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Perspective

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Epigenesis is the Idea that Organisms Develop from Seed or Egg in a Sequence of Steps

Andrej Zivor *

Department of Zoological Sciences at the University of Manchester, UK

*Corresponding author: Andrej Zivor, Department of Zoological Sciences at the University of Manchester, UK, Email: zivorandrez05@edu.uk

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Description

Early embryology was proposed by Marcello Malpighi, and known as preformationism, the theory that organisms develop from pre-existing miniature versions of themselves. Aristotle proposed the theory that is now accepted, epigenesis. Modern embryology developed from the work of Karl Ernst von Baer, though accurate observations had been made in Italy by anatomists such as Aldrovandi and Leonardo da Vinci in the Renaissance. As recently as the 18th century, the prevailing notion in western human embryology was preformation: the idea that semen contains an embryo – a preformed, miniature infant, or homunculus – that simply becomes larger during development. The competing explanation of embryonic development was epigenesis, originally proposed 2,000 years earlier by Aristotle. Much early embryology came from the work of the Italian anatomists Aldrovandi, Aranzio, Leonardo da Vinci, Marcello Malpighi, Gabriele Falloppio, Girolamo Cardano, Emilio Parisano, Fortunio Liceti, Stefano Lorenzini, Spallanzani, Enrico Sertoli, and Mauro Ruscóni. According to epigenesis, the form of an animal emerges gradually from a relatively formless egg. As microscopy improved during the 19th century, biologists could see that embryos took shape in a series of progressive steps, and epigenesis displaced preformation as the favored explanation among embryologists. In developmental biology, cleavage is the division of cells in the early embryo, following fertilization. The zygotes of many species undergo rapid cell cycles with no significant overall growth, producing a cluster of cells the same size as the original zygote. The different cells derived from cleavage are called blastomeres and form a compact mass called the morula. Cleavage ends with the formation of the blastula.

Holoblastic

Holoblastic cleavage is the complete division of cells. Holoblastic cleavage can be radial (see: Radial cleavage), spiral (see: Spiral cleavage), bilateral (see: Bilateral cleavage), or rotational (see: Rotational cleavage). In holoblastic cleavage the entire egg will divide and become the embryo, whereas in meroblastic cleavage some cells will become the embryo and others will be the yolk sac. Meroblastic cleavage is the incomplete division of cells. The division furrow does not protrude into the yolky region as those cells impede membrane formation and this causes the incomplete separation of cells. Meroblastic cleavage can be bilateral (see: Bilateral cleavage), discoidal (see: Discoidal cleavage), or centrolecithal (see: Centrolecithal). Animals that belong to the basal phyla have holoblastic radial cleavage which results in radial symmetry (see: Symmetry in biology). During cleavage there is a central axis that all divisions rotate about. The basal phyla also have only one to two embryonic cell layers, compared to the three in bilateral animals (endoderm, mesoderm, and ectoderm).

Bilaterians

In bilateral animals cleavage can be either holoblastic or meroblastic depending on the species. During gastrulation the blastula develops in one of two ways that divide the whole animal kingdom into two-halves (see: Embryological origins of the mouth and anus). If in the blastula the first pore, or blastopore, becomes the mouth of the animal, it is a protostome; if the blastopore becomes the anus then it is a deuterostome. The protostomes include most invertebrate animals, such as insects, worms and molluscs, while the deuterostomes include the vertebrates. In due course, the blastula changes into a more differentiated structure called the gastrula. Soon after the gastrula is formed, three distinct layers of cells (the germ layers) from which all the bodily organs and tissues then develop.

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