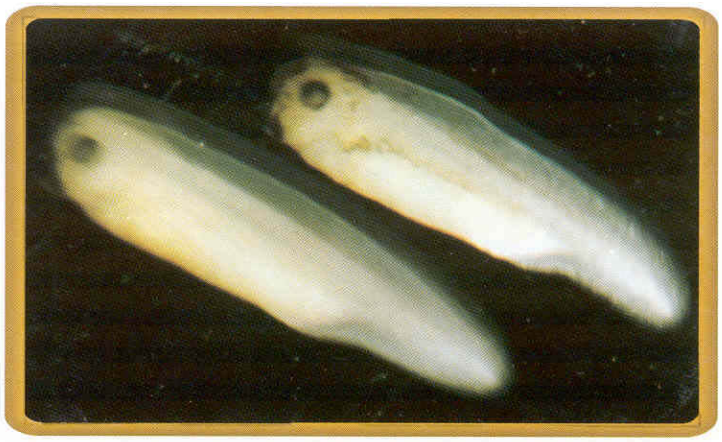
RESEARCH NOTES: Of Heads and Tails

Vertebrate embryos begin as a single fertilized egg cell, which repeatedly divides until a hollow ball of cells (blastula) is formed.The cells then form three distinct layers (endoderm, mesoderm, ectoderm) and begin to overtly differentiate into different organ and tissues. This requires cells to transcribe different parts of their DNA library into active messenger-RNA and thus produce different proteins. This process controlled by specific transcription factors (TF), special proteins which bind to DNA. The TF function as control elements that help turn specific genes "off" or "on". Like movie battle scenes with a cast of thousands," the genes that produce TF proteins are themselves turned off and on at just the right time by a set of super-coordinating "homeobox genes. The powerful proteins produced by these homeobox genes orchestrate the development of whole body regions: head, trunk segments, limbs, tail.



Normal Xenopus (frog) embryos

Israel NSF grantee Prof. D. Frank and his Technion colleagues have recently demonstrated the dramatic effects of (the product of a POU homeobox gene), the XLPOU91, protein in the frog Xenopus laevis, a well-studied animal model. They find that XLPOU91 protein can bind to a specific set of eight base pairs in the frog's DNA to stop the transcription of important adjacent genetic messages. Adding even 1-2 nanograms (thousandths of a millionth of a gram) of XLPOU91 protein to a fertilized frog egg can severely reduce or abort the normal development of the subsequent embryo's tail region (see photographs).

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Adding micro-amounts of XLPOU91 to a fertilized egg dramatically truncates the tail region of the subsequent embryo

The extra XLPOU91 protein apparently decreases the development of mesoderm cells (ten-fold), the effectiveness of fibroblast growth factor (FGF) signals, and the expression of muscle-specific MyoD and actin genes, all of which are needed to produce tail muscle and connective tissue. Artificially reducing the level of active XLPOU91 protein, using site-directed mutants or anti-sense DNA, produces opposite effects. Without sufficient tail-repressing XLPOU91 protein, the head structures are less developed and the tail structures are more developed than normal. These studies cast important light on how the body's overall plan is controlled at the molecular level.

The **Research Notes** highlighted in **The Forum** are selected from the over 600 research projects funded each year by the Israel National Science Foundation. The Foundation, administered by the Israel Academy of Sciences and Humanities, plays a major role in assuring the future quality and scope of Israeli basic science. However, due to budgetary limitations, only 20-30% of the eligible grant submissions can currently be funded. Additional science articles and information on opportunities for dedicated contributions can be obtained from the AFBRI (see masthead).