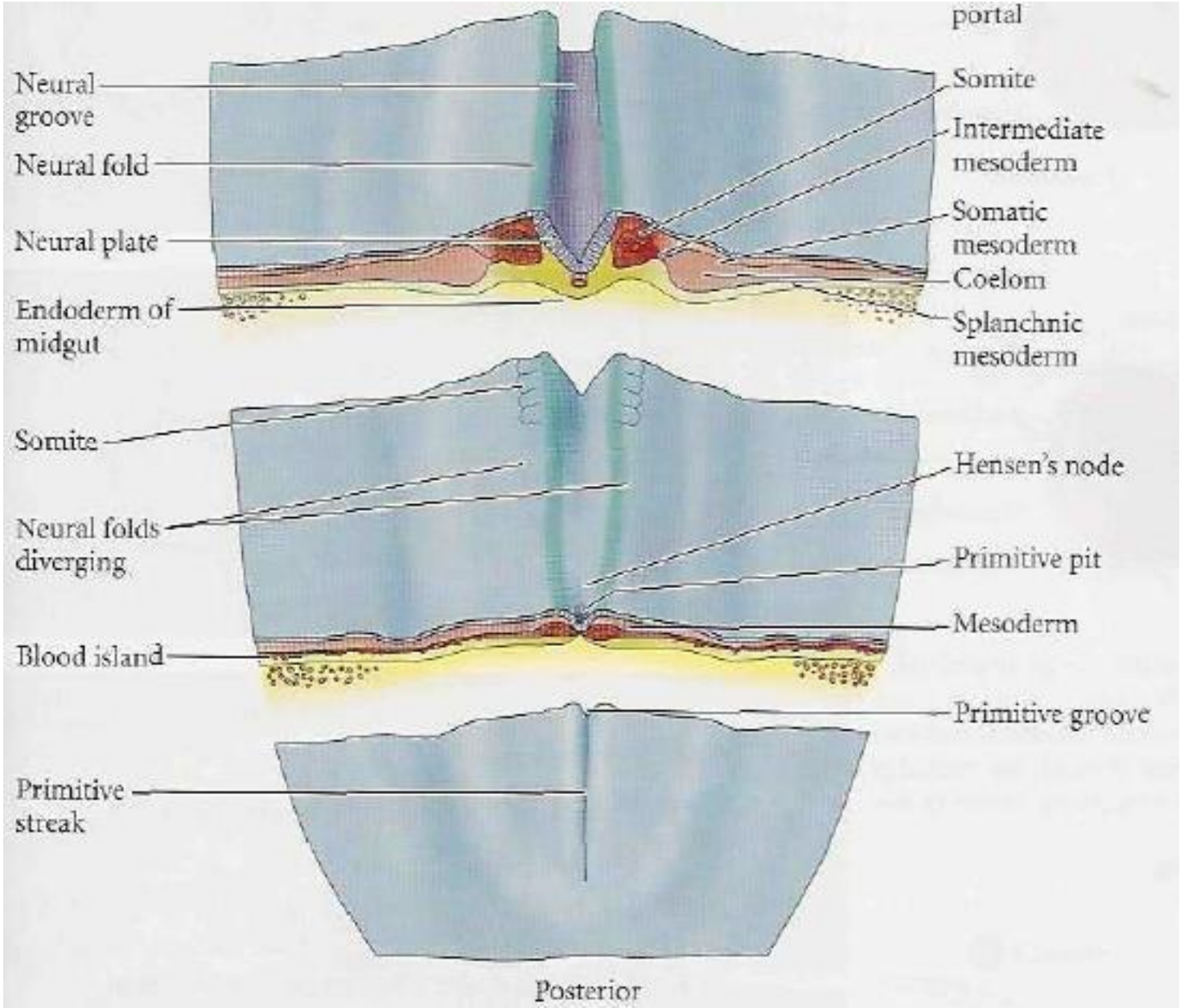




Neurulation 1

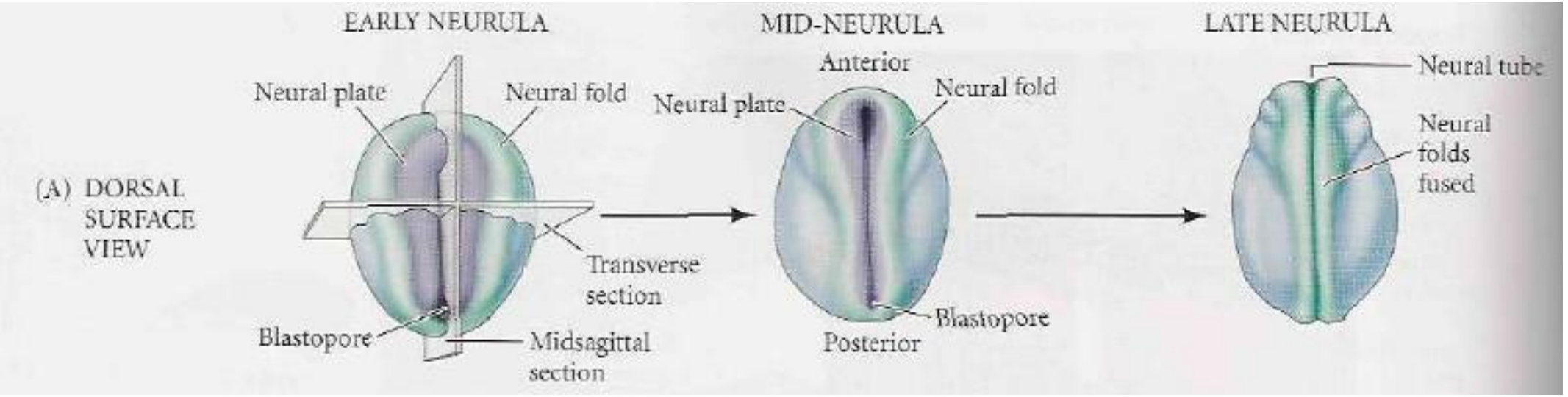


Neurulation 2



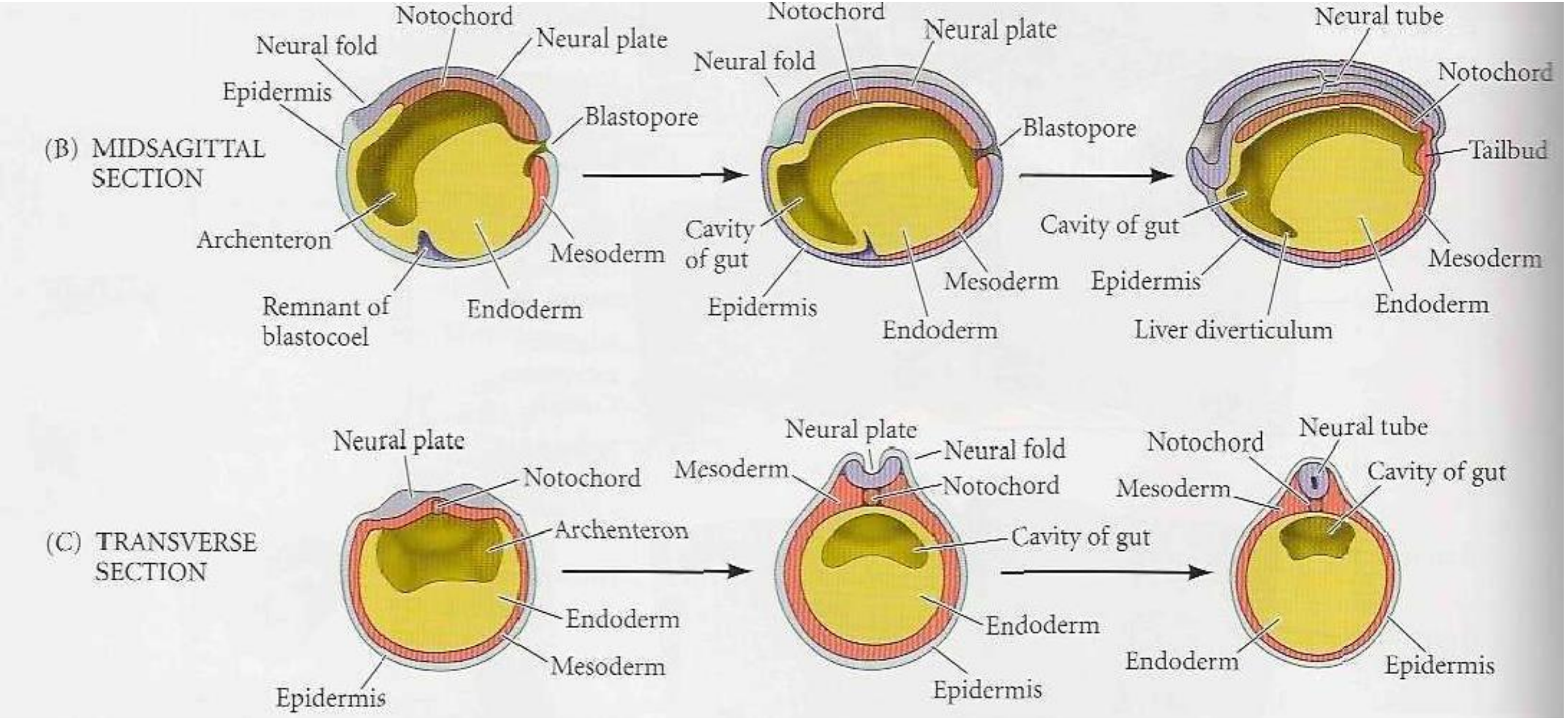
Primary neurulation 1

- (1) the internally positioned neural tube, which will form the brain and spinal cord;
- (2) the externally positioned epidermis of the skin; and
- (3) the neural crest cells



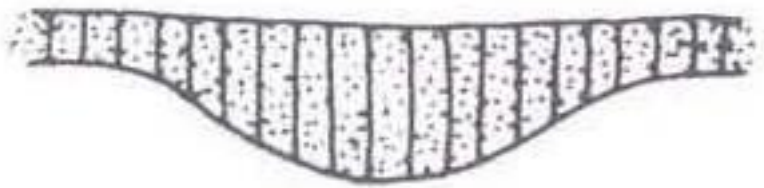
The images are from frog but are consistent in all vertebrate

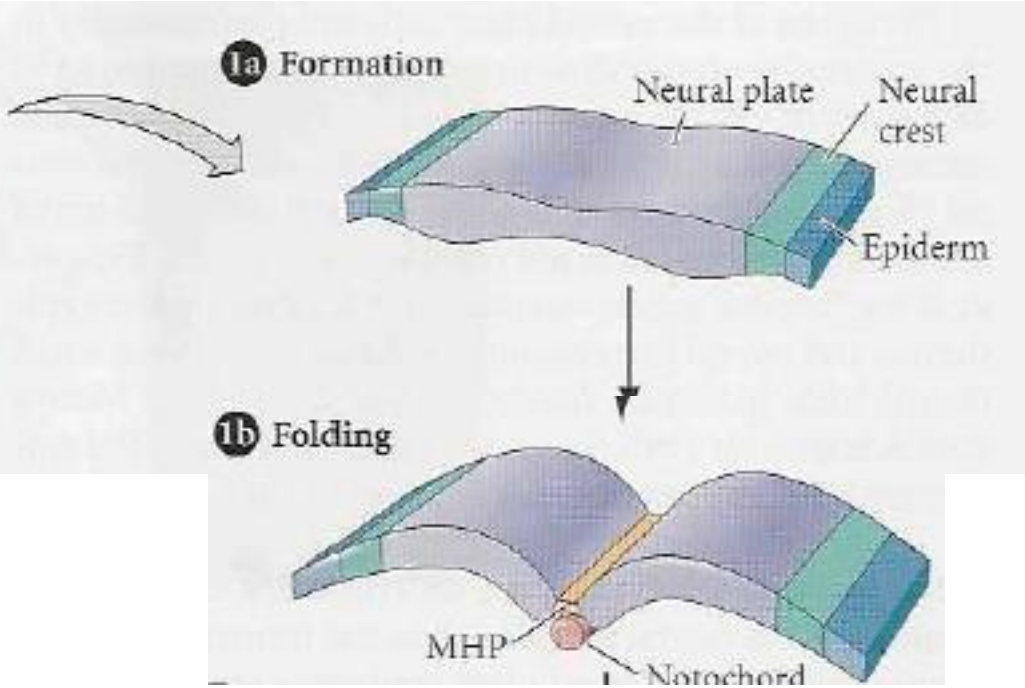
Primary neurulation 2



Neural plate

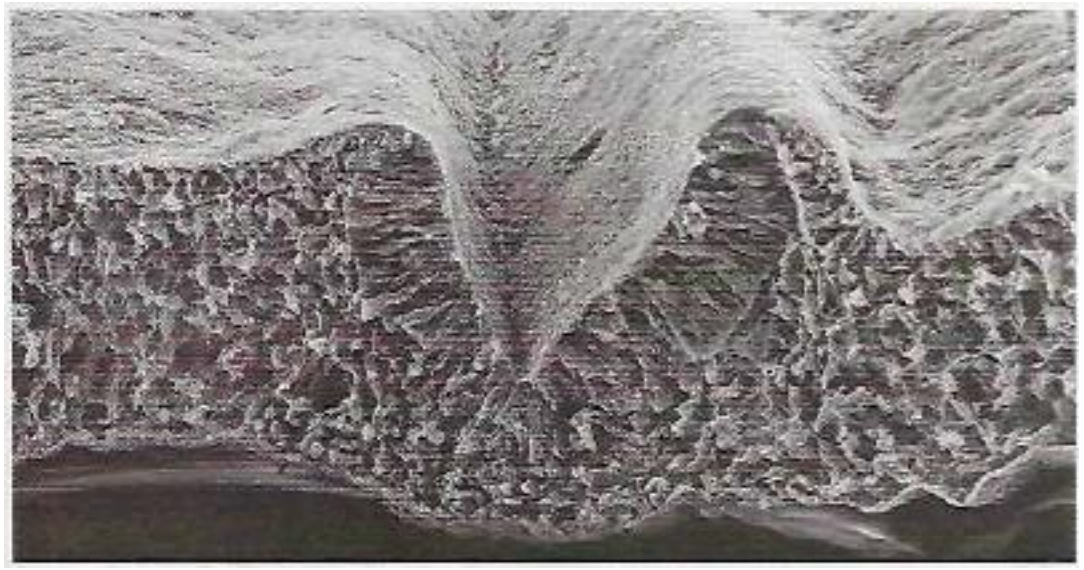
- Epidermal cells elongate thus forming neural plate cells
- The cells at the midline of the neural plate form the medial hinge point (MHP).

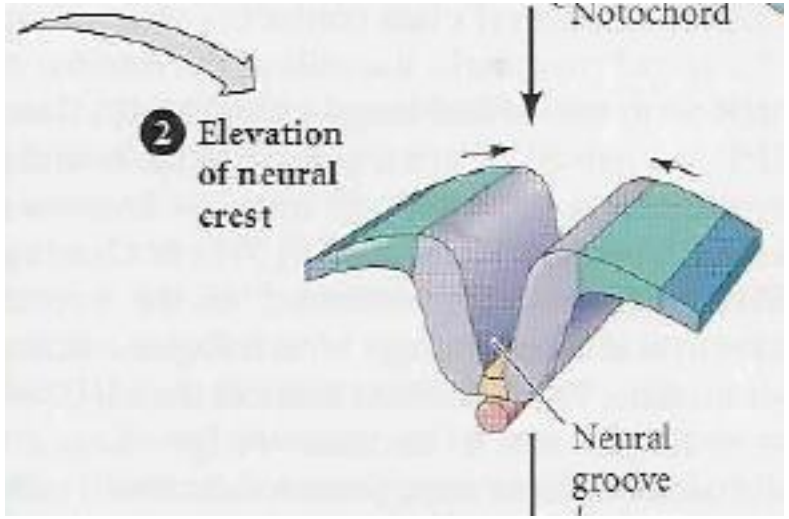




Groove

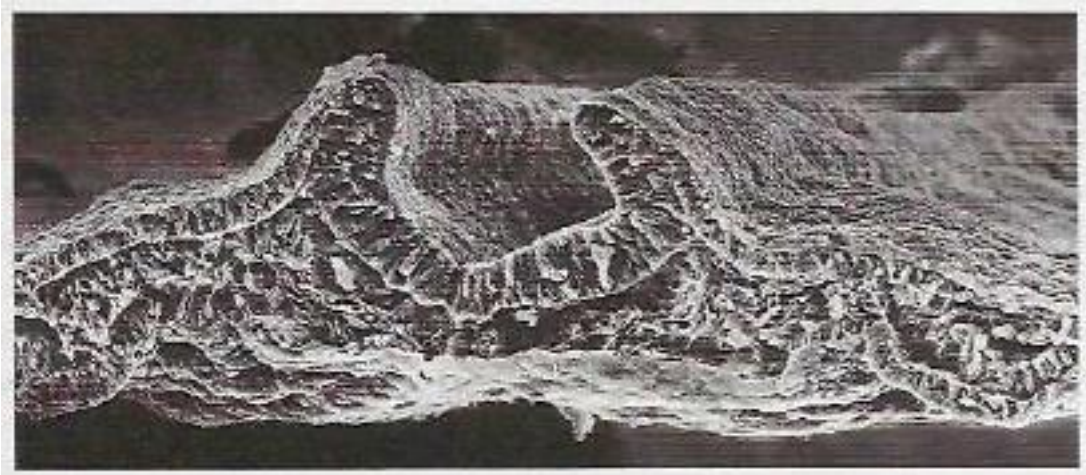
- MHP cells makes the neural groove

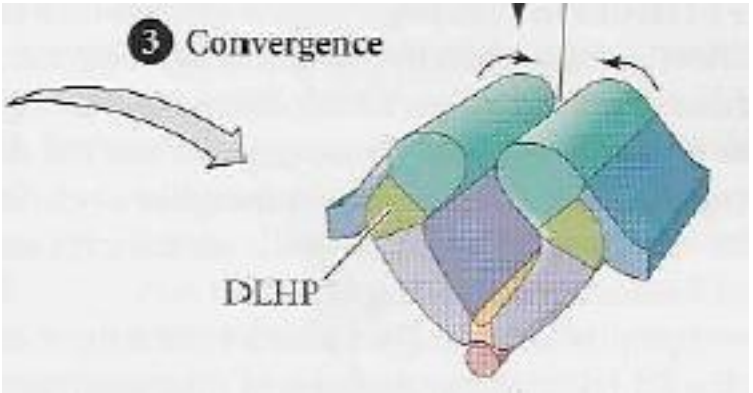




Convergence

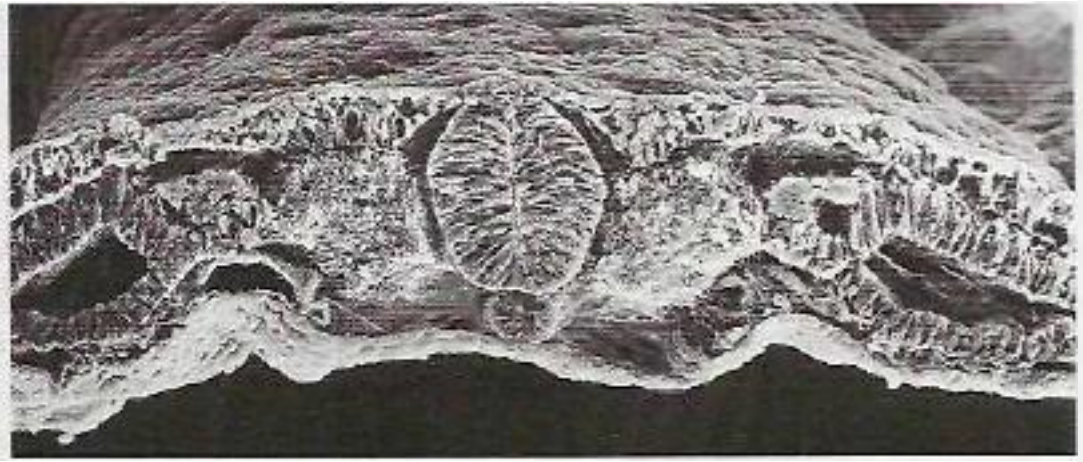
- Two more hinges develop to close the furrow

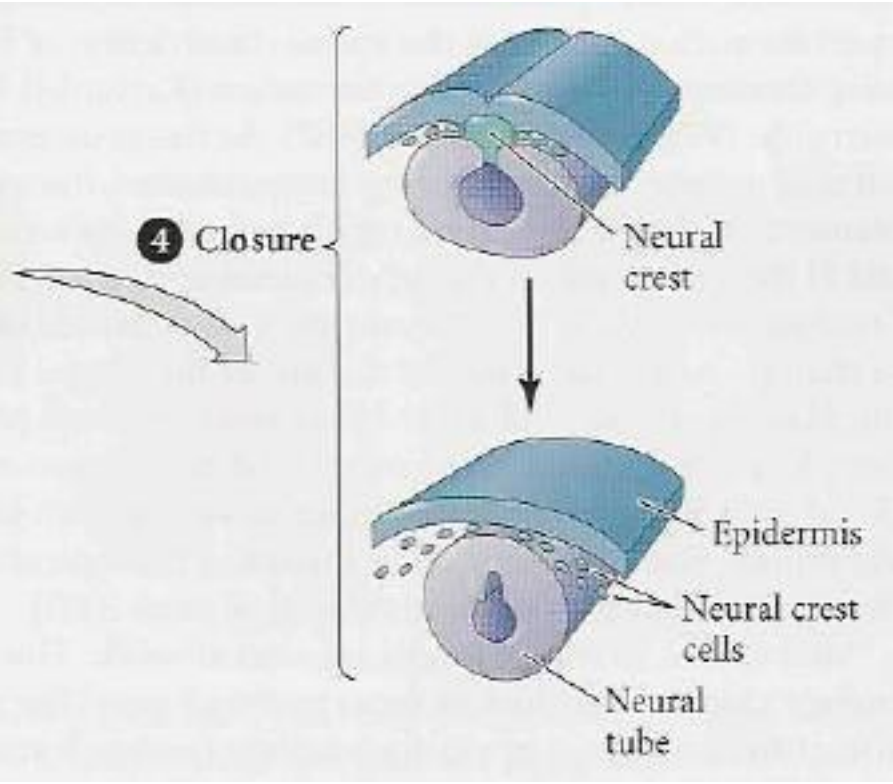




Closure

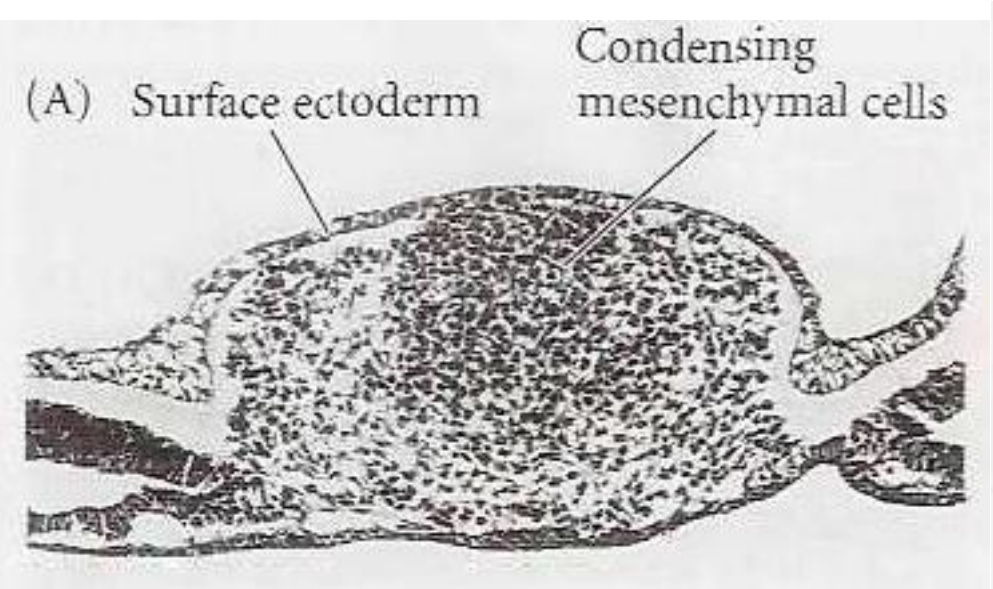
- Finally the paired neural folds zips up

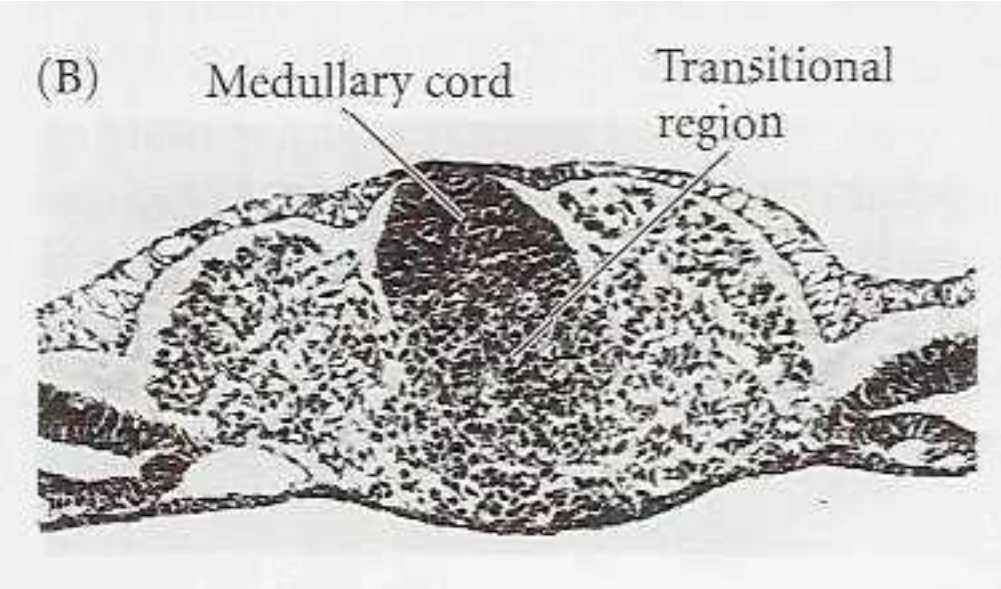




Secondary neurulation 1

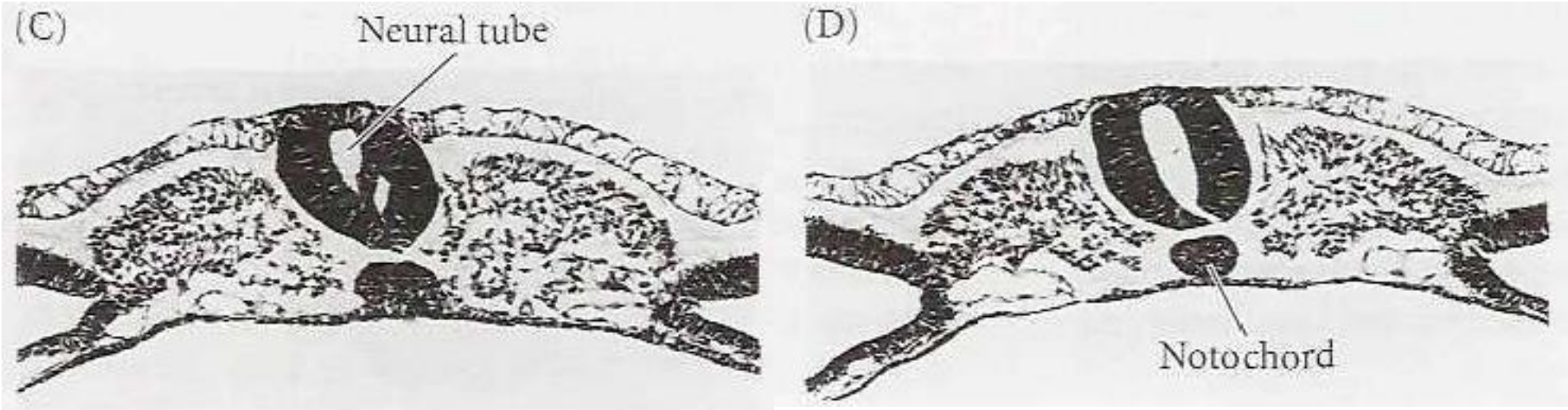
- Secondary neurulation involves the production of mesenchyme cells from the prospective ectoderm and endoderm, followed by the condensation of these cells into a medullary cord beneath the surface ectoderm





Secondary neurulation 2

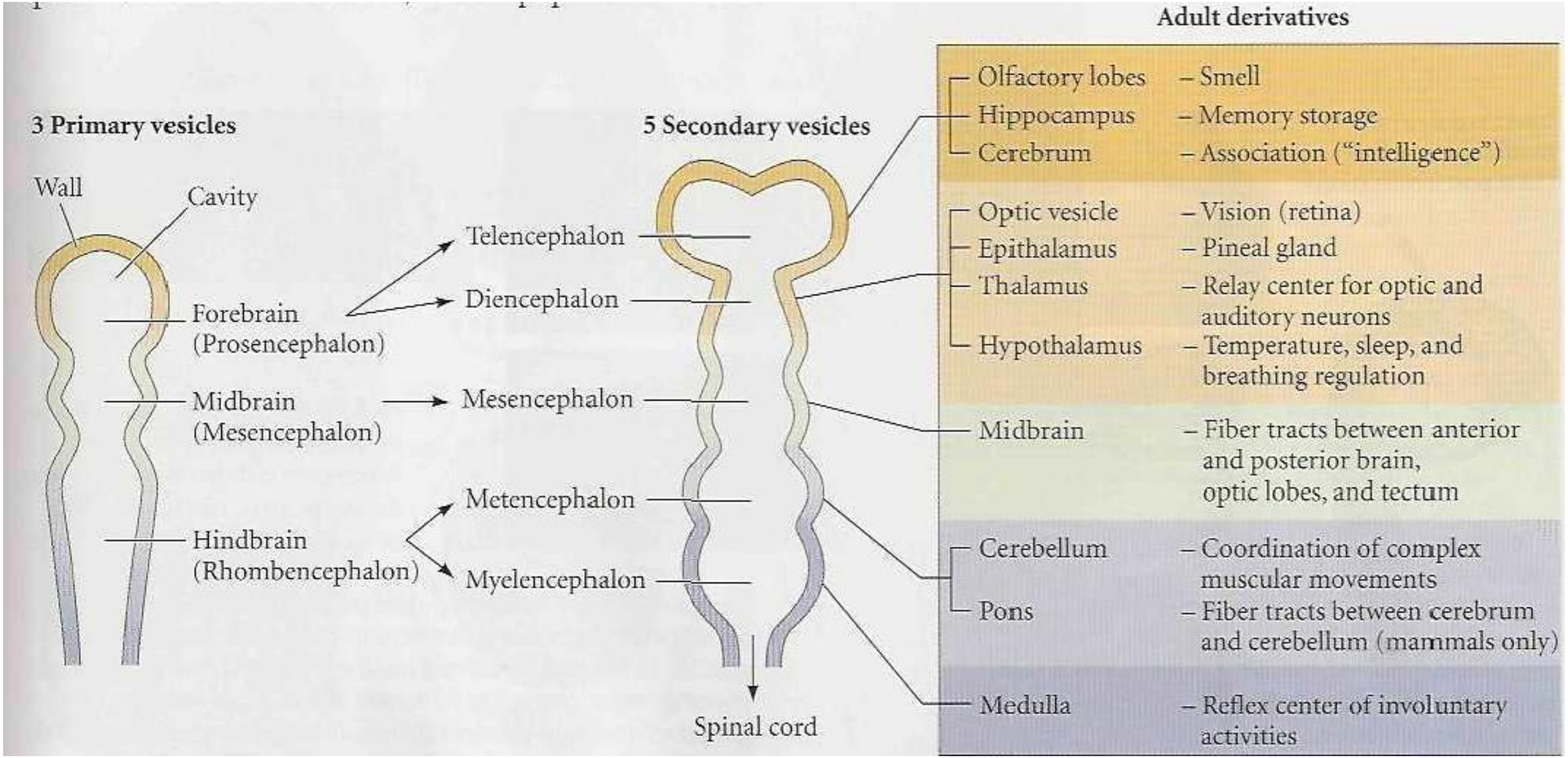
- Central portion of this cord undergoes cavitation to form several hollow spaces, or *lumens*; the lumens then coalesce into a single central cavity



Building the brain

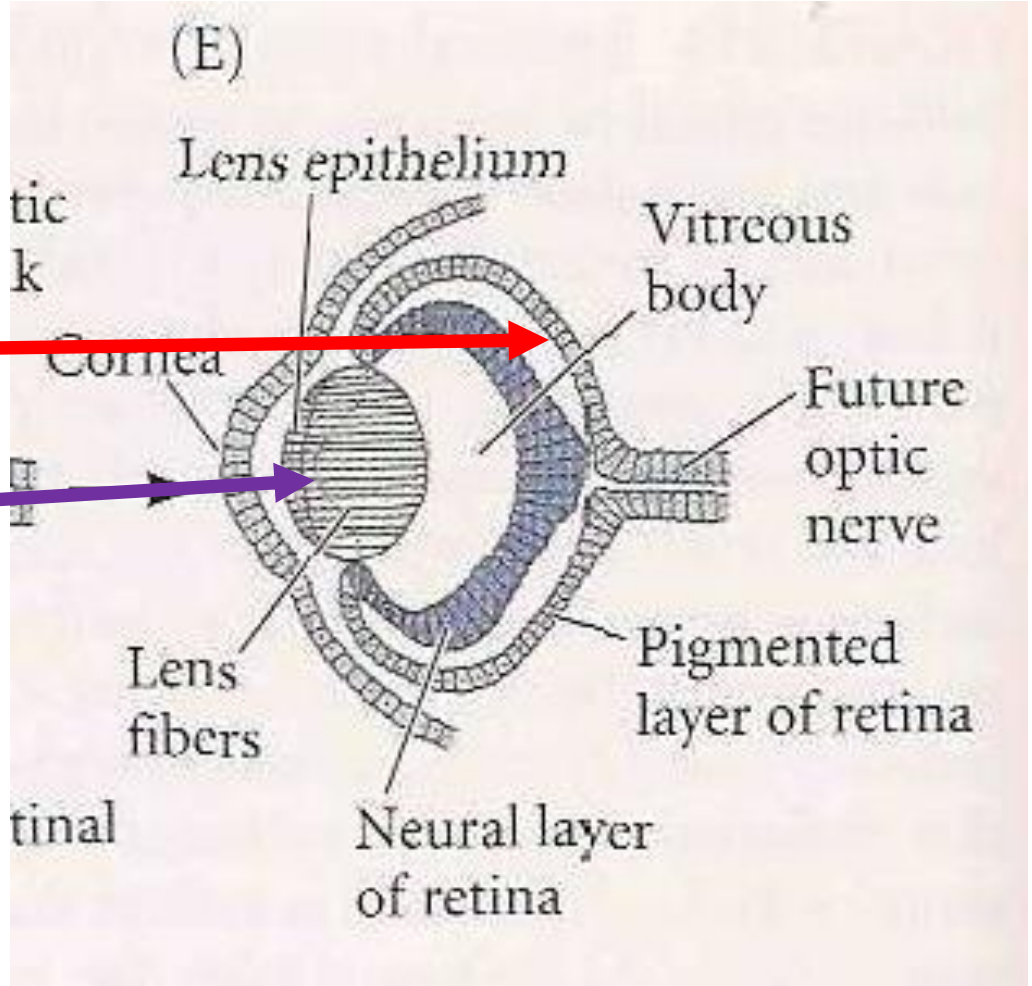
Differentiation of the neural tube into the various regions of the central nervous system (i.e., the brain and spinal cord) occurs simultaneously in three different ways. On the gross anatomical level, the neural rube and its lumen bulge and constrict to form the chambers of the brain and spinal cord. At the tissue level, the cell populations in the wall of the neural tube rearrange themselves to form the different functional regions of the brain and spinal cord. Finally, on the cellular level, the neuroepithelial cells themselves differentiate into the numerous types of nerve cells (neurons) and supportive cells (glia) present in the body.

Differentiation of the neural tube



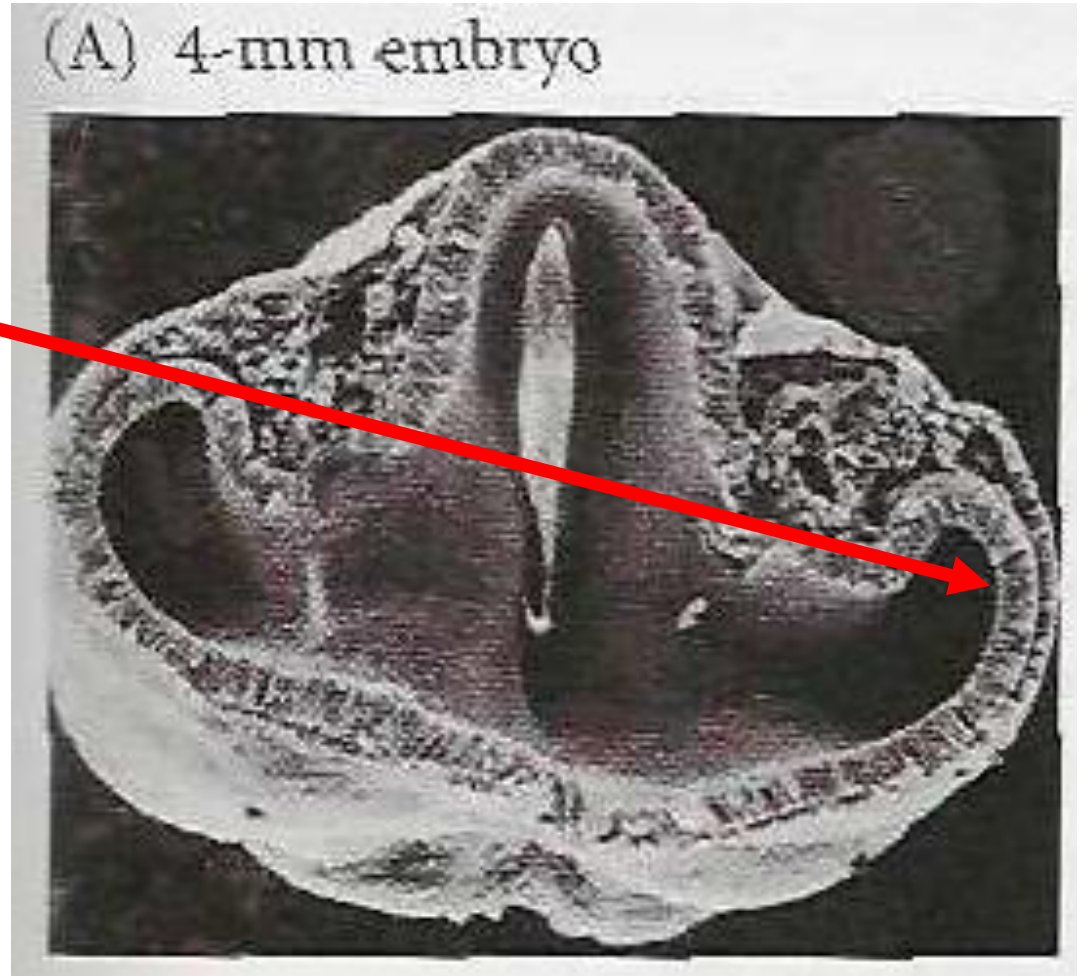
The eye

- To understand the eye formation one needs to understand ‘induction’
- Every eyes are made from two different cell layers
  - Neural ectoderm: makes most of the eye
  - Ectoderm: more specifically lens placode making lens and cornea
- In making the eye the neural ectoderm have to come close contact with ectoderm thereby inducing the ectodermal cells to form retina and cornea



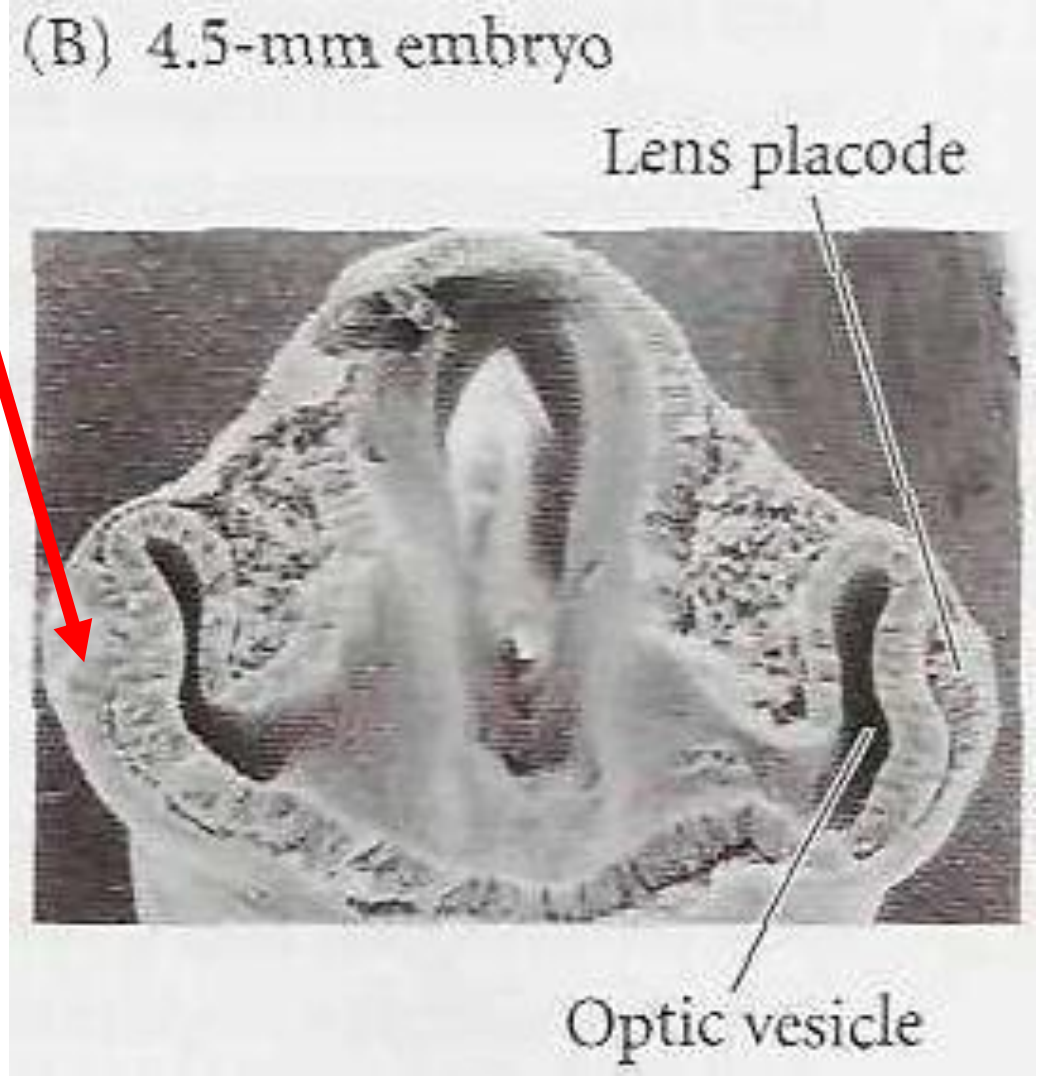
First the swelling of brain

- The optic vesicle extends from the diencephalon
- Meets the head ectoderm



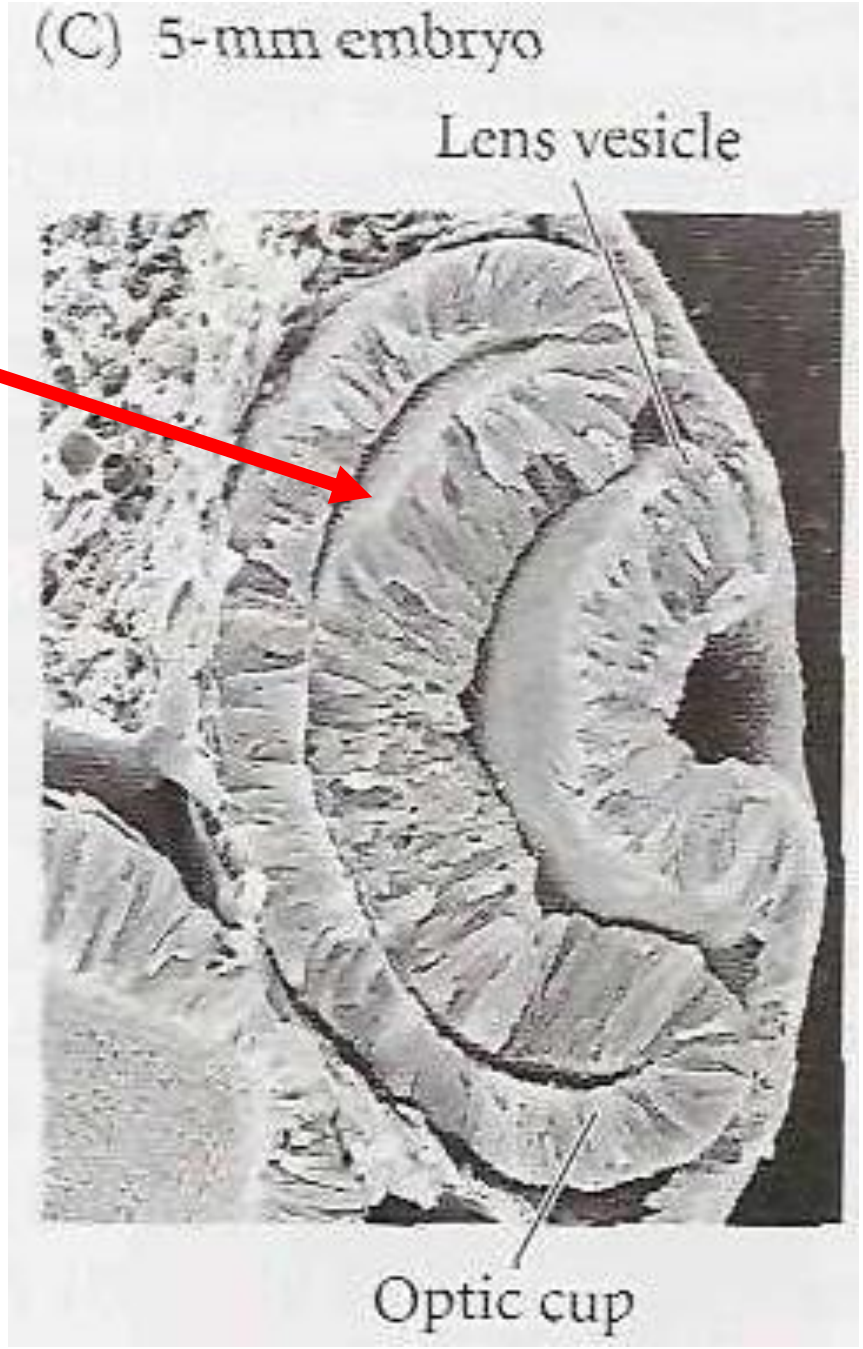
Lens placode

- Optic vessel induces the formation of a lens placode
- which then invaginates to form the lens. This invagination is accomplished by the cells of the lens placode extending adhesive filopodia to contact the optic vesicle.



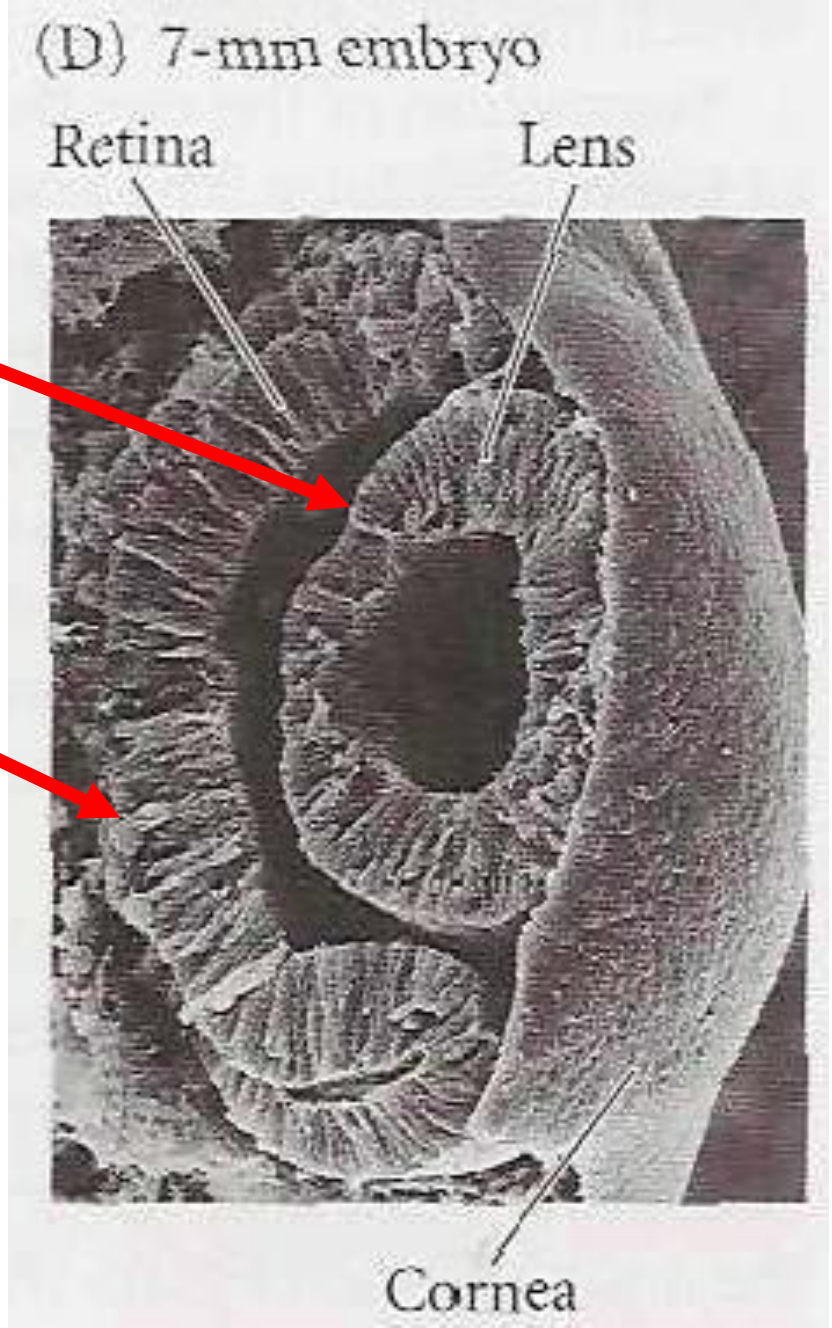
Optic cup

- As the optic vesicle bends to form the optic cup, the presumptive lens cells are brought inside the embryo

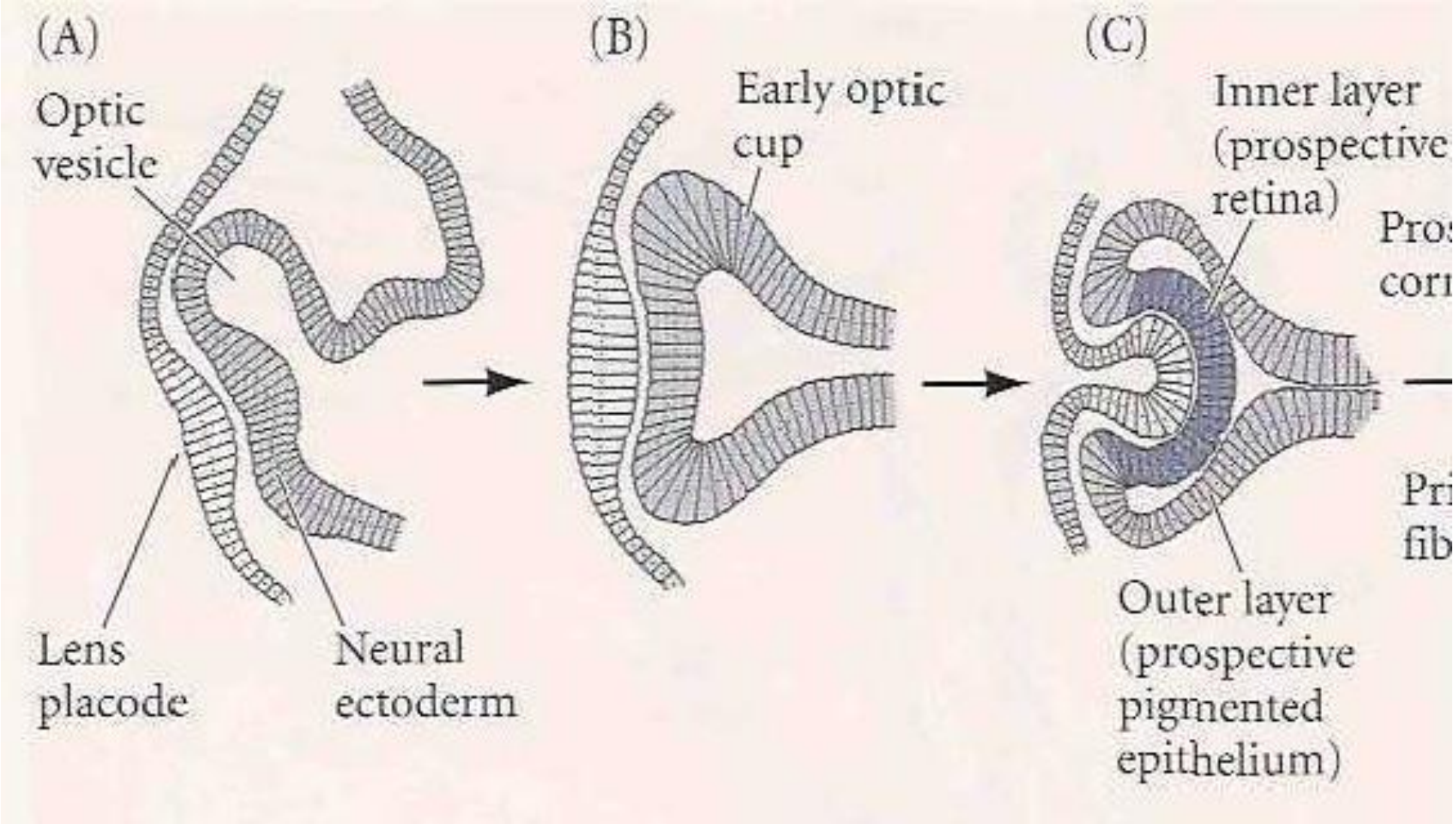


Retina & Lens

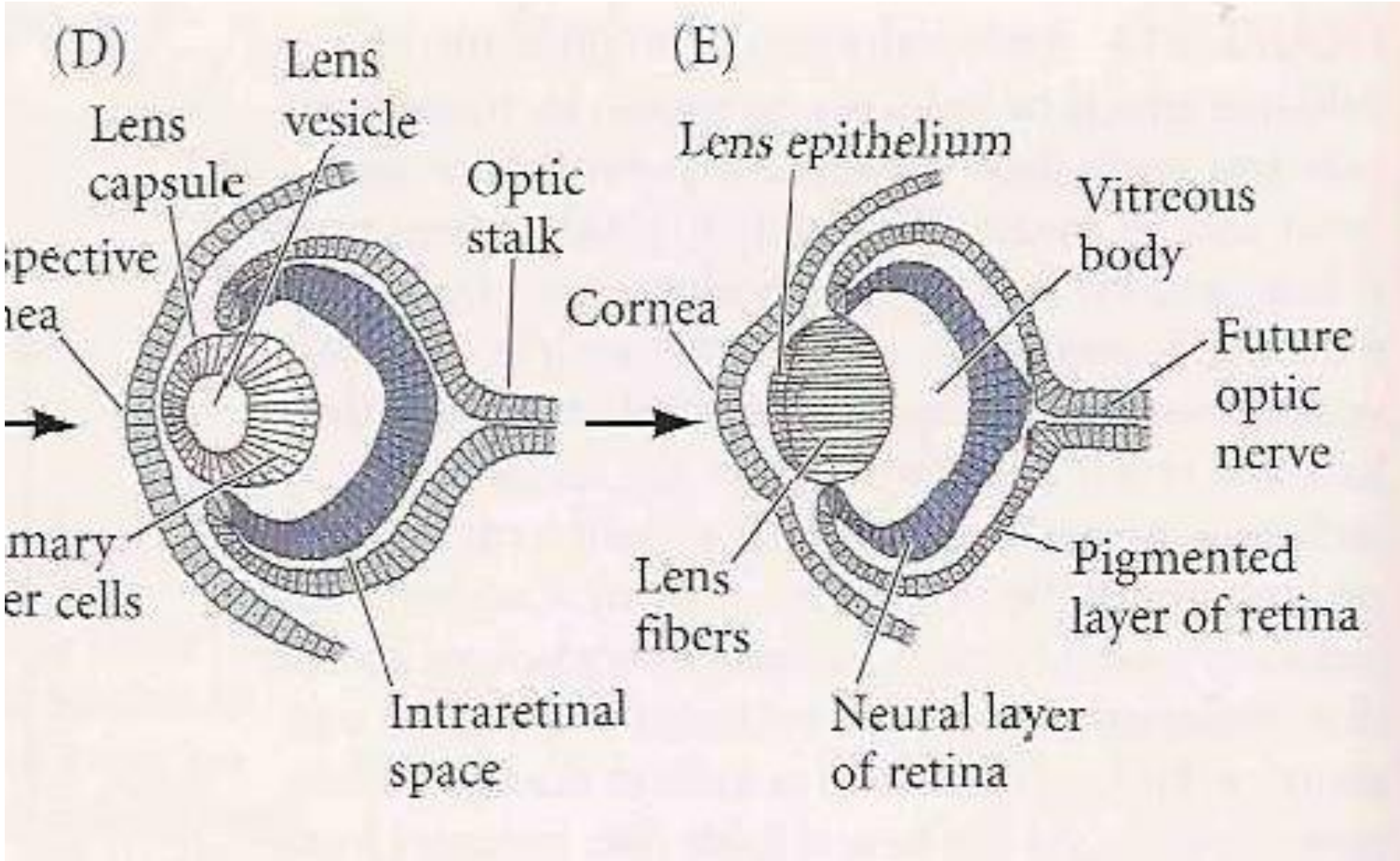
- Two layers of optic cup differentiate in different ways. The cells of the outer layer produce melanin pigment (being one of the few tissues other than the neural crest cells that can form this pigment) and ultimately become the pigmented retina. The cells of the inner layer proliferate rapidly and generate a variety of glia, ganglion cells, intemeurons, and light-sensitive photoreceptor neurons. Collectively, these cells constitute the neural retina.
- The lens placode does not form neurons; rather, it forms the transparent lens that allows light to impinge on the retina



Schematic 1


(A)
Optic vesicle
Lens placode
Neural ectoderm
(B)
Early optic cup
(C)
Inner layer (prospective retina)
Outer layer (prospective pigmented epithelium)

Schematic 2


(D)
Lens capsule
Lens vesicle
Optic stalk
pective
ea
mary
er cells
Intraretinal space
(E)
Lens epithelium
Vitreous body
Cornea
Future optic nerve
Lens fibers
Pigmented layer of retina
Neural layer of retina

How do we know?