



## Various Stages of Embryonic Stem Cell Development

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### DESCRIPTION

Embryonic Stem Cells (ESCs) are the cells that make up a blastocyst's inner cell mass before it is implanted into the uterus. The blastocyst stage occurs 4-5 days after fertilisation in human embryonic development, and it contains 50-150 cells. ESCs are pluripotent, meaning they can develop into any of the three germ layers (ectoderm, endoderm, and mesoderm) during growth. In other words, when given sufficient and necessary stimulation, they can develop into any of the more than 200 cell types found in the adult body. They have no effect on the placenta or extraembryonic membranes. The cells of the inner cell mass continuously divide and become more specialised during embryonic development. For example, in the dorsal part of the embryo, a portion of the ectoderm specialises as 'neurectoderm,' which will eventually become the central nervous system. The neurectoderm forms the neural tube later in development as a result of neurulation. The anterior portion of the neural tube undergoes encephalization to generate or pattern the basic form of the brain at the neural tube stage. The main cell type of the CNS at this stage of development is referred to as a neural stem cell.

The neural stem cells regenerate and eventually transform into Radial Glial Progenitor Cells (RGPs). Early-stage RGPs divide symmetrically to form a reservoir of progenitor cells. These cells enter a neurogenic state and begin to divide asymmetrically, resulting in a wide range of neuron types, each with its own gene expression, morphological, and functional characteristics. Neurogenesis is the process of creating neurons from radial glial

cells. To this point, almost all studies have used Mouse Embryonic Stem Cells (mES) or Human Embryonic Stem Cells (hESC) derived from the early inner cell mass. Both have essential stem cell characteristics, but to remain undifferentiated, they require very different environments. Mouse ES cells require the presence of Leukaemia Inhibitory Factor (LIF) in serum media and grow on a layer of gelatin as an extracellular matrix (for support). A drug cocktail called 2i, which contains inhibitors of GSK3B and the MAPK/ERK pathway, has also been shown to keep pluripotency in stem cell culture.

### CONCLUSION

The expression of a number of transcription factors and cell surface proteins also helps to define a human embryonic stem cell. *Oct4*, *Nanog*, and *Sox2* are transcription factors that form a core regulatory network that ensures the suppression of genes that lead to differentiation and pluripotency maintenance. The glycolipids stage-specific embryonic antigens 3 and 4, as well as the keratan sulphate antigens Tra-1-60 and Tra-1-81, are the antigens most commonly used to identify hES cells. Many more proteins are included in the molecular definition of a stem cell, which is still a work in progress. Scientists can access adult human cells without taking tissue from patients by using human embryonic stem cells to produce specialised cells like nerve cells or heart cells in the lab. They can then study these specialised adult cells in greater depth to try to identify disease complications or to investigate cell reactions to potential new drugs.

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