Workshop on Molecular Evolution
July 27-August 8, 2003
(Extended Special Topics Session
August 8-August 15, 2003)

Course Director: Michael P. Cummings, University of Maryland and Marine Biological Laboratory

Molecular evolution has become the nexus of many areas of biological research. It both brings together and enriches such areas as biochemistry, molecular biology, microbiology, population genetics, systematics, developmental biology, genomics, bioinformatics, in vitro evolution, and molecular ecology. The Workshop provides an important contribution to these fields in that it promotes interdisciplinary research and interaction, and thus provides a glue that sticks together disparate fields. Due to the wide range of fields addressed by the study of molecular evolution, it is difficult to offer a comprehensive course in a university setting. It is rare for a single institution to maintain expertise in all necessary areas. In contrast, the Workshop is uniquely able to provide necessary breadth and depth by utilizing a large number of faculty with appropriate expertise. Furthermore, the flexible nature of the Workshop allows for rapid adaptation to changes in the dynamic field of molecular evolution. For example, the 2003 Workshop included recently emergent research areas of molecular evolution of development and genomics.

The interest in the Workshop remains very strong and is increasing. The number of applications for the 2003 course was 143, continuing the trend of increased applications since 2000. In 2003 there were 60 students participating in the Workshop, which was taught by 19 faculty and 4 teaching assistants. The students came from all over the world (17 countries), and represented several career stages: graduate students (57%), postdoctoral researchers (13%), faculty/principal investigators (27%), and other (3%). For the years 2000 – 2003, the students came from more than 164 different institutions.

The subjects covered in the Workshop included the following:

1. Databases and sequence matching: database searching; protein sequence versus protein structure; homology; mathematical, statistical, and theoretical aspects of sequence database searches.

2. Phylogenetic analysis: theoretical, mathematical and statistical bases; sampling properties of sequence data; Bayesian analysis; hypothesis testing.


4. Molecular evolution integrated at organism and higher levels: population biology; biogeography; ecology; systematics and conservation.
5. Molecular evolution and development: gene duplication and divergence; gene family organization; coordinated expression in evolution.


7. Comparative genomics: genome content; genome structure; genome evolution.

8. Transposable elements: types; history; evolutionary dynamics; as a major component of genomes.

9. Molecular evolution integrated at different levels II: biochemistry; cell biology; physiology; relationship of genotype to phenotype.

Formal instruction consisting of lectures, software demonstrations and computer work was scheduled over a 13 hour period each day during the two week period. The extended topics session provided essentially unlimited access to Workshop resources over a one week period. Twelve students participated in the extended topics session.

For 2003 the Workshop Web site was rebuilt from scratch and implemented a simpler design and some expanded content. The web site serves four primary purposes -

1. Prepare students in advance of their participation in the Workshop. All Workshop participants are strongly encouraged to make use of the web site as part of their preparations for attending the course. In this way each participant is made aware of the details of the Workshop schedule, expectations, and provided with resources to help prepare them in the best ways possible at their convenience. There is a web page with detailed information on preparing prior to the start of the Workshop.

2. Assist students while in attendance at the Workshop. Students have opportunities to review lecture notes and graphics, and follow-up on lecture and lab presentations through rapid access to relevant materials. The web site provides an extensive reference list, glossary and pages devoted to software used in the Workshop.

3. Provide a means to maintain and increase learning after participating in the Workshop. Although the attendance at the Workshop is only two or three weeks in length, the ability for a participant to refresh their knowledge by review of course materials continues well after they depart Woods Hole. In this way the students can use the Workshop as a continuing source of learning about molecular evolution.

4. Provide a resource for those who do not attend the Workshop. For a variety of reasons not everyone who is interested in doing so can attend the Workshop. The web site serves these people by providing an integrated resource through which they can learn more about molecular evolution. Many participants in past Workshops share their notes, handouts, and recollections from their experience with their colleagues. One motivation
for the web site is to increase the value and reach of the Workshop by leveraging its assets by providing a definitive source of material. The Workshop web site has been quite successful, having received over 2.4 million requests for pages in the first 36 months of operation. The web site has been accessed from over 90,000 different computers from all over the United States and many other countries (primarily Europe and Japan). The web site will continue to be updated and expanded in future years.

Partial funding support for the Workshop comes from the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA). Some software was generously provided by Accelrys.

Table 1 – Diversity of Students Participating in the Workshop on Molecular Evolution

<table>
<thead>
<tr>
<th>Year</th>
<th># of Students</th>
<th>Female Students</th>
<th>Minority Students</th>
<th>Foreign Students*</th>
</tr>
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<tbody>
<tr>
<td>2003</td>
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<td>29</td>
<td>0</td>
<td>32</td>
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<td>61</td>
<td>23</td>
<td>1</td>
<td>31</td>
</tr>
</tbody>
</table>

*These students for the years 2000 – 2003 represented 38 different countries.

Table 2: 2000 – 2003 Molecular Evolution Course Faculty

2003
Course Director
Michael Cummings University of Maryland

Faculty
Peter Beerli University of Washington
Scott Edwards University of Washington
Jonathan Eisen TIGR
Joseph Felsenstein University of Washington
Mary Kuhner University of Washington
Axel Kuhner University of Konstanz
Michael Miyamoto University of Florida
Daniel Myers Pomona College
William Pearson University of Virginia
David Rand  Brown University
David Swofford  Florida State University
Steve Thompson  Florida State University
Paul Turner  Yale University
Ziheng Yang  University College London
Anne Yoder  Yale University

Lecturers
Mark Holder  University of Connecticut
William Pearson  University of Virginia
Margaret Riley  Yale University
Daniel Voytas  Iowa State University

Teaching Assistants
Matthew Dean  University of Iowa
Johanna Fehling  Scottish Assoc for Marine Sci
Scott Handley  Washington University
David Kysela  Yale University

2002
Course Director
Michael Cummings  Marine Biological Laboratory

Faculty
Scott Edwards  University of Washington
Jonathan Eisen  The Institute for Genomic Research
David Swofford  Florida State University
Peter Beerli  University of Washington
Joseph Felsenstein  University of Washington
Mary Kuhner  University of Washington
Paul Lewis  University of Connecticut
Axel Meyer  University of Konstanz
David Rand  Brown University
Steven Thompson  Florida State University
Ziheng Yang  University College London
Anne Yoder  Yale University

Lecturers
Claire Fraser  The Inst. for Genomic Research
William Pearson  U. of Virginia
Michael Sanderson  UC Davis
Daniel Voytas  Iowa State University
Shozo Yokoyama  Syracuse University

Teaching Assistants
Antonis Rokas  University of Wisconsin-Madison
Rauri C.K. Bowie  
Louise Mead  
Katarina Winka  

University of Cape Town  
Oregon State University  
Umeå University  

2001  

Director  
Michael Cummings  
Marine Biological Laboratory  

Faculty  
Peter Beerli  
Scott Edwards  
Jonathan Eisen  
Joseph Felsenstein  
Claire M. Fraser  
Mary Kuhner  
Paul O. Lewis  
Emilia Martins  
Axel Meyer  
William Pearson  
David Rand  
Ken Rice  
David Swofford  
Steven Thompson  
Daniel F. Voytas  
Ziheng Yang  
Anne D. Yoder  
Shozo Yokoyama  

University of Washington  
University of Washington  
Institute for Genomic Research  
University of Washington  
Institute for Genomic Research  
University of Washington  
University of Connecticut  
University of Oregon  
University of Konstanz, Germany  
University of Virginia Health Sciences Center  
Brown University  
GlaxoSmithKline Pharmaceuticals  
Smithsonian Institution  
BioInfo 4U  
Iowa State University  
University College London  
Northwestern University Medical School  
Syracuse University  

Teaching Assistants  
Josephine Babin  
Sheri A. Church  
Scott Handley  
Andrew McArthur  
Ellen Pritham  
David Reed  
Antonis Rokas  
Julie Thompson-Maaloum  
Katarina Winka  

Louisiana State University  
University of Virginia  
Washington University  
Marine Biological Laboratory  
University of Massachusetts  
University of Utah  
University of Edinburgh  
Inst. de Genetique et de Biol. Moleculaire et Cellulaire  
Umeå University  

2000  

Course Director  
Michael Cummings  
Marine Biological Laboratory  

Faculty  
Peter Beerli  
Scott Edwards  

University of Washington  
University of Washington  

Jonathan Eisen  
Joseph Felsenstein  
Claire M. Fraser  
John P. Huelsenbeck  
Mary Kuhner  
Paul O. Lewis  
Wayne P. Maddison  
Axel Meyer  
Nipam Patel  
William Pearson  
David Rand  
Ken Rice  
Margaret A. Riley  
David Swofford  
Steven Thompson  
Daniel F. Voytas  
Anne D. Yoder  
Shozo Yokoyama

Teaching Assistants
Linda Amaral-Zettler  
Josephine Babin  
Sheri A. Church  
Paige M. Dennis  
Ben FrantzDale  
Andrew McArthur  
Monica Medina  
Ellen Pritham  
David Reed  
Molly E. Waring

Institute for Genomic Research  
University of Washington  
Institute for Genomic Research  
University of Rochester  
University of Washington  
University of Connecticut  
University of Arizona  
University of Konstanz, Germany  
University of Chicago  
University of Virginia Health Sciences Center  
Brown University  
Bioinformatics  
Yale University  
Smithsonian Institution  
BioInfo 4U  
Iowa State University  
Northwestern University Medical School  
Syracuse University  

Marine Biological Laboratory  
Louisiana State University  
University of Virginia  
University of Massachusetts  
Marine Biological Laboratory  
Marine Biological Laboratory  
University of Massachusetts  
Louisiana State University  
Marine Biological Laboratory