Ear development in Frog

★ The frog's internal ear is labyrinth.

★ Labyrinth is derived from auditory placodes, which are formed by thickening of the sensory layer of head epidermis against sides on hindbrain.

★ Each auditory placodes separates from the rest of epidermis and invaginates to form a closed vesicle called otic or ear vesicle.

★ The ear vesicle is the rudiment of inner ear. It is pear shaped. It is pointed and remains attached upwards directed and develops into endolymphatic duct.

★ The expanded portion of the vesicle give rise to membranous labyrinth.

★ The walls of ear vesicle is thin and epithelial cells become flat forming membranous area of labyrinth.

★ The medio ventral wall of each labyrinthe become thick. cells become columnar and give rise to secondary epithelium and forms macule of internal ear.

★ The frog's middle layer is eustachian tube, ear ossicle (columella) and tympanic membrane.

★ Development of middle layer takes place from first pharyngeal gill pouch.

* The gill pouch does not form gill cleft but exists as an expanded lateral cavity which lateral form tympanic membrane.

* Mesoderm covers it and convert it to tympanum ear drum or tympanic membrane.

* Internal lining of tympanic membrane is endoderm, outer lining is ectodermal.

* Tympanic membrane is thin, sensitive to air waves.

* The inner cavity of tympanum forms pharynx and forms eustachian tube.

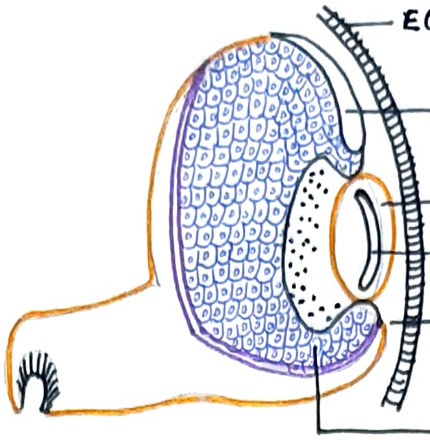
* A cylindrical bone columella auris crosses tympanic cavity from tympanum to fenestra ovalis.

* Tympanic membrane covers opening of ear capsule

Neural Ectoderm —(Roof of Archenteron / Primary inductor)→ Hind brain

Auditory placodes —(Hind brain / Secondary inductor)→ Ear vesicle

Formation of ear capsule —(Ear vesicle + Head mesoderm / Tertiary inductor)→ cartilaginous ear capsule (around internal ear)



In frog, the optic vesicles arise early by the tail bud stage as lateral diverticula from the ventro-lateral walls of diocoel.

The connection of the brain cavity with the optic vessels become constricted by the convergence of the surrounding mesenchyme into a tube known as optic stalk.

The dorso-lateral wall of each optic vesicle comes into contact with the head ectoderm as it expands laterally then flattened and becomes invaginated.

The invagination begins ventro-laterally and continued obliquely mesio-dorsally.

The invagination is aided by thickening of vesicle wall between dorsal and ventral limits.

This region later forms retina.

The thickening begins at first point of contact (dorsal)

and as a result the connecting optic stalk is moved to a more ventral position.

The newly inverted cavity thus formed by invagination of lateral wall of optic vesicle known as optic cup

The rim of the cup now exposes the pupil. The cup will invaginate further and grow in thickness until it all it obliterates the original optic vesicle (optocoel).

The lateral (retinal) and the inner or mesial (pigmented) layers of the optic cup are therefore brought into close proximity with only a slit-like space remaining between, the remains of the original optocoel.

ventrally this double layered optic cup is connected with the optic stalk.

The three-dimensional aspect of these changes must be under--stood.

Transverse, sagittal or horizontal (frontal) sections through the eye will appear to be essentially alike.

The cup is circular with only a ventral cut out where the inverted optic stalk is attached.

If one could look directly into such a developing eye, after removal of lens, the impression would be of a horseshoe shaped cup, the pupil of eye, with a groove like opening ventral.

This central cavity is the optic cup but ventral to it is the double - layered groove of optic stalk, known as choroid fissure.

The lens of the eye is formed from the superficial ectoderm by invagination of deeper or nervous layer of ectoderm opposite the opening of the optic cup.

This is brought abound under the inductive influences emanating from the dorsal rim of the optic cup by 4mm.

stage, sometime before hatching. The lens originates as a placode or thickening in the inner or neural layer of head ectoderm.

This placode invaginates to form a lens (lens vesicle) by 5mm stage. This vesicle pinches off from the head ectoderm and comes to lie within the ring of optic cup.

It is supported by suspensory ligament.

The outer wall of lens vesicle remains as cuboidal epithelial cells and the inner wall becomes elongated as lens fibers.

The cavity is ultimately obliterated. The head ectoderm then closes over the lens to form a new covering which, in conjunction with the head mesenchyme forms double-layered cornea.

Reference : 1. N. Arumugam (2013). Developmental Biology, Saras Publication, Nagercoil.

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Net source.

Progressive process of regeneration

1. Regeneration is the process of renewal, restoration and tissue growth that make genomes, cells, organisms, and ecosystems resilient to natural fluctuations or events that cause damage or disturbance.

2. Every species is capable of regeneration from bacteria to humans.

3. Regeneration can either be complete where the new tissue is same as the lost tissue.

4. In incomplete regeneration, after necrosis comes fibrosis.

5. At its most elementary level, regeneration is mediated by the molecular process of gene regulation and involves

the cellular process of cell proliferation, morphogenesis and cell differentiation.

Regeneration in biology, refers to morphogenic characters, the phenotypic plasticity of traits allowing multicellular organisms to repair and maintain the integrity of their physiological and morphological states.

Above the genetic level, regeneration is fundamentally regulated by asexual cellular process.

Reference : 1. N. Arumugam (2013). Developmental biology, Saras publication, Nagercoil

2. J. Cameron (2003). Developmental biology, Net source

2. Insect metamorphosis

Insect metamorphosis is a biological process by which the insect develops after birth or hatching involving a conspicuous and relatively abrupt change in animal's body structure through cell growth and differentiation.

no or direct development

* Ametaboly or ~~incomplete or partial~~ metaboly shows very little difference between larval and adult forms

* Hemimetaboly or incomplete or partial metaboly and holometaboly or complete metamorphosis shows significant morphological and behavioural differences between larval and adult forms, most importantly the inclusion of pupal or resting stage.

* The immature forms are called nymphs

* The stages are called instars

A typical growth instar (4)

* Larva ⟶ Pupa $\xrightarrow[\text{thread}]{\text{spew}}$ chrysalis ⟶ Adult

Reference : 1. N. Arumugam (2013). Developmental Biology, Saras Publication, Nagercoil.

2. George Liddell (2012). Developmental biology, Net source.

1. Extra embryonic membrane in chick

The chick embryo contains four extra embryonic or foetal layers/membranes - the yolk sac, the allantois, amnion and chorion or serosa.

During development, ectoderm, mesoderm (somatopleure) and endoderm (splanchopleure) extend into extra embryonic area.

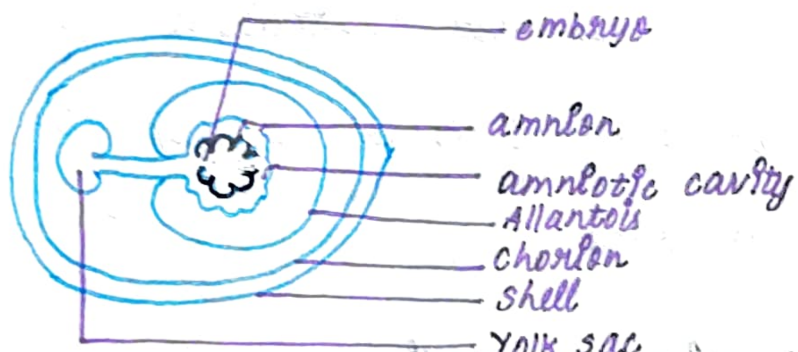
The central area of blastodisc contain developing embryo.

(i) Yolk sac - endoderm + mesoderm. Yolk sac gives nutrition. It has digestive enzymes and act as gut.

(ii) Allantois - endoderm + mesoderm. Allantois excrete N_2 waste and act as kidney.

(iii) Amnion - ectoderm + mesoderm. Protect from dessication.

(iv) Chorion - ectoderm + mesoderm. Exchange gases and act as lung.



Reference : 1. N. Arumugam (2013). Developmental Biology, Saras Publication, Nagercoil.

2. Blakiston (1920). Developmental Biology, Net source.

3. Types of regeneration

1. Reparative regeneration

In this multicellular organisms have power to repair damaged cells of the body seen in both invertebrates and vertebrates.

2. Restorative regeneration

Multicellular organisms can redevelop the severed body parts or the whole body can be regenerated from a body segment. It occurs by morphallaxis – reconstruction of an entire animal from a small segment by reorganising the existing cells. The reorganised animal is smaller than original one.

But it grows to normal size Eg Hydra or by epimorphosis- replacement by proliferation of new cells from the surface of the injured part. Eg- appendage of arthropod, starfish arm, salamander limb and lizard's tail.

Reference :

1. N. Arumugam (2013). Developmental Biology, Saras Publication, Nagercoil.

2. Powell Halden (2001). Developmental Biology, Net source.