Endoderm

Endoderm is one of the germ layers—aggregates of cells that organize early during embryonic life and from which all organs and tissues develop. All animals, with the exception of sponges, form two or three germ layers, through a process known as gastrulation. During gastrulation, a ball of cells transforms into a two-layered embryo made of an inner layer of endoderm and an outer layer of ectoderm. In more complex organisms, such as vertebrates, two or three germ layers form, including an intermediate layer of mesoderm. The layers of endoderm are the innermost layer, which lines the gut, organs like the digestive tract, liver, pancreas, and lungs develop.

Throughout the early stages of gastrulation, a group of cells called mesendoderm expresses sets of both endoderm and mesoderm-specific genes. Cells in the mesendoderm have the ability to differentiate into either endoderm or mesoderm, depending upon their position among surrounding cells. Scientists have found mesendoderm is widespread among invertebrates, including the nematode Caenorhabditis elegans and the purple sea urchin Strongylocentrotus purpuratus. Within vertebrates, mesendoderm has been found in the zebrafish, Danio rerio, and has been induced in mice, Mus musculus.

Endoderm, along with the other two germ layers, was first described in 1817 by Christian Pander, a doctoral student at the University of Würzburg. In 1957 Briggs and King transplanted nuclei from the presumptive endoderm of the sea urchin. By creating a plot, or fate map, of the developmental route of each of the cells, Conklin located the precursor cells, traced the formation of each of the endodermal cell types.


Sources

2. Huxley, Thomas Henry. In England, applied Pander's concept of germ layers to jellyfish. In his 1849 paper "On the Anatomy and Affinities of the Family of the Medusae," Huxley noted that the two layers of cells he saw in the adult jellyfish related to each other the same way as the endoderm and ectoderm in an invertebrate, but that information was not further investigated for two decades.

By the 1860s researchers compared germ layers across the animal kingdom. Beginning in 1864 embryologist Aleksandr Kovalevsky, who studied embryology at the University of St. Petersburg, Russia, studied invertebrates. His research showed that invertebrate embryos had the same primary germ layers that regulate the specification of cells he saw in the adult jellyfish related to each other the same way as the endoderm and ectoderm in an invertebrate, but that information was not further investigated for two decades.

While endoderm theory garnered broad support, not everyone accepted it. Beginning in the late nineteenth century, embryologists such as Hans Spemann at the University of Königsberg, in Königsberg, Prussia (later Poland), found evidence in a developing frog, Rana pipiens, that the mesoderm layer held that each of the germ layers, regardless of species, gave rise to a fixed set of organs. These organs were deemed homologous across the animal kingdom, effectively unifying ontogeny with phylogeny. Scientists like Hans Spemann in Germany and Edwin Ray Lankester at the University College, London, in London, England convined many to accept germ layer theory by the end of the nineteenth century.

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