Gerald Maurice Edelman (born July 1, 1929) is an American biologist who won the 1972 Nobel Prize in Physiology or Medicine for his work on the immune system. Edelman's Nobel Prize-winning research concerned discovery of the structure of antibody molecules.In interviews, he has said that the way the components of the immune system evolve over the life of the individual is analogous to the way the components of the brain evolve in a lifetime. This is the continuity between his Nobel-Prize-winning work on the immune system and his highly influential and groundbreaking later work in neuroscience.

Gerald Edelman was born in 1929 in Ozone Park, Queens, New York to Jewish parents, physician Edward Edelman, and Anna Freedman Edelman, who worked in the insurance industry.[3] After being raised in New York, he attended college in Pennsylvania where he graduated magna cum laude with a B.S. from Ursinus College in 1950 and received an M.D. from the University of Pennsylvania in 1954.

After a year at the Johnson Foundation for Medical Physics, he became a house officer at the Massachusetts General Hospital and then practiced medicine in France while serving with US Army Medical Corps.Edelman joined the Rockefeller Institute for Medical Research as a graduate fellow in 1957, receiving a Ph.D. in 1960.Rockefeller made him the Assistant (later Associate) Dean of Graduate Studies until 1966, when he became a professor at the school. In 1992, he moved to California and became a professor of neurobiology at The Scripps Research Institute.

After his Nobel prize award, Edelman began research into the regulation of primary cellular processes, particularly the control of cell growth and the development in multi-celled organisms, focussing on cell-to-cell interactions in early embryonic development and in the formation and function of the nervous system. These studies led to the discovery of cell adhesion molecules (CAMs), which guide the fundamental processes that help an animal achieve its shape and form, and by which nervous systems are built. One of the most significant discoveries made in this research is that the precursor gene for the neural cell adhesion molecule gave rise in evolution to the entire molecular system of adaptive immunity.

Edelman is the founder and director of The Neurosciences Institute, a nonprofit research center in San Diego that studies the biological bases of higher brain function in humans, and is on the scientific board of the World Knowledge Dialogue project While in Paris serving in the Army, Edelman read a book that sparked his interest in antibodies. He decided that, since the book said so little about antibodies, he would investigate them further upon returning to the United States, which led him to study physical chemistry for his 1960 Ph.D.Research by Edelman and his colleagues and Rodney Robert Porter in the early 1960s produced fundamental breakthroughs in the understanding of the antibody's chemical structure, opening a door for further study. For this work, Edelman and Porter shared the Nobel Prize in Physiology or Medicine in 1972.

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Edelman is noted for his theory of consciousness, published in a trilogy of technical books, and in later books written for a general audience including Bright Air, Brilliant Fire (1992), A Universe of Consciousness (2001, with Giulio Tononi), Wider than the Sky (2004) and Second Nature: Brain

Science and Human Knowledge (2007).

In Second Nature Edelman defines human consciousness as being:

"... what you lose on entering a dreamless deep sleep ... deep anesthesia or coma ... what you regain after emerging from these states. [The] experience of a unitary scene composed variably of sensory responses ... memories ... situatedness ... "

The first of these books, Neural Darwinism (1987) contains a theory of memory that is built around the idea of plasticity in the neural network in response to the environment. Topobiology (1988) contains a theory of how the original neuronal network of a newborn's brain is established during development of the embryo. The Remembered Present (1990) contains an extended exposition of his theory of consciousness.

Edelman has asked whether we should attempt to construct models of functioning minds or models of brains which, through interactions with their surroundings, can develop minds. Edelman's answer is that we should make model brains and pay attention to how they interact with their environment. Edelman accepts the existence of qualia and incorporates them into his brain-based theory of consciousness. His concept of qualia attempts to avoid the pitfalls of the idea of special qualia with non-functional properties, which was criticized by Daniel Dennett.

Edelman proposes a biological theory of consciousness, based on his studies of the immune system. He explicitly locates his theory within Darwin's Theory of Natural Selection, citing the key tenets of Darwin's population theory, which postulates that individual variation within species provides the basis for the natural selection that eventually leads to the evolution of new species[9]. He rejects dualism and also dismisses newer hypotheses such as the so-called 'computational' model of consciousness, which liken the brain's functions to the operations of a computer.

Edelman argues that the mind and consciousness are wholly material and purely biological phenomena, arising from highly complex cellular processes within the brain, and that the development of consciousness and intelligence can be satisfactorily explained by Darwinian theory.

In Edelman's view, human consciousness depends on and arises from the uniquely complex physiology of the human brain:

* the vast number of neurons and associated cells in the brain
* the almost infinitely complex physiological variations in neurons (even of the same general type) and in their connections with other cells
* the massive multiple parallel re-entrant connections between individual cells, and between larger neuronal groups, and so on, up to entire functional regions and beyond.

Edelman's theory is strongly anti-reductionist and seeks to explain consciousness by reference to the uniquely rich and complex morphology of the brain. A newborn baby's brain contains a massive population of neurons (approx. 100 billion cells) and those that survive the initial phases of growth and development will make approximately 100 trillion connections with each other. A sample of brain tissue the size of a match head contains about a billion connections, and if we consider how these neuronal connections might be variously combined, the number of possible permutations becomes hyper-astronomical -- in the order of ten followed by millions of zeros[10]. The young brain contains many more neurons than will ultimately survive to maturity, and Edleman argues that this redundant capacity is needed because neurons are the only cells in the body that cannot be renewed and only those cells and networks best adapted to their ultimate purpose will be selected as they organise into neuronal groups.

Edelman's theory of neuronal group selection, also known as neural Darwinism, has three basic tenets -- Developmental Selection, Experiential Selection and Reentry.

* Developmental selection -- the formation of the gross anatomy of the brain is controlled by genetic factors but in an individual brain, the connectivity between neurons at the synaptic level and the organisation of neurons into functional neuronal groups is determined by somatic selection during growth and development. This process generates tremendous variability in the neural circuitry -- like the fingerprint or the iris, no two people will have precisely the same synaptic structures in any comparable area of brain tissue. Their high degree of functional plasticity and the extraordinary density of their interconnections enables neuronal groups to self-organise into many complex and adaptable "modules". These are made up of many different types of neurons which are typically more closely and densely connected to each other than they are to neurons in other groups.

* Experiential selection -- Overlapping the initial growth and development of the brain, and extending throughout an individual's life, a process of synaptic selection occurs within the diverse repertoires of neuronal groups. This process may strengthen or weaken the connections between groups of neurons and it is constrained by value signals that arise from the activity of the ascending systems of the brain, which are continually modified by successful output. Experiential selection generates dynamic systems that can 'map' complex spatio-temporal events from the sensory organs, body systems and other neuronal groups in the brain onto other selected neuronal groups. Edelman argues that this dynamic selective process is directly analogous to the processes of selection that act on populations of individuals in species, and he also points out that this functional plasticity is imperative, since the coding capability of entire human genome is not sufficient to explicitly specify the synaptic structure of the developing brain

* Reentry -- the third tenet of Edelman's thesis is the concept of reentrant signalling between neuronal groups. He defines reentry as the ongoing recursive dynamic interchange of signals which occurs in parallel between brain maps and which continuously interrelates these maps to each other in time and space. It depends for its operations on the intricate networks of massively parallel reciprocal connections within and between neuronal groups, which arise through the processes of developmental and experiential selection outlined above. Edelman describes reentry as "a form of ongoing higher-order selection ... that appears to be unique to animal brains" and that "there is no other object in the known universe so completely distinguished by reentrant circuitry as the human brain".