

BIO 368- COMPARATIVE VERTEBRATE EMBRYOLOGY

LECTURE NOTES AND READING GUIDE

INTRODUCTION

COMPARATIVE VERTEBRATE EMBRYOLOGY is the comparison of developmental stages among vertebrates: Ernst Haeckel (1834-1919) is famous for his principle of "ONTOGENY RECAPITULATES PHYLOGENY" which claims that the development of an individual reflects the stages through which the individual species has passed during its evolution.

All vertebrate embryos follow a common developmental plan due to having a set of genes that gives the same instructions for development. As each organism grows, it diverges according to its species way of life.

HISTORY

Comparative embryology is the study of how anatomy changes during development of different organisms. Comparative embryologists are interested in how tissues that form the bird wing relate to the tissues that form the fish fin or the human hand.

Aristotle – First known embryologist. Famous for his studies on the different ways that animals are born (viviparity, ovoviviparity, oviparity)

William Harvey – 1651

Marcello Malpighi – 1672

Christian Pander -1817

Heinrich Rathke

Karl Ernst Von Baer – Proposed the 4 principle or law of development

1. General features of a large group of animals appears earlier in development than do the specialized features of a smaller group. All developing vertebrate appears similar up to the gastrulation; before developing special features that differentiate them into Class, Order, Family and Genus.
2. Less general characters are developed from the more general. All vertebrates initially have the same types of skin. Only later does the skin develop fish scales, reptile scales, bird feather or hair, claws, nails etc.
3. The embryo of the given species instead of passing through the adults stages of lower animals, departs more and more from them. The visceral cleft of embryonic birds and mammal do not resemble the gills slits of adult fish in details. Rather they resemble the visceral cleft of embryonic fish.

4. Therefore the early embryo of a higher animal is never like a lower animal, but only its early embryo.

GAMETOGENESIS

Gametogenesis is the differentiation of primordial germ cells into functional gametes. The differentiation of germ cells into sperm is known as spermatogenesis and the differentiation of germ cells to ovary is known as oogenesis

ORIGIN OF GERM CELL

Primordial germ cell is usually segregated from the rest of the cell in a developing gonad. All multicellular organisms contain a special material the GERMPLASM that faithfully transmits the complete hereditary makeup of the species from one generation to the next.

FERTILISATION – The fusion of the male gamete and the female gamete to form an embryo. Fertilization is very important step in embryo development. Fertilization triggers the commencement of development and growth of female ovum (zygote).

CLEAVAGE- The partition of the egg cell into several cells is known as cleavage. It is a period of rapid, synchronized cell division as hundreds and sometimes thousand of cells are produced within a matter of hours. The cell becomes smaller with each cleavage. There are different types of cleavage pattern depending on the amount of yolks in egg cell or size of the eggs

Type of yolk

Hololecithal (isolecithal, Oligolecithal) eggs

GASTULATION – Transformation of the blastula stage into a folded, double-layered embryo leading to the formation of germ layers i.e ectoderm, mesoderm and endoderm.

ORGANOGENESIS - This the formation of tissues and organs. The process of organ formation is complex and follows a pattern depending on the species.

The first stage in organ development is NEURULATION which established the vertebrate nervous system.