

Gail Roberta Martin (1944-)

In the twentieth and early twenty-first centuries, Gail Roberta Martin specialized in biochemistry and embryology, more specifically cellular communication and the development of organs. In 1981, she named any cell taken from inside a human embryo at the blastocyst stage an “embryonic stem cell”. During development, an embryo goes through the blastocyst stage just before it implants in the uterus. Embryonic stem cells are useful for experiments because they are self-renewing and able to develop into almost any cell type in the body. Martin later identified a key chemical component in limb development and continues to study embryogenesis, or the growth of embryos over time. Martin’s work on embryonic stem cells has allowed scientists to further research and treat human diseases, and her study of how organs form has helped scientists learn about the healthy growth of embryos.

Martin was born in New York City, New York on 2 April 1944. She received her Bachelor of Arts degree in zoology from the University of Wisconsin, Madison in Madison, Wisconsin, in 1964. In the late 1960s, Martin studied as a graduate student at the University of California at Berkeley in Berkeley, California, and worked under Harry Rubin studying how the Rous sarcoma virus affected chicken cells’ genetic material, commonly known as DNA, or deoxyribonucleic acid. When injected in to chickens, the Rous sarcoma virus causes tumors to develop. In Berkeley, Martin met her husband, Steven Martin, who was chair of the Molecular and Cellular Biology Department at the University of California at Berkeley. Martin married Steven in 1969. In 1971, she earned her PhD in molecular biology from the University of California at Berkeley and moved to London, UK, because her husband was offered a job there. After being denied a position at the British Museum in London, UK, for not being a UK citizen, Martin worked under biochemist Martin Evans at University College London in London, UK. His lab attempted to isolate, maintain, and develop pluripotent mouse teratoma cells. Teratoma means “monstrous tumor” in Greek and is named so because one teratoma can contain different types of cells that can develop into bone, hair, teeth, eyes, and neurons. The ability to develop into different types of cells makes the teratoma cells pluripotent.

Martin worked on some of the first experiments involving embryonic stem cells and analyzed their properties, laying the foundation for further research and applications concerning embryonic stem cells. In 1975, Martin moved to San Francisco, California, and continued her postdoctoral work at the University of California, San Francisco in San Francisco, California. There, she worked under Charles Epstein and joined the anatomy department as a professor. In 1977, Martin, alongside Beatrice Mintz, created the first mice with mutations similar to those found in humans. That accomplishment improved the study of human diseases because it reduced the need for human test subjects.

In 1981, Martin isolated pluripotent stem cells from mouse embryos and coined the term “embryonic stem cell”. After isolating embryonic stem cells, Martin observed that the cells clumped together in a manner similar to that of a developing embryo and that the cells outside the clump looked different than the cells inside the clump. Those differences were similar to the germ layers that embryos form during development. She called those clumps of embryonic stem cells embryoid bodies because they were conglomerations resembling embryos. Moreover, she determined that injecting mice with embryonic stem cells caused tumors to form at the injection location. As of 2018, Scientists still use the term “embryonic stem cells” today.

In the 1990s, Martin and other scientists identified different types of fibroblast growth factors, or proteins that support cell growth and play a role in growth of embryos and organs, that have multiple effects on body development. In 1993, Martin and Lee Niswander found that the protein

fibroblast growth factor-4 initiates the growth of limbs in developing embryos and a protein called bone morphogenetic protein-2 stops the growth of limbs in developing embryos. Later that year, Martin and Niswander published an article stating that the protein fibroblast growth factor-4 provides all of the embryonic chemical communication necessary to grow complete limbs in developing chickens. In 1994, Martin, along with Jean Hébert, Jürgen Götz, and Thomas Rosenquist suggested that fibroblast growth factor-4 stops hair elongation in mice, as mice without that growth factor grow fur longer than a typical mouse. In 1997, Martin, Annette Neubüser, Heiko Peters, and Rudi Balling identified fibroblast growth factor-8 as a marker for tooth growth and bone morphogenetic protein-2 and bone morphogenetic protein-4 as chemicals that stop tooth growth in mice. In 1999, Martin and Erik Meyers identified fibroblast growth factor-8 and Sonic Hedgehog, a gene involved in body formation named for the spiky appearance of the *Drosophila* flies that don't express the gene, to be necessary chemicals for proper chick and mouse heart growth.

Academic societies and universities recognized Martin after she isolated and manipulated embryonic stem cells in non-human animals. In 1991, Martin became a member of the American Academy of Arts and Sciences, headquartered in Cambridge, Massachusetts. In 2002, she became a member of the US National Academy of Sciences, headquartered in Washington DC. In 2002, Martin also received the Edwin Grant Conklin Medal from the Society for Developmental Biology, headquartered in Bethesda, Maryland. From 2006 to 2007, she served as the president of the Society for Developmental Biology.

On 25 March 2007, earned the Pearl Meister Greengard Prize from Rockefeller University in New York City, New York, for her contribution to transgenic technologies. Scientists use transgenic technologies in studies where they mix the genes of different organisms. Corri Bargmann, speaker at the award ceremony and head of Rockefeller's Laboratory of Neural Circuits and Behavior, stated that the transgenic research done on mice is important because it allows for the ethical and efficient understanding of human diseases and development of treatments for those diseases. Bargmann goes on to say that cancer and psychiatric diseases are special diseases that humans can learn about from the development of embryonic stem cells and transgenic research. At a panel after the awards ceremony, Martin explained that embryonic stem cells will be useful in creating replacement organs.

In 2011, Martin received the Excellence in Science award from the Federation of American Societies for Experimental Biology, headquartered in Bethesda, Maryland.

Martin and her husband Steven have a son named Nicholas.

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