



Eric R. Kandel

Early Years

"Memory has always fascinated me. Think of it. You can recall at will your first day in high school, your first date, and your first love. In doing so you are not recalling the event, you are also experiencing the atmosphere in which it occurred—the sights, sounds, and smells, the social setting, the time of day, the conversations, and the emotional tone. Remembering the past is a form of mental time travel; it frees us from the constraints of time and space and allows us to move freely along completely different dimensions." -*In Search Of Memory*

- Born in Vienna on November 7, 1929
- He lived in Vienna for ten years and during the last year under Nazi rule.
- His early years in Vienna gave rise to a fascination with memory, a fascination that focused first on history and psychoanalysis, then on the biology of the brain, and finally on the cellular and molecular processes of memory.
- Immigrated to the United States in April 1939 with his brother. His parents followed a few months later. They settled in Brooklyn, New York and it felt like a breath of fresh air.

Education

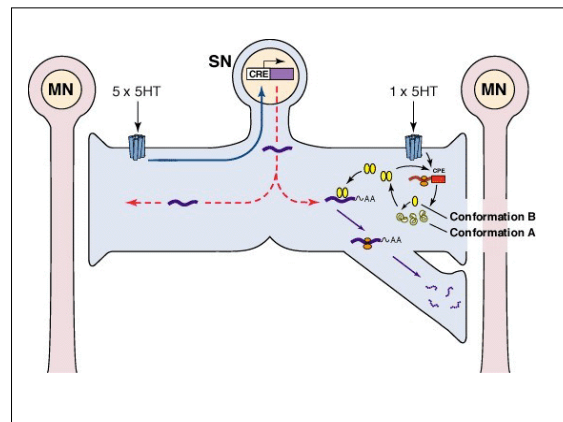
- Graduated from Harvard College in 1951 where he majored in history and literature.
- Received his Medical degree from N.Y.U. medical school in 1956. He became interested in the biology of the brain unlike most psychoanalysts.
 - Elective period-Grundfest Laboratory at Columbia University. He wanted to study neural science and Harry Grundfest was the most intellectually interesting neurobiologist in the New York area.
 - Here he met his future wife Denise who was a sociologist but loved science and always encouraged him to pursue it.
- 1957 National Institute of Health-Laboratory of Neurophysiology he did his postdoctoral training with Wade Marshall.
 - Wade Marshall in the 1930's and 40's revolutionized the study of the sensory representations in the brain and showed that the brain had systematic topographical maps of the sensory surface for each of the three major sensations – touch, vision, and hearing.
 - He studied mammalian brain neurophysiology through the reductionist approach and chose the giant marine snail, *Aplysia*.
- Psychiatric residency at the Massachusetts Mental Health Center of the Harvard Medical School in 1960.
- 1962 Postdoctoral fellowship with Ladislav Tauc at the Institut Morey in Paris who was one of the two people working in the world with *Aplysia*.

Research and Career

- **Aplysia**
- Its nervous system has a small number of cells
- The cells are unusually large
- Many of the cells are invariant and identifiable as unique individuals
- Demonstrated fundamental ways in which nerve cells alter their responsiveness to chemical signals to produce a coordinated change in behavior.
- 1965, Dr. Kandel was appointed associate professor in the Departments of Physiology and Psychiatry at New York University Medical School, and was promoted to full professor in 1968.
 - Here he continued his research of *Aplysia* and how it learned and retained short term memory and long term memory through protein synthesis and synaptic plasticity.

Research and Career

- 1974 Moved from N.Y.U. to the Columbia University to become the founding director of the Center for Neurobiology and Behavior where he remains today.
- University Professor at Columbia in 1983 and a Hughes Senior Investigator in 1984
- Kandel's research has been pivotal in relating three psychologically defined forms of learning—habituation, sensitization, and classical conditioning—to subcellular processes and intercellular signaling. In his studies, Dr. Kandel found that simple behaviors could be accounted for by distinctive sets of nerve cells connected in invariant circuits. Dr. Kandel and colleagues found that learning produces changes in behavior not by altering basic circuitry, but by adjusting the strength of particular connections between nerve cells. Dr. Kandel and co-workers also defined sets of genes and proteins that stabilize synaptic connections and trigger growth of new ones. More recently, Kandel's lab has extended this approach from simple forms of memory in the *Aplysia* to more complex forms of spatial learning in mammals.



- A model for memory and its persistence in *Aplysia*. Repeated pulses of 5-HT (5-HT) to one branch send a retrograde signal to the cell body activating transcription. The newly synthesized mRNAs, some of which are translationally inactive, are distributed to all synapses. One pulse of 5-HT applied to the other branch is sufficient to increase the level of CPEB (cytoplasmic polyadenylation element-binding protein). The newly synthesized CPEBs (conformation A) are the inactive conformational state of the protein. Some of the protein in conformation A, either spontaneously or in a regulated way, converts into the dominant, self-perpetuating active conformation B. Few molecules in conformation B have the ability to convert all of conformation A to that of conformation B. The protein in conformation B can activate the translationally inactive mRNAs by elongating their polyA tail. The CPEB mRNA itself has a putative CPE element. Thus, once activated, the conformation B proteins can potentially regulate the availability of the proteins in conformation A. This can lead to a self-sustaining, autoregulatory feedback loop that could contribute to the stabilization of learning-related synaptic growth and the persistence of memory storage.

Awards

- Lasker Award, the Gairdner Award, the Harvey Prize, and the National Medal of Science.
- The most prestigious Nobel Prize in 2000 in Medicine along with Arvid Carlsson of the University of Göteborg, and Paul Greengard of The Rockefeller University. The three scientists were honored for their discoveries concerning signal transduction in the nervous system.

Books

- Psychiatry, Psychoanalysis, and the New Biology of Mind
- Principles of Neural Science, Fourth Edition (with James H. Schwartz and Thomas M. Jessell)
- Memory: From Mind to Molecules (with Larry Squire)
- Essentials of Neural Science and Behavior (with James H. Schwartz and Thomas M. Jessell)
- Behavioral Biology of *Aplysia*
- Cellular Basis of Behavior
- In Search of Memory