

## Professor Ryuzo Yanagimachi



Date of Birth: August 27, 1928

Nationality: Japan (U. S. Permanent Resident)

Position: Professor, University of Hawaii

Address: Department of Anatomy and  
Reproductive Biology,  
Medical School,  
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### Education and Career:

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| 1952    | B. Sc., Department of Zoology, Faculty of Science, Hokkaido University                       |
| 1955    | M. Sc., Department of Zoology, Faculty of Science, Hokkaido University                       |
| 1955-58 | Research Scientist, Faculty of Science, Hokkaido University                                  |
| 1960    | D. Sc., Hokkaido University  |
| 1960-64 | Postdoctoral Research Scientist, Worcester Foundation for Experimental Biology               |
| 1964-65 | Research Scientist, Faculty of Science, Hokkaido University                                  |
| 1966-74 | Assistant Professor and Associate Professor of Anatomy, Medical School, University of Hawaii |
| 1974    | Professor of Anatomy, Medical School, University of Hawaii                                   |

### Awards and Distinctions:

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| 1977 | Japan's Zoological Society Prize  |
| 1982 | Research Award, Society for the Study of Reproduction (USA)                             |
| 1988 | Award for Excellence in Research and Teaching, The University of Hawaii Board of Regent |
| 1989 | Recognition Award, Serono Symposia USA  |
| 1994 | Marshall Medal, Society for the Study of Fertility (UK)                                 |

## Academic Achievements:

Over the past 35 years, Dr. Yanagimachi has consistently conducted innovative research on reproductive biology, especially on mammalian gamete biology, and as a worldwide leading researcher in this field has contributed immensely to the development of various fields of reproductive biology and biology in general. Through his clear-cut and precise experiments, his keen insight has brought forth his remarkable achievements which are published in numerous reports and papers.

Following his pioneering work on fertilization in herring, which is still quoted in various text books today, he started his research on mammalian gamete biology using hamsters as an animal model. He succeeded in demonstrating that hamster spermatozoa can be capacitated in a culture fluid with relatively simple composition. Until 1963 when this work was reported, it was believed that capacitation required some interaction of spermatozoa with specific secretion of the female tract. However, Dr. Yanagimachi's experiments proved that this was not true, and the discovery led to the development of methods for *in vitro* capacitation of mammalian spermatozoa, including human, and thus for human *in vitro* fertilization.

Dr. Yanagimachi discovered that capacitation involves activation in the sperm motility which is caused by changes in the sperm plasma membrane. He also showed that this change in the sperm motility is vital for the penetration of the zona pellucida. He demonstrated that the low motility of the sperm in testis is due to the character of sperm plasma membrane and not to any deficiency of motility apparatus itself and that the maturation of sperm motility in the epididymis is brought about by the changes in the plasma membrane of the sperm head, inducing acrosome reaction. He identified calcium as an essential factor for activation of the sperm and induction of acrosome reaction, which changes the plasma membrane of the sperm head in a way that enables the sperm's fusion in its mid-region with the egg plasma membrane.

As for the analysis on the egg at fertilization, Dr. Yanagimachi clarified that the egg cortical granule material released after activation by the fertilizing sperm changes the zona pellucida and prevents further fertilization by sperms arriving later. This change (the zona pellucida reaction) is essential for prevention of polyspermy. In the latter half of the 1970's Dr. Yanagimachi discovered that zona-free hamster eggs can be "fertilized" by other mammalian sperms, including the human. Based on this discovery was the development of the hamster test for the functional status of human spermatozoa. It also led to the only method by which sperm chromosomes have been visualized experimentally, and by which human sperm chromosomes are analyzed (karyotype analysis). This technique is now used for clinical treatment.

In 1976 Dr. Yanagimachi discovered that sperm micro-injection into the egg membrane forms the male pronucleus, and this discovery opened the way to the development of ICSI (intracytoplasmic sperm injection) technique, now essential in clinical use. Also Dr. Yanagimachi recently reported that in the process of spermiogenesis and sperm maturation, germ cells at even the secondary spermatocyte stage are able to support normal embryonic development. From this discovery one can infer an essential theory for

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developmental biology. The spermiogenesis and sperm maturation in the epididymis are complex cell metamorphoses concerned only with the mechanics of getting the sperm genomes into and activating the egg and so have no genetic implications on the sperm nuclei level (the genome carried). This has further opened the way to a new clinical treatment of aspermiogenic men.

Dr. Yanagimachi has laid the fundamental theories of mammalian fertilization and his achievements have contributed immensely to the development not only of reproductive biology but also of biology in general. His experiments have greatly influenced treatments concerned with reproduction in clinical medicine and zootechnical science.