

## NEOTENY IN AMPHIBIA

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Neoteny is defined as the failure or delay of larva to metamorphose while becoming sexually mature. It is **character of some amphibians**.

The best example is axolotl **larva** of *Ambystoma*. It is aquatic. It has gills. It develops gonads. It lays eggs and attains large size. *Ambystoma* on the other hand, is terrestrial and without gills. It was considered the axolotl as a separate genera in the beginning, with the administration of thyroxine, axolotl lost its gills and develops lungs. It metamorphosed into the adult. Metamorphosis of axolotl can be induced by reducing the water level.

*Proteus*. and *Necturus* are permanently neotenus forms. They retained the larval features and reproduce sexually like a mature animal.

Two terms, paedogenesis and neoteny ,coined by Kollwann and are often used as synonyms which is not correct. Neoteny refers to the retention of a larval or embryonic trait in the adult body. Familiar examples are retention of embryonic cartilaginous skeleton in adult in *Chondrichthyes*; and the larval gills in some adult salamanders.

Paedogenesis or paedomorphosis refers to development of gonads and/or production of young ones by an otherwise immature, larval or preadult animal. The examples are scattered in several groups or animals (e.g. gall fly, liver fluke, and salamanders). Thus, whereas neoteny emphasizes the retention of embryonic or larval features in the adult body and paedogenesis stresses precocious development of gonads in larval body

Axolotl. Classical and most informative examples of neoteny and paedogenesis among Amphibia (vertebrates) are furnished by *Ambystoma*. *A. tigrinum* (tiger salamander) in high altitudes of Colorado (North America). Ordinarily they go through typical gilled aquatic larval stages, then metamorphosis, to transform into adult air-breathing land forms. However, under certain circumstances, the larvae do not metamorphose, retain their gills and aquatic habitat but become sexually mature. This sexually mature but morphologically immature, larva Stage with external gills is called an axoiotl. Thus, neoteny emphasizes the retention of embryonic or larval features in the adult body and paedogenesis stresses precocious development of gonads in larval body. Amphibian examples. Some aquatic larval urodeles delay or fail to metamorphose.

Environmental factors affecting neoteny. The significance and causes of neoteny are not properly understood. Environmental factors affect metamorphosis in several ways. Abundance of food, cold temperature or insufficient iodine (a component of thyroxin hormone that induces amphibian metamorphosis) may cause failure of metamorphosis and retention of larval features. This is indicated by the fact that drying up of swamps, lack of

food and rise in temperature in surrounding water induce axolotls to metamorphose. Various extrinsic and intrinsic factors are supposed to be responsible for such an unusual phenomenon.

Extrinsic factors (1) Abundance of food and other favourable requisites in the aquatic life is the cause of retention of larval features (Gadow, 1903). (2) Deepwater and coldness inhibit the secretion of thyroxin (Shufeldt). (3) Saline nature of water is responsible for neoteny (Weismann). (4) Low temperature is responsible for the arrest of metamorphosis (Huxley, 1929). Despite of extensive researches on the role of extrinsic factors on metamorphosis it is still not clear that whether extrinsic factors are exclusively responsible for arrest of metamorphosis.

So the existence of other factors, internal and physiological becomes apparent Intrinsic factors. Many experimental evidences have been advanced by different investigators. But recent researches incline to reveal that' metamorphosis is primarily influenced by (i) varying threshold levels of thyroxin and its analogues and (ii) by the degree of responsiveness of the larval tissues to the hormones. During early premetamorphic stage in amphibian development, the level of thyroxin is kept very low in the body by genetic mechanism (Etkin, 1968). But deviation from the normal pathway of development is found in the life cycle of many urodeles. Such deviated pathways of development in axolotls due to extrinsic as well as intrinsic environmental factors may be regarded as "canalisation", i.e., buffering of development against environmental change. G.K. Noble (1954) regarded that the retention of larval features during sexual maturity has nothing to do in the phylogeny of the amphibians.

### **Types of neoteny.**

Neoteny is- partial when metamorphosis is delayed due to temporary ecological or physiological changes in environment. It is shown by tadpoles and larvae tiding over winter.

Intermediate neoteny is shown by axolotls which also reproduce sexually but undergo metamorphosis in suitable conditions. Under experimental conditions in laboratories, it is possible to produce either axolotls or transformed individuals.

The extreme or total neoteny is shown by several salamanders such as *Necturus*, *Siren* and *Proteus*. They remain larval throughout. Even treatment with thyroxin fails to induce metamorphosis; the tissue response is absent.

### ***Kollman has distinguished two types of neoteny:***

**Partial neoteny:** Tadpoles of *Hyla arborea*, *Rana esculenta* during winter will show simple retardation of metamorphosis beyond the normal period.

**Total neoteny:** It will retain its gills and becomes sexually mature throughout the life. *Necturus*, *Siren* and *Proteus*

**Significance of neoteny:** Weismann (1875) thought neoteny to be a case of retarded evolution or atavism, that is, reversion to ancestral condition. However, this is now regarded to be of secondary specialization, a physiological adaptation of advantage.