

The Marine Biological Laboratory Embryology Course

The Marine Biological Laboratory (MBL) in Woods Hole, Massachusetts, began in 1888 to offer opportunities for instruction and research in biological topics. For the first few years, this meant that individual investigators had a small lab space upstairs in the one wooden building on campus where students heard their lectures and did their research in a common area downstairs. The lectures for those first years offered an overview of general biology with a focus on zoology, and they were intended for teachers and graduate students interested in acquiring the background for teaching about and/or actually doing laboratory work. As the lab quickly grew, it added sets of lectures that made up courses in zoology, then botany, then physiology, and in 1893 what became the first Embryology Course.

The 1890s were a lively time in embryology, with new techniques and discoveries related to the roles of cells in development, and a growing excitement about the way that experimental embryological manipulations could reveal processes that otherwise remain inside the usually opaque embryo. The MBL recognized the importance of this work and began their course in embryology, which was offered as an elementary course in vertebrate embryology. This was designed for those who had already had the general course, and it had the appeal of offering something more advanced that would bring students back for an additional year. The goal that first year was to allow students to discover the details of development, and to learn the methods for doing the work. The six-week course was directed by Charles Otis Whitman, who was the MBL director, and his student and protégé Frank Rattray Lillie, who became Whitman's Assistant Director and then his successor as Director both at the MBL and also at the Biology Department at the University of Chicago.

Students were expected to bring their own equipment, including a compound microscope, a dissecting microscope (and it was specified that the Paul Meyer pattern made by Zeiss was the best of the kind), a camera lucida, microtome, and other standard embryological equipment to make up a "complete outfit." Each student was given a supply of fish eggs and expected to follow the stages of development starting with fertilization. The camera lucida was to facilitate drawing, which was an important part of embryological work until relatively recently. The students all learned the most up-to-date techniques for observing, preserving, embedding, fixing, staining, and then drawing, reconstructing, and modeling embryological processes. The course cost fifty dollars for a number of years and was limited to a dozen students.

For the second year, students were required to have not just a general biology course but also an anatomy course as a pre-requisite. The course continued until 1901, when the lab had grown enough that the course expanded its staff and added zoology as a pre-requisite. The goal of the course was not just to teach the basics of embryology but also to prepare students to take up independent investigations of their own. In addition, the course announcements emphasized the value of studying such a subject at the MBL. Here it was not necessary to rely on preserved developmental stages fixed to slides, but it was possible also to study the living material available during a summer at the seashore. The course continued, with new directors and instructors and with students going on to their own research and sometimes returning as instructors themselves.

Only in 1921 did the course begin to cost seventy-five dollars. Hubert Goodrich became director in 1922 and remained so until 1942. This was an important time for embryology, and the course clearly offered the basics in experimental techniques and introduction to modern theory. It probably served as a very valuable introduction for many young scientists, who encountered living material, interacted with established researchers, and learned how to use equipment and techniques not just to see what others had reported before but also how to ask new questions and prod the embryos to

yield answers.

1942 brought a continuation of the basic approach but also a new director. Viktor Hamburger had served as an instructor (view PDF [10.1 MB] of original Hamburger lecture notes) since 1937, shortly after he had taken his experience in Hans Spemann's lab in Germany to the University of Chicago. There, Lillie undoubtedly lured him to the MBL for the summer and put him to work. Hamburger directed the Embryology Course from 1942 through 1945, when long-time instructor, Donald Costello from the University of North Carolina, took over through 1950. Where Hamburger looked at neuroembryology in his own work and emphasized patterns of development and causes of differentiation, Costello was especially interested in comparative invertebrate embryology. No doubt their approaches worked together well, and the course retained its flavor of lab research drawing on the natural history of the marine offerings.

In the 1950s S. Meryl Rose from the University of Illinois and then Mac V. Edds from Brown University directed the course. This is a period when such notables as John Tyler Bonner of Princeton University, with his enthusiasm for slime molds and problems of morphogenesis, John P. Trinkaus (known as Trink), Clifford Grobstein from the National Cancer Center, Philip Grant from Johns Hopkins University, John W. Saunders from Marquette University, and others brought new perspectives to the traditional course. Throughout this period and dating back to the 1940s, they listed a set of books that students should have, and the list remained surprisingly constant in ways that would be unlikely in this rapidly changing field today.

In 1962 James Ebert at the Carnegie Institution of Washington became director and things changed. The course description shifted for the next year, and the course fee rose to \$300—\$150 for the series of lectures plus \$150 for those who wished to stay for an additional period of individual investigation. The course was becoming less introductory and more designed for would-be researchers such as graduate students and post-doctoral fellows who wanted to learn advanced techniques and to hear about theories and problems in development. The content remained, with additions of Ebert's specialty work in organogenesis, but Ebert's five year run as course director made the course at least look more professional in its focus on modern technical topics. This move to professionalism was reinforced by NIH training grants that supported the Embryology and sometimes other courses in the late 1960s and beyond.

In 1971 the course fees rose to \$400 + \$400, and the announcement made clear that the course was targeted to graduate students and post-doctoral fellows, and to advanced undergraduates seriously interested in pursuing research in this field. Also in 1971, Eric Davidson from Cal Tech served as an instructor. In 1972 he became course director and served in that role through 1974, then again from 1988 through 1996, making him the longest-running course director and giving him the opportunity for the greatest impact on the history of the course. He took great advantage of the opportunity to revise and update the course. In fact, Davidson brought the first major changes in the course which was now "centered around one particular conceptual area of developmental biology." And the emphasis clearly shifted from instruction and introduction to research to a higher level of expected training and investment in research on the part of the participants.

The focus for 1972 was cytoplasmic localization phenomena, for 1973 the synthesis, storage, and utilization of developmental genetic information during oogenesis in vertebrates and invertebrates, and in 1974 "Sequence Organization in the animal genome and transcription-level gene regulation." This was a significant shift, and arguably Ebert and Davidson in their different ways had done the most to move the traditional popular course into the professional and molecular era of the late twentieth century.

David Epel from the University of California at San Diego brought an emphasis on cells and cell-cell communication with "Cell Interactions, Cell Membranes, and Cell Surfaces in Development" (1975). Then Tom Humphreys from the University of Hawaii joined Epel in offering "Developmental Regulation of Gene Expression" (1976), "Extracellular Signals in Cell Growth and Differentiation" (1977), and "Localization, Pattern Formation, and Morphogenesis" (1978 and 1979). Rudolf Raff from Indiana University directed "The Control of Events in Early Embryology Development" (1980), "Gene Control and the Events of Early Embryonic Development" (1981), and "Cytoplasmic Localization, Determination, and Gene Control in Development" (1982). These years brought a much expanded

list of instructors and lecturers, as the field became more complex and it was important to bring together speakers across the wide range of new ideas and techniques.

Then in 1984, under the direction of William Jeffery from the University of Texas at Austin and Bruce Brandhorst from McGill University, the course reverted to the simpler title of “Embryology: A Modern Course in Developmental Biology.” From 1989 through 1996 the title was “Embryology: Cell Differentiation and Gene Expression in Early Development” and from 1997 to present, it has been “Embryology: Concepts and Techniques in Modern Developmental Biology.”

Discussions by the Education Committee and course directors at various points show that the MBL considered whether to change the name to reflect more current thinking, namely with an emphasis on developmental biology and an emphasis on molecular genetics rather than the traditional embryology. They decided to stick with the traditional course that is now more than one hundred and fifteen years old and instead added other January short courses focused on developmental and molecular techniques. Of course the Embryology course, taught in traditional labs, includes a considerable dose of modern molecular work. And students in recent years admit that they no longer go out to muck about and collect specimens themselves, nor do they have any idea where to look in most cases. Yet there is a tie to tradition, to the observations and collections of the past century, and course instructors will send their students to the MBL Rare Books Room to discover something of the history and context of the work that is now so different from and yet so grounded in the traditions of its predecessors.

View a timeline of the directors and instructors here.

Sources

1. Marine Biological Laboratory Annual Announcements: MBL-WHOI Library Special Collections.
2. Marine Biological Laboratory Annual Reports: available in the MBL The Biological Bulletin Vols. 17 and 21-105 at <http://www.archive.org/details/biologicalbullet01mari> and beginning with 2004 at http://www.mbl.edu/governance/gov_annual_report.html.