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VOLUME 14 ISSUE 2

LIFE E-NEWSLETTER

Welcome to Morphosis!

Transformation is the essence of life, and nature is its finest artist. From the silent evolution of species over eons to the dramatic metamorphosis of a caterpillar into a butterfly, the animal kingdom is a tapestry of incredible changes.

In this issue of Morphosis, we invite you to journey through the stories of adaptation, growth, and survival in the natural world. Let these tales of change inspire a deeper appreciation for the resilience and creativity of life.

Turn the pages and explore the art of transformation—because every change holds the power to create something extraordinary!

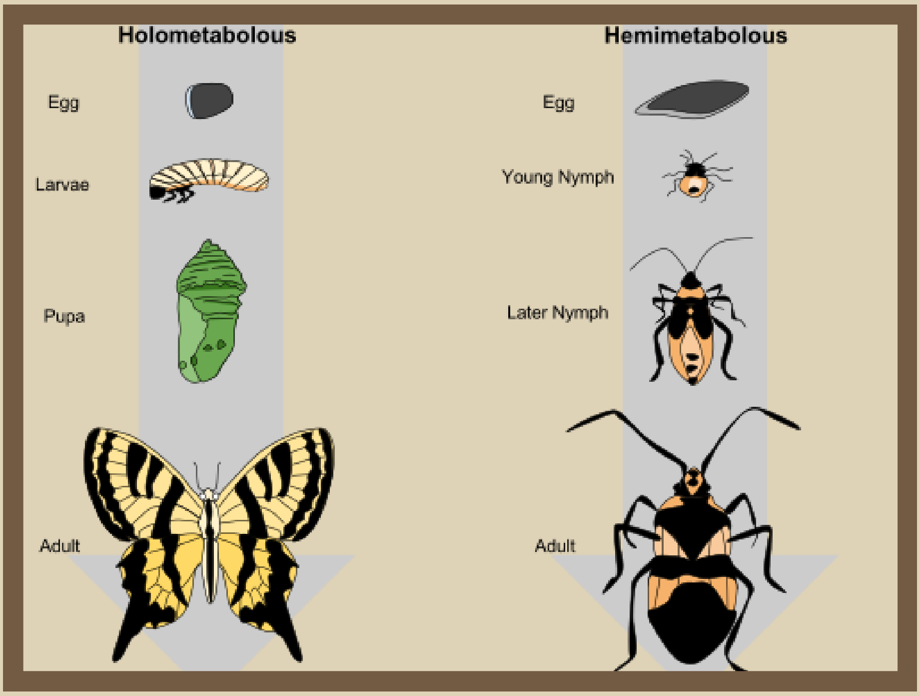
Metamorphosis: The Wonders of Biological Transformation

By Adithya (SYBsc)

Metamorphosis is a biological process by which an animal physically develops including birth transformation or hatching, involving a conspicuous and relatively abrupt change in the animal's body structure through cell growth and differentiation. Some insects, jellyfish, fish, amphibians, mollusks, crustaceans, cnidarians, echinoderms, and tunicates undergo metamorphosis, which is often accompanied by a change of nutrition source or behaviour. Animals can be divided into species that undergo complete metamorphosis termed as holometabolous, incomplete metamorphosis termed as hemimetabolous, or no metamorphosis called ametabolous. The word meta means ‘after’ and morph means ‘form’.

In insects, growth and metamorphosis are controlled by hormones synthesized by endocrine glands near the front of the body (anterior). Neurosecretory cells in an insect's brain secrete a hormone, the prothoracicotropic hormone (PTTH) that activates prothoracic glands, which secrete a second hormone, usually ecdysone (an ecdysteroid), that induces ecdysis (shedding of the exoskeleton). PTTH also stimulates the corpora allata, a retrocerebral organ, to produce juvenile hormone, which prevents the development of adult characteristics during ecdysis. In holometabolous insects, molts between larval instars have a high level of juvenile hormone, the moult to the pupal stage has a low level of juvenile hormone, and the final, or imaginal, molt has no juvenile hormone present at all. Experiments on firebugs have shown how juvenile hormone can affect the number of nymph instar stages in hemimetabolous insects. In chordates, metamorphosis is iodothyronine-induced and an ancestral feature of all chordates.

IAll three categories of metamorphosis can be found in the diversity of insects, In hemimetabolous insects, immature stages are called nymphs. Development proceeds in repeated stages of growth and ecdysis (moulting); these stages are called instars. The juvenile forms closely resemble adults, but are smaller and lack adult features such as wings and genitalia. The size and morphological differences between nymphs in different instars are small, often just differences in body proportions and the number of segments; in later instars, external wing buds form. The period from one molt to the next is called a stadium. In holometabolous insects, immature stages are called larvae and differ markedly from adults. Insects which undergo holometabolism pass through a larval stage, then enter an inactive state called pupa (called a "chrysalis" in butterfly species), and finally emerge as adults. Some fish, both bony fish (Osteichthyes) and jawless fish (Agnatha), undergo metamorphosis. Fish metamorphosis is typically under strong control by the thyroid hormone. Examples among the non-bony fish include the lamprey. Among the bony fish, mechanisms are varied. Frogs undergo a different type of complete metamorphosis. From the egg emerges a tadpole, which lives in the water, breathes with gills, and has a tail. As the tadpole grows, lungs and legs form, and the gills and tail are absorbed into the body. Finally, the animal leaves the water and lives mainly on land, as a frog.



Nobel Prize 2024 in Physiology or Medicine: RNA's Role in Genetics Uncovered

By Mohaddesa Fatema (SYBsc)

On October 7, the Nobel Committee announced that Victor Ambros and Gary Ruvkun would share the Nobel Prize for Medicine or Physiology "for the discovery of microRNA and its role in post-transcriptional gene regulation," unlocking a secret in how different cell types develop. This year's Nobel Prize honors their discovery of a fundamental principle governing how gene activity is regulated.

The information within our chromosomes can be compared to an instruction manual for all cells in our body. Every cell contains the same chromosomes, so every cell has the same set of genes and instructions. Yet, different cell types, such as muscle and nerve cells, have distinct characteristics. How do these differences arise? The answer lies in gene regulation, which ensures that only the relevant genes are active in each cell type.

Victor Ambros and Gary Ruvkun were interested in how different cell types develop. They discovered microRNA, a new class of tiny RNA molecules that play a crucial role in gene regulation. This discovery revealed an entirely new principle of gene regulation that is essential for multicellular organisms, including humans. The human genome now codes for over one thousand microRNAs. Their groundbreaking work revealed a completely new dimension to gene regulation, showing that microRNAs are vital for how organisms develop and function.

In the late 1980s, Ambros and Ruvkun were postdoctoral fellows in Robert Horvitz's laboratory, where they studied the small roundworm C. elegans. Despite its size, C. elegans possesses specialized cell types like nerve and muscle cells, which are also found in larger animals, making it a useful model for studying tissue development in multicellular organisms.

Ambros and Ruvkun focused on genes that control the timing of genetic program activation, ensuring different cell types develop at the right time. They studied two mutant strains of worms, lin-4 and lin-14, which had defects in the timing of genetic program activation. Ambros had shown that the lin-4 gene negatively regulated lin-14, but the mechanism behind this was unclear. The two researchers aimed to uncover how this worked.

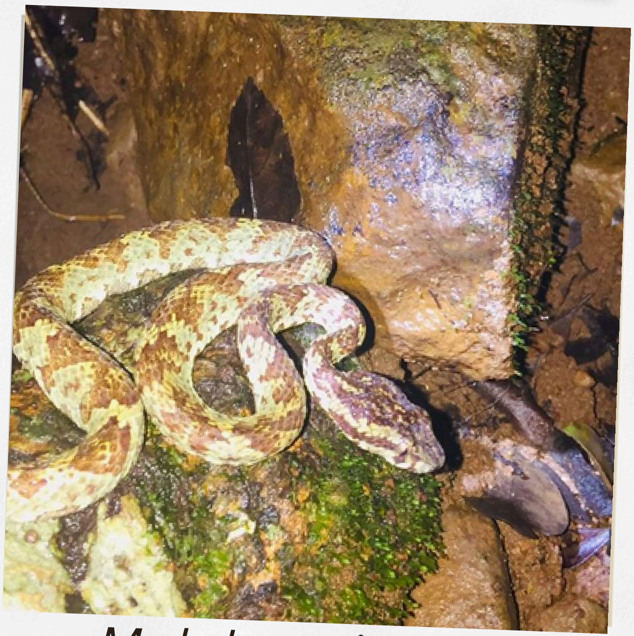
After his postdoctoral research, Ambros analyzed the lin-4 mutant in his newly established laboratory at Harvard University. His methodical mapping led to the cloning of the gene, revealing an unexpected finding: the lin-4 gene produced an unusually short RNA molecule that lacked a protein-coding sequence. This suggested that the short RNA from lin-4 was responsible for inhibiting lin-14. Meanwhile, Ruvkun studied lin-14 regulation at Massachusetts General Hospital and Harvard Medical School. He showed that gene regulation occurred later in gene expression, by shutting down protein production. His experiments revealed that a segment of lin-14 mRNA was essential for its inhibition by lin-4. The two researchers compared their findings and made a breakthrough. The short lin-4 RNA sequence matched complementary sequences in the critical segment of lin-14 mRNA. Further experiments showed that lin-4 microRNA inhibited lin-14 by binding to complementary sequences in its mRNA, blocking protein production. This discovery unveiled a new principle of gene regulation mediated by microRNA.

The results were published in 1993 in Cell. Initially, the scientific community paid little attention to the findings, considering them a peculiarity of C. elegans. However, in 2000, Ruvkun's group identified another microRNA, encoded by the let-7 gene. This microRNA was highly conserved and present throughout the animal kingdom, sparking significant interest. Over time, hundreds of microRNAs were discovered, and today we know that gene regulation by microRNA is universal among multicellular organisms.

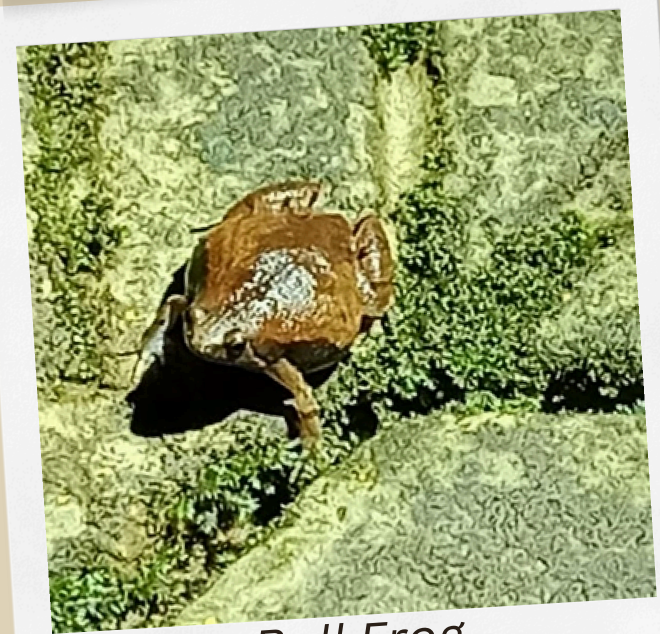
Photo Gallery

Stick Insect
Phasmatodea
By Rajeshwari (SYBsc)

Wrinkle Frog
Nyctibatrachus humayuni
By Tanishq (SYBsc)



Malabar pit viper
Trimeresurus malabaricus
By Rajeshwari (SYBsc)



Bull Frog
Lithobates catesbeianus
By Koushmi (SYBsc)

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