

Andrew Zachary Fire (1959-)

Andrew Zachary Fire is a professor at Stanford University and Nobel Laureate. Fire worked at the Carnegie Institution of Washington's Department of Embryology with colleague Craig Mello, where they discovered that RNA molecules could be used to turn off or knock out the expression of genes. Fire and Mello called the process RNA interference (RNAi), and won the Nobel Prize in Physiology or Medicine in 2006 for their discovery.

Fire was born on 27 April 1959 in Stanford, California, to Janet and Philip Fire. The young Fire spent his childhood in Sunnyvale, California, where he graduated from Fremont High School at the age of fifteen. Fire then attended the University of California at Berkeley, in Berkeley, California, to study mathematics, and he received his degree in 1978 at the age of nineteen. Afterward, Fire pursued graduate studies in biology at the Massachusetts Institute of Technology, in Cambridge, Massachusetts, where he studied with Nobel laureate geneticist, Philip Sharp. Fire was awarded a doctorate degree from MIT in biology in 1983 after studying the genetic transcription of adenovirus.

From 1983 to 1986, Fire worked in Cambridge, England, as a Helen Hay Whitney Foundation Fellow. Fire worked in the molecular biology laboratory run by Nobel laureate biologist Sydney Brenner, where they studied DNA transformation techniques. Fire examined how foreign DNA injected into a species of nematode worm (*Caenorhabditis elegans*) could be analyzed, and he developed new micro-injection techniques for inserting DNA into cells, a process called transfection. Fire described his new technique of DNA transfection in the 1986 article "Integrative Transformation of *C. elegans*". Within the paper, Fire presented new techniques for micro-injection technology that impacted future cloning research in developmental biology.

In 1986, Fire accepted a position at the Carnegie Institution of Washington's Department of Embryology in Baltimore, Maryland. Fire began collaborating with fellow molecular biologist, Craig Mello, who was conducting research on *C. elegans* at Harvard. Through their collaboration, Fire and Mello analyzed data from their experiments with early developmental genes, like *apx-1*, which is involved in embryogenesis. During their experiments, Fire and Mello noticed that some developmentally harmful genes were silenced in certain embryos, and were not passed on to the next generation through the germ line. Fire and Mello called that genome protection response RNA interference, or RNAi, as it silenced genes producing aberrant or harmful proteins.

After Fire and Mello's initial discovery of RNAi, researchers began to experience difficulty investigating the process due to unknown contaminants. Fire hypothesized that the unknown contaminants were double-stranded RNA (dsRNA). Fire relayed the information about dsRNA to Mello, and they subsequently redesigned the experiment to remove dsRNA contamination. They published their refined results in their 1998 article "The Potent and Specific Genetic Interference by Double-stranded RNA in *C. elegans*". By removing errors from dsRNA contamination, Fire and Mello facilitated the widespread use of RNAi as a research tool.

In 2003 Fire left the Carnegie Institution of Washington for a teaching position at Stanford University, in Palo Alto, California. In his first year there, Fire co-authored an article called, "UNC-39, The *C. elegans* Homolog of the Human Myotonic Dystrophy Associated Homeodomain Protein SIX5, Regulates Cell Motility and Differentiation." Fire's findings demonstrated a high correlation between the gene *unc-39* and cell differentiation. Building on this and many other genetic discoveries, Fire's laboratory at Stanford created a tool called The Fire Lab *C. elegans* Vector Kit, which allows for easy tagging of hundreds of protein pathways in the model animal *C. elegans*.

In 2003, *Science* called Fire and Mello's discovery the RNAi the breakthrough of the year. The

same year, Fire and Mello also received the National Academy of Sciences Award for Molecular Biology, as well as Rockefeller University's Wiley Prize in Biomedical Sciences. In 2004 both Fire and Mello were elected to the National Academy for Sciences. When asked about his achievements, Fire stated that he was elated, but conscious of his place within a larger community of scientists who all work together. In 2005, Fire and Mello both received the Rosenstiel Award for Distinguished Work in Medical Research, the Gairdner International Award, and the Massry Prize. All of these accolades prefaced the award of the Nobel Prize in Physiology or Medicine in 2006 that both Fire and Mello shared for their discovery of RNAi.

As of 2012, Fire taught at Stanford, in the Department of Pathology and Genetics, and he has served as an adjunct professor of biology at Johns Hopkins University in Baltimore, Maryland, since 1989. The Fire Lab continues to investigate cellular responses to changes in the environment, such as developmental transitions, environmental shifts, and pathogen exposure.

Sources

1. Fire, Andrew. "Integrative Transformation of *Caenorhabditis elegans*," *The EMBO Journal* 5 (1986): 2673-80.
2. Fire, Andrew Z., SiQun Xu, Mary K. Montgomery, Steven A. Kostas, Samuel E. Driver, and Craig C. Mello. "The Potent and Specific Genetic Interference by Double-stranded RNA in *Caenorhabditis elegans*," *Nature* 391 (1998): 806-11.
3. Johns Hopkins University. "Headlines at Hopkins: Nobel Co-Winner is Johns Hopkins Faculty Adjunct." <http://www.jhu.edu/news/home06/oct06/fire.html> (Accessed December 26, 2010)
4. Nobel Foundation. "Press Release: The Nobel Prize in Physiology or Medicine 2006". http://www.nobelprize.org/nobel_prizes/medicine/laureates/2006/press.html (Accessed October 15, 2010)
5. Stanford University. "Andrew Fire Profile." http://med.stanford.edu/profiles/Andrew_Fire/ (Accessed December 24, 2010)
6. Stanford University. "Andrew Fire Shares Nobel Prize for Discovering how double-stranded RNAs Can Switch off Genes." http://med.stanford.edu/featured_topics/nobel/fire/ (Accessed December 26, 2010)
7. University of Massachusetts Medical School. (2010). "UMass Medical School Professor Wins Nobel Prize." <http://www.umassmed.edu/pap/news/MelloPrize.aspx> (Accessed December 26, 2010)
8. Yanowitz, Judith L., M. Afaq Shakir, Edward Hedgecock, Andrew Z. Fire, and Erik A. Lundquist. "UNC-39, The *C. elegans* Homolog of the Human Myotonic Dystrophy Associated Homeodomain Protein SIX5, Regulates Cell Motility and Differentiation," *Developmental Biology* 272 (2004): 389-402.