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What does indirect development meaning

Direct and Indirect development are two types of development patterns shown by organisms. The key difference between Direct and Indirect development of organisms is the form of the offspring born. During Direct development, the form of the newly born offspring resembles the parents, whereas, in indirect development, the newly born offspring takes a different form when compared to the parent. The developmental biology of higher order animals shows various patterns that are studied widely in order to study the behavioural and physiological changes of their development period. Upon completion of the fertilization process to the emergence of the mature adult organism, different development processes take place. Broadly the development of animals can be categorized as Direct and Indirect development. Direct development is referred to the phenomenon in which an animal is born that resembles its adult, and it only undergoes maturity in the same form as its adult or parent. Therefore, the organism is directly developed to its adult. Indirect development is referred to the phenomenon in which the development of an animal takes place via different stages known as larval stages. This is due to the fact that the newborn is of a different form in comparison with the parent. Therefore, the organism has to undergo different changes before developing to the adult. CONTENTS 1. Overview and Key Difference 2. What is Direct Development 3. What is Indirect Development 4. Similarities Between Direct and Indirect Development 5. Side by Side Comparison - Direct vs Indirect Development in Tabular Form 6. Summary What is Direct Development? Direct development refers to the phenomenon in which an animal undergoes maturity in the same form as its adult or parent. Organisms directly develop into the adult without passing different forms. This method of development does not involve intermediate stages in the life cycle. The organisms who undergo direct development such as humans, most mammals and other higher order animals, resemble their parents at birth. During direct development, the organisms mainly undergo growth and differentiation. The newborn offspring is physically, morphologically and sexually resembles the parents. Thus, there is an irreversible increase in growth during direct development. The cells also differentiate to perform specialized functions during this process. Animals who undergo direct development contain a rich yolk during its fetal development. The yolk is well supplemented with fats and proteins allowing the growth of the fetus. Thus, the size of the yolk determines the development of the organism. The most important thing about direct development in animals is the development of sexual maturity over time. At birth, the animals have the complete reproductive system with the gonads, although their activity is not matured and complete until a certain age. At puberty, the secondary sexual characters emerge making the organism eligible for sexual activity. This is an important process in animals undergoing direct development. Thus, sexual maturity marks the pinnacle of development. The animals who undergo direct development are most mammals, birds and reptiles. What is Indirect Development? Indirect Development is the phenomenon, where the development of the organism to its mature adult takes place under different forms known as the larval stages. This process is known as metamorphosis. The larval stages do not resemble the parents in their physiology or morphology. Most insects like Butterfly and wasp undergo development in an indirect manner. The newly born offspring is a completely different organism in comparison with the parent. For example, the young of the butterfly is a caterpillar, which then undergoes different changes to develop into an adult butterfly. Metamorphosis also can be characterized further as complete metamorphosis and incomplete metamorphosis. Complete metamorphosis is a life cycle of an organism that shows distinct larva and pupa stages, whereas in incomplete metamorphosis is only contains a larva stage but lack a pupa stage. These larval stages have completely different nutrition patterns, physiological, behavioural patterns and sexual characteristics in comparison with the adult. The larval stages are mainly important as feeding stages that supply nourishment for the maturation. Figure 01: Butterfly Life Cycle The animals who undergo indirect development lay a high number of small eggs, therefore, the yolk of the egg is reduced. The reduced egg yolk in these animals will provide fewer nutrients for the fetal maturation into a complete adult. Thus, when the eggs hatch, the larvae are born instead of a complete adult. The animals that undergo indirect development are; some echinoderms, insects and amphibians. What are the Similarities Between Direct and Indirect Development? Both Direct and Indirect Development types are determined by the yolk availability. Both Direct and Indirect Development modes are shown by living organisms. What is the Difference Between Direct and Indirect Development? Direct development is referred to the phenomenon in which an animal undergoes maturity in the same form as its adult or parent. Indirect development is referred to the phenomenon in which the development of an animal takes place via different stages known as larval stages. Resemblance at Adulthood The newborn resembles the adult at birth. Same form as the adult in direct development. The newborn takes a different form than the adult in indirect development. Availability of Yolk More yolk is available to provide more nutrients in direct development. Less yolk is available in indirect development. Number of Eggs A number of eggs is less, and the eggs are bigger in direct development. More and smaller eggs are produced during the indirect development. Presence of Larva and Pupa Stages Absent in direct development. Depending on the type of metamorphosis, larva and pupa stages are seen in indirect development as follows. Complete metamorphosis - both larva and pupa stage Incomplete metamorphosis - only larva stage Examples Mammals, Reptiles and Birds show direct development. Insects, some echinoderms and Amphibians show indirect development. Direct and indirect development describe the two main developmental procedures followed by the hatching of the egg. During direct development, the newborn resembles the adult, and sexual maturity takes place over time to complete development. In contrast, during indirect development, the newborn takes a different form in relation to its adult form. Therefore, the newborn undergoes several stages in order to develop into a mature adult. These stages are known as larval stages, and the phenomenon of indirect development is known as Metamorphosis. This is the difference between direct and indirect development. Reference: 1.Arenas-Mena, Cesar. "Indirect Development, Transdifferentiation and the Macroregulatory Evolution of Metazoans." Philosophical Transactions of the Royal Society B: Biological Sciences, The Royal Society, 27 Feb. 2010. Available here 2.Balinsky, Boris Ivan. "Animal Development." Encyclopædia Britannica, Encyclopædia Britannica, Inc., 23 Sept. 2011. Available here Image Courtesy: 1. 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