

NEOTENY IN AMPHIBIA

TERMINOLOGIES

PAEDOGENESIS: The phenomenon of attainment of sexual maturity leading to reproduction in an arrested larval stage (preadult stage) is referred to as Paedogenesis

NEOTENY: Neoteny is a special case of paedogenesis where sexual maturity occur but somatic development slows allowing juvenile features to persist. Neotenuous larval stage is found in Axolotl larval stage of Ambystoma.

AXOLOTL LARVA-MODEL FOR STUDY OF NEOTENY

Axolotl larva of *Ambystoma* has a well developed post anal tail with a continuous tail fin unsupported by fin rays. It has three pairs of external gills.



TYPES OF NEOTENY

- **PARTIAL NEOTENY-** This illustrates simple retardation of metamorphosis beyond the normal time period. Here we find extension of larval characters and temporary retardation of metamorphosis owing to certain temporary changes in the neighboring environment. But sooner or later they will be metamorphosed into adults in natural optimum condition.

Example : *Bufo vulgaris*

- **TOTAL NEOTENY-** When the animals retain their gills but becomes sexually matured throughout the life.

Example- *Necturus maculosus* (mudpuppy) is permanently neotenic. It lives on the bottoms of lakes and retains its gills throughout life.

TYPES OF NEOTENY (CONTINUED)

- **QUASI PERMANENT NEOTENY-**

Larva does not metamorphose into adult in certain specific natural condition and attains sexual maturity. But metamorphosis can take place after artificial treatment or suitable natural conditions

Example- Axolotl larva of *Ambystoma* typically exhibits this type of neoteny. The larva remains throughout its life without metamorphosis, but under suitable conditions they may metamorphose into adult form.

TYPES OF NEOTENY (ACCORDING TO YOUNG 1981)

1. OBLIGATE NEOTENY- Neoteny occurs in all individuals and metamorphosis cannot be induced by T₄.

EXAMPLE- *Necturus*.

2. FACULTATIVE NEOTENY- Some or all the individuals of a given population metamorphose. In facultative neoteny, T₄ generally induces metamorphosis.

EXAMPLE- Axolotl larva of *Ambystoma*

COMPARATIVE LARVAL NATURE OF AXOLOTL

ORGAN	CHANGES IN OTHER URODELS	CHANGES IN AXOLOTL
CAUDAL FIN	Disappears	Persists
EXTERNAL GILLS	Disappear in most forms	Persists with four gill slits
HEAD	Proportionate with the developing trunk	Comparatively large
EYES	Prominent	Weakly developed
LIMBS	Moderately developed	Feeble in nature
LATERAL LINE SENSE ORGANS	Disappears	Persists
VERTEBRAE	Procoelus	Amphicoelus
HEART	Symmetrical	Asymmetrical

HORMONAL REGULATION OF NEOTENY

- Failure of metamorphosis in the Axolotl is due to the inability of the thyroid to secrete thyroxine.
- The thyroids are sensitive to the thyroid stimulating hormone (TSH), but the evidence suggests that the neoteny is due to a low level of thyrotropin releasing hormone (TRH) from hypothalamus, probably due to a combination of genetic predisposition with environmental factors.

INTRINSIC AND EXTRINSIC FACTORS INVOLVED IN NEOTENY

EXTRINSIC FACTORS

- Abundant food materials and other favorable requisites for larval and aquatic life is the cause of Neoteny.
- Deep and cold water inhibit the production of thyroxine hormone which retards metamorphosis.
- Larval tissues lose sensitivity to thyroxine as temperature drops.
- Inadequate iodine content of water.
- Retardation of metamorphosis is due to the saline nature of water.

INTRINSIC AND EXTRINSIC FACTORS INVOLVED IN NEOTENY

INTRINSIC FACTORS

- Calcium ion concentration inhibits metamorphosis in Axolotl larva and therefore favors neoteny.
- Different threshold values of thyroxine- The timing of metamorphic events is controlled by thyroxine concentration.
- Insulin hormones inhibit metamorphosis.
- Prolactin acts as an inhibitor of metamorphosis.

ENVIRONMENTAL INFLUENCE ON NEOTENY

- In lowland populations of the northwestern salamander, *Ambystoma gracile*, individuals remain aquatic for several years and then metamorphose into sexually mature terrestrial adults that breed.
- In high montane populations of this same species, many individuals stop short of metamorphosis. Their larval forms become sexually mature and breed.

Note: For these montane individuals, forgoing metamorphosis means that they avoid becoming a terrestrial form exposed to harsh alpine winters. By remaining larval, they retain their aquatic lifestyle in which they can safely over winter in the unfrozen depths of ponds.

