Continuing Education for Biological and Life Sciences Librarians in the Post-Genomic Era

You CAN Teach an Old Dog New Tricks

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Chemical Information Division
American Chemical Society
Atlanta, Georgia
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New Biology Challenges

- Following the success of the Human Genome Project, genetics research is expanding and having a major impacts on society. As political leaders debate human cloning, stem cell research, biodiversity, advances in genetic research in agriculture and clinical medicine are changing R&D in biology, pharmacy science, and medicine.
Drivers

- Basic/ Applied R&D
  - Pharmacy/Biomedical Sciences/Agrosciences
  - Multidisciplinary in Scope
  - Internal Partnering
  - External Collaborations
- Education & Training
  - BS, MS & PhD Degrees
  - Continuing Education
Evolution of the “New Biology”

Biology & Life Sciences
- Biochemistry & Medicine
- Genetics
- Cell Biology & Physiology

Chemistry
- Medicinal/Pharmacy
- Combinatorial Chemistry
- Instrumentation

Molecular & Structural Biology/Genetics

Engineering
- Biotechnology
- Robotics
- Laboratory Automation

Mathematics & Statistics
- Computer Science
  - Hardware Configuration
  - Software Development

Information Science
- Applications
- Simulations and Modeling
- Visualization
- Data Archives

Bioinformatics

Business & Management
- Policies & Regulations

Education

- Robotics
- Laboratory Automation

Information Science
- Applications
- Simulations and Modeling
- Visualization
- Data Archives

Bioinformatics
Growth of Data & Information

Growth of GenBank
(1982 - 2005)
Bibliographic Data

Molecular/Structural Biology/Genetics, Chemical Abstracts 1907-2005

Citations/yr

years

0 1 10 19 28 37 46 55 64 73 82 91 100

1 5000 10000 15000 20000
The New Biology and Its Challenges for Librarians

- In our role as librarians and information providers to researchers, students, health care workers, patients, and the public, we must be prepared to help them manage this new technology and the vast amounts of data and information it is generating.
Knowledge Needs

• Bioinformatics
• Computational & Molecular Biology
• Genetics/Heredity
• Genomics & Proteomics

Goals

• Locating resources, programs, databases
• Identifying tools for research or clinical applications
• (Assist) Planning experiments
Professional Development

• Continuing Education
• Life-long Learning
• Training & Skills Development
• Intellectual Nourishment
• Forums for Reflection
• Exposure to New Ideas
• Work Experience
• Professional Refreshment & Rejuvenation
• Personal Networks
Means for Getting There

• **Formal Workshops**
  - Hands-on and lecture
  - Specific techniques, software, databases

• **Credit-bearing Courses**
  - Biology, Chemistry, Mathematics, Computer Science Departments
    - Library Schools have been slow to respond
    - Science reference MAY include a lecture
    - Biological or Bioinformatics in only a handful of MLS-granting programs

• SOME librarians (many with PhD, Many WITHOUT MLS) provide training
Means for Getting There

- Conferences & Symposia
- Research & Publication
- Professional Reading
- Association Activity
- Personal Networking & Self-directed Activity
  - Online tutorials
  - Professional literature
BEST Place to Start

- National Center for Biotechnology Information (NCBI)
  - Established in 1988 as a national resource for molecular biology information, NCBI creates public databases, conducts research in computational biology, develops software tools for analyzing genome data, and disseminates biomedical information
NCBI Education Opportunities

- Science Primer
- Programs at Professional Meetings (~15/yr)
- 1-day Field Guide Workshops
  - 4x in Bethesda, MD
  - 40+ locations across U.S.
- 3-day Introduction to Molecular Biology Information Resources
- 5-day NCBI Advanced Workshop for Bioinformatics Information Specialists (Bethesda, MD)
- 2.5-hr Mini-Courses (10)
nucleic acid or nucleotide: Individual nucleotides are linked through the phosphate group, and it is the precise order, or sequence, of nucleotides that determines the product made from that gene.

Figure 1. The four DNA bases.

Each DNA base is made up of the sugar 2'-deoxyribose linked to a phosphate group and one of the four bases depicted above: adenine (top left), cytosine (top right), guanine (bottom left), and thymine (bottom right).

A DNA chain, also called a strand, has a sense of direction, in which one end is chemically different than the other. The so-called 5' end terminates in a 5' phosphate group (PO4), the 3' end terminates in a 3' hydroxyl group (-OH). This is important because DNA strands are always synthesized in the 5' to 3' direction.
Keeping up with enhancements and the increasing diversity of NCBI molecular biology resources can be challenging. To help scientists meet this challenge, the NCBI service desk provides a free training course, A Field Guide to GenBank and NCBI Resources. All researchers, educators and students will find the Field Guide to be a useful introduction and survey of the available NCBI tools and databases, even experienced NCBI users will learn something new and useful. More ...

NCBI also provides focused bioinformatics mini-courses for researchers, teachers, and college students. NCBI mini-courses are either problem-based such as "Identification of Disease Genes" or NCBI resource-based such as "BLAST Quick Start". The courses are 2 hours in length with the first hour devoted to an overview that is followed by a one hour hands-on session.

Librarians interested in learning an overview of search systems available at NCBI can attend the three-day Introduction to Molecular Biology and Information Resources course. This course reviews many NCBI services and search systems by combining lectures, demonstrations, and hands-on experience.

Information and tutorials
Where NCBI Will Be in 2006


Exhibit Schedule

NCBI help desk staff, and occasionally scientific staff, will be available at the following scientific meetings:

January 2006

Plant and Animal Genome XIV Conference
January 14-18
Town & Country Convention Center, San Diego, California

February 2006

Association of Biomolecular Resource Facilities
February 11-14
Long Beach Convention Center, Long Beach, California

American Association for the Advancement of Science
February 16-20
America's Center Convention Center, St. Louis, Missouri

Biophysical Society
February 18-22
Salt Palace Convention Center, Salt Lake City, Utah
A Field Guide to NCBI Resources

Course Description

The National Center for Biotechnology Information (NCBI) presents A Field Guide to GenBank and NCBI Molecular Biology Resources, a lecture and hands-on computer workshop on GenBank and related databases covering effective use of the Entrez databases and search service, the BLAST similarity search engine, genome data and related resources.

Now featuring the NCBI assembly and annotation of human, mouse and rat genomes, the updated map viewer genome displays, the new genome-specific BLAST pages, the new NCBI curated conserved domains, and Cn3D 4.1.

Topics:

- GenBank Database: description and scope
- The NCBI Derivative Databases: RefSeqs
- Database Searching using Entrez
  - Neighboring and Links
  - Entrez searching
- The NCBI Structures Database
  - The Molecular Modeling Database (MMDB)
  - Structural Alignments
  - Viewing Structures and Structural Alignments with Cn3D
- Similarity Searching using NCBI BLAST
  - Local Alignment Statistics
  - Significance Systems
  - Using BLAST web services
  - PSI-BLAST
  - BLAST (CDD Search)
  - Specialized BLAST pages
- Genomic Resources at NCBI
# 1-Day Field Guides
**from 04/06 to 09/06**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
<th>Presenter</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 10</td>
<td>The University of Rochester Medical Center</td>
<td>Rochester, New York</td>
<td>Mary Beth</td>
<td>pc</td>
</tr>
<tr>
<td>Apr 13</td>
<td>&quot;NCBI Expression Resources&quot;</td>
<td>The University of Nebraska at Omaha</td>
<td>Mark Patry</td>
<td>tba</td>
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<td>Apr 19</td>
<td>The National Library of Medicine</td>
<td>Bethesda, Maryland</td>
<td>Peter Cooper</td>
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<td>Apr 25</td>
<td>Special Seminar</td>
<td>Medical College of Wisconsin</td>
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<td>Mount Holyoke College</td>
<td>South Hadley, Massachusetts</td>
<td>Mary Clarkin</td>
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<td>May 16</td>
<td>Virginia Tech</td>
<td>Blacksburg, Virginia</td>
<td>Victoria Kok</td>
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<td>June 8</td>
<td>The University of Minnesota Twin Cities</td>
<td>Minneapolis, Minnesota</td>
<td>Kevin Messner</td>
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<td>Minneapolis, Minnesota</td>
<td>Lee Kozar</td>
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<td>July 6</td>
<td>&quot;TGPplus&quot;</td>
<td>The Mayo Clinic</td>
<td>Teresa Holen</td>
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<td>Columbus, Ohio</td>
<td>Pam Cheek</td>
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<td>July 25</td>
<td>University of Massachusetts Medical School</td>
<td>Worcester, Massachusetts</td>
<td>Irene Bosch</td>
<td>tba</td>
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<tr>
<td>July 31</td>
<td>&quot;TGPplus: Enhanced Field Guide&quot;</td>
<td>National Library of Medicine</td>
<td>Peter Cooper</td>
<td>all</td>
</tr>
<tr>
<td>Aug 16</td>
<td>The University of California at Berkeley</td>
<td>Mary Ann Mahoney</td>
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<td>Aug 21</td>
<td>Mississippi State University</td>
<td>John Boyle</td>
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<tr>
<td>Aug 31</td>
<td>Tuskegee University</td>
<td>Berhami Tameci</td>
<td>tba</td>
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<tr>
<td>Sept 7</td>
<td>The University of Michigan</td>
<td>Ann Arbor</td>
<td>Morris</td>
<td>tba</td>
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<tr>
<td></td>
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<td>Rosenzweig</td>
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www.ncbi.nlm.nih.gov/Class/MLACourse/

Introduction to Molecular Biology Information Resources

This three-day course provides an introduction to four domains of information generated by the field of molecular biology:

- nucleotide sequences
- protein sequences
- three-dimensional structures
- complete genomes and maps

An overview of flagship search systems and databases available at the National Center for Biotechnology Information emphasizes how your current search skills apply to molecular biology databases. A tour of advanced Entrez search features illustrates techniques for effective and efficient retrieval of molecular data and will help you to address some common user needs. The course also introduces other search systems, including BLAST, Map Viewer, and the Cn3D Viewer for three-dimensional protein structures. The course format combines lecture, demonstration, and hands-on experience, and concludes with a discussion of various levels of molecular biology information services provided by libraries. Additional detail about the material covered is accessible from the modules page, and the Data Schedule is also provided. This course is approved for 28 CBI contact hours by the Medical Library Association (MLA).

March 28-30, 2006
March 28-30, 2006
Davis, CA
Cambridge, MA

Additional details about each location as well as a link to a registration form are provided on the upcoming courses page. Each course is three days long, 9:00 AM - 5:00 PM each day (see schedule for details). Additional course dates/locations will be posted as they are scheduled. A list of past courses is also available.

Librarians with limited or no previous experience searching molecular sequence databases. Biology or other scientific background is very helpful but not required.

(Note that an Advanced Workshop, described under "Additional Courses," below, is available for full-time bioinformatics specialists based in libraries. Participation in the Advanced Workshop must have a science background and experience with molecular biology databases and tools.)

Please read the following web pages prior to attending the course. They provide an essential foundation for understanding the molecular databases.

[Link to web pages]
## NCBI Advanced Workshop for Bioinformatics Information Specialists

### Description
This five day course is designed for individuals, particularly those based in medical libraries, who provide bioinformatics support to their institutions. It provides an overview of a wide range of molecular biology resources that research communities use, and about which bioinformatics support staff might receive questions. The course is divided into ten modules, each of which includes a combination of lecture, demonstration, and hands-on experience with actual user questions. Following the course, participants are added to a bioinformatics user outreach (BSN) mailing list to facilitate future communication among the group and continued learning. This course is approved for 40 CE contact hours by the Medical Library Association (MLA).

### Dates
August 7-11, 2006
8:00 AM - 5:00 PM each day (see schedule for details)

### Location
National Library of Medicine
8600 Rockville Pike
Bldg. 36A, Room 32014 (NCBI Library)
Bethesda, MD 20894

### Intended Audience
Bioinformatics specialists based in libraries, including scientists who have been hired for these specialized positions as well as bioinformatics librarians.

### Prerequisites
Knowledge of molecular biology or genetics, and basic experience with NCBI resources such as Entrez, BLAST, Cn3D, and Map Viewer.

If you are interested in this area but do not have the prerequisites, please note that an introductory course is available. See "Additional Courses" below for more information.

### Application
Please submit the [brief application](#) by June 2, 2006. Due to limited space in the computer lab, priority will be given to those who provide bioinformatics support as a full-time job. Others will be welcome as space allows.

### Cost
There is no registration fee for the course, although you must cover your own travel, hotel, and meals.

### Instructors
This course was developed as a collaborative project between NCBI and colleagues who are already actively involved in supporting molecular biology resources for users in their libraries. The course will be taught by the

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### Schedule

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to NCBI Tools and Resources</td>
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<tr>
<td>2</td>
<td>BLAST and Related Algorithms</td>
</tr>
<tr>
<td>3</td>
<td>Entrez and Related Services</td>
</tr>
<tr>
<td>4</td>
<td>Cn3D and Protein Structure Visualization</td>
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<tr>
<td>5</td>
<td>Map Viewer and Related Services</td>
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<tr>
<td>6</td>
<td>Sequence Similarity and Phylogenetics</td>
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<td>7</td>
<td>Gene Expression and Microarrays</td>
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<tr>
<td>8</td>
<td>Transcriptomics and Proteomics</td>
</tr>
<tr>
<td>9</td>
<td>Data Integration and Web Services</td>
</tr>
<tr>
<td>10</td>
<td>Advanced Topics and Future Directions</td>
</tr>
</tbody>
</table>

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### Comments

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### Credits

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NCBI Mini-Course List

1. Making Sense of DNA and Protein Sequences
2. Unmasking Genes in Human DNA
3. Identification of Disease Genes
4. Correlating Disease Genes and Phenotypes
5. BLAST Quick Start
6. EntrezGene Quick Start
7. Structure Analysis Quick Start
8. MapViewer Quick Start
9. GenBank Quick Start
10. Entrez Quick Start

How to Attend

Ten NCBI Mini-Courses

NCBI bioinformatics mini-courses are either problem based, such as “Identification of Disease Genes” or NCBI resource based such as “BLAST Quick Start”. The courses are 2.5 hours in length with first hour and half devoted to an overview that is followed by a one hour hands-on session.

The courses are free and, with the exception of those sessions offered at CIT, are open to anyone who would like to attend. CIT sessions are open only to the NIH employees. They can be taken in any order. The current schedule of the minicourses is listed here.

Although, primarily given on the NIH campus, NCBI is beginning to offer the mini-courses at extramural institutions as well. In these cases, NCBI pays for the travel expenses of the instructors within the United States. Contact Mecha Bhasawal if you want to schedule a mini-course at your institute.

A course, NCBI 4-Pack: Practical Web-based Analysis, consisting of 4 mini-courses will be offered at NIH, Bethesda, MD on June 7-8, 2006. The course is free and open to everyone but an application is required. Click here for more information.

Course No. 1 “Making Sense of DNA and Protein Sequences”

In this mini-course, we will find a gene within a eukaryotic DNA sequence. We will then predict the function of the implied protein product by seeking sequence similarities to proteins of documented function using BLAST and other tools. Finally, we will find a 3D modeling template for this protein sequence using a Conserved Domain Database Search.

During the first hour, the instructor will walk through an example...
Formal Classes and Programs

- For the REALLY Ambitious
  - Credit-bearing classes
    - Certificates of Advanced Studies
    - Program Concentrations
    - Degrees
  - University at Buffalo—SUNY
  - University of Illinois—Urbana Champaign
  - University of North Carolina
  - University of Alabama at Birmingham
  - University of North Carolina
  - University of Pittsburgh
  - University of Indiana
  - Montgomery College
  - Stanford University
Program in Bioinformatics and Computational Biology

Bioinformatics and computational biology (BCD) is an interdisciplinary program that involves the application of mathematics and computer science to the study of genes and proteins. Computational biology addresses more general questions involving the application of computer and sub-cellular structures. Students in bioinformatics and computational biology integrate topics of applied mathematics, computer science, and biology into specialties as diverse as genetics, biophysics, computational science, and microbiology.

Undergraduate Degrees

- Bachelor of Science (BS)

Programs

- Bioinformatics-Biology (BS)
- Bioinformatics-Biochemistry (BS)
- Bioinformatics-Computer Science and Engineering (BS)
- Bioinformatics-Mathematics (BS)

Research

Research opportunities for students: In addition to the numerous research opportunities available to undergraduates through their majors, UB has centers for research in high performance computing, visualization, and the Center of Excellence in Bioinformatics.

Resources

- University at Buffalo, Center of Excellence in Bioinformatics
- Center for Computational Research

Libraries:

- University at Buffalo Libraries

Facts

- Number of faculty: 33
- Graduates from this program can go on to pursue careers as: The life sciences industries represent one of the fastest growing sectors of the US economy. The program prepares students for graduate studies in either a bioinformatics-related field or in a traditional discipline, as well as for immediate entry into the job market.

Noteworthy

- The new degree program will provide training in bioinformatics and computational biology, the fast-growing fields, that have developed around the interface between the life sciences and the...
Master of Science in Bioinformatics

As a professional school specializing in information management and systems, GSLIS is a natural fit to offer a concentration within the campus-wide M.S. in Bioinformatics. In the GSLIS Concentration in Bioinformatics (GCB), we define “bioinformatics” broadly as the management of biological information of all types. The GCB is an entirely separate program from the existing GSLIS M.S. degree; students may not be simultaneously admitted to both programs; and the new concentration is not accredited by the American Library Association.

Program Information | Coursework | Admission Requirements

Program Information

In the GCB program, students may take courses in several departments across the University of Illinois campus. This breadth of training provides students with the multidisciplinary skills that are required for a career developing and managing information systems for the biological community. The program provides training from faculty who are international experts in many areas of information management, including bioinformatics, biology, chemistry, statistics, and computer science.

Library and Information Science (LIS) as a discipline has emphasized the use of information technology to support new approaches to the organization of and access to information. The GCB provides applied skills in building and evaluating systems that mediate effectively between users and collections. The GCB program emphasizes the range of library and information science including: collection development, classification schemes, information retrieval, knowledge representation, user evaluation, data curation, and policy standards. Our students are taught to develop information management systems in biological applications, with opportunities to consider a broad spectrum of domains including molecular biology, environmental ecology, and biomedicine.

Coursework

A GSLIS committee for admission to and oversight of the GCB reviews the suitability of each student's program of study, including any necessary remediation in biology or computing. The GCB requires a total of 36 hours of coursework, either with 36 hours of core required and elective courses or with 28 hours of core required and elective courses plus 8 hours of thesis work. At least 12 hours must be at the 500 graduate level.
Continuing Education Certificate in Bioinformatics
Wednesday, September 31st, 2003

Continuing Education Certificate in Bioinformatics

Department of Computer and Information Sciences
University of Alabama at Birmingham

What is bioinformatics?

Bioinformatics (sometimes called computational biology) consists of the development and use of computer science techniques to help solve problems in molecular biology. With the recent complete sequencing of the human and other genomes, a massive amount of DNA data has been generated. The understanding of this molecular sequence data requires sophisticated computer analysis.

Goals of the Certificate Program

Biomedical research is becoming more genomic data intensive and is therefore moving increasingly from a bench-based to a computer-based activity. This transition is producing a very high demand for individuals who have knowledge and skills in the use of existing bioinformatics computer tools, statistics and data analysis and certain specialized computer programming techniques. The importance of this trend has been underscored by Dr. Marvin Cassman, Director of the NIH Institute for General Medical Science.
Degrees & Programs

Certificate in Bioinformatics

ABOUT UNC SILS
A certificate of specialization in bioinformatics from SILS is awarded in conjunction with either the master of library science or master of information science degrees from SILS. To earn this certificate, a currently enrolled student must satisfy the following requirements:

1. Successful completion of the MSIS or MLSIS degree from SILS, requiring 48 hours of approved graduate coursework.

2. Successful completion of a series of required graduate-level courses (36-40 credits). Most of these courses are already required as part of the master's degree or would otherwise count for the master's degree.

3. Complete a significant project in the area of bioinformatics. This can be satisfied by either:
   - successfully completing a master's project/paper in the area of bioinformatics;
   - working on a research project in an academic environment (research rotation, project course, etc.);
   - acquiring experience in a commercial setting, for instance a summer internship with a company, or presenting evidence of previous work experience.

The work to satisfy the project requirement must be approved by the coordinator of the SILS bioinformatics certificate program. Training projects are expected to be about 10 hours per week for one semester or one summer.

Current training program projects include:

- research rotations with UNC faculty members participating in the UNC bioinformatics curriculum

http://sils.unc.edu/
Health Sciences Library & Bioinformatics Traineeship

The University of Pittsburgh Health Sciences Library System (HSLS) and Center for Biomedical Informatics (CBMI) offer two types of training programs in health sciences librarianship and biomedical informatics as a component of the Biomedical Informatics Training Program of the CBMI.

HEALTH SCIENCES LIBRARIANSHIP & BIOMEDICAL INFORMATICS PROGRAM

This traineeship is a post-degree, work/study experience designed for an entry-level or mid-career professional who has experience or special interests in health sciences librarianship. The training experience concentrates on supplementing academic experience with practical experience in the operational skills of the HSLS and the projects at CBMI.

In the HSLS, the trainees' activities include: (1) use of information technology in satisfying user needs; (2) the role of a health sciences library in a complex health information environment; (3) user education; (4) technical and service issues involved in implementing and maintaining library information systems; (5) management of information resources and their associated data.

In the CBMI, the trainees complete at least 15 credits of coursework, including 4 graduate level courses, 2 terms of a 1-credit journal club and a 3-credit independent research project. A sample curriculum might include Introduction to Biomedical Informatics, Statistics, Evaluation Methods in Medical Informatics, and Problem-oriented Programming in Medical Informatics.

The independent research project is a research or special project on a specific topic of the trainee's choosing under the joint supervision of a CBMI faculty member and the HSLS coordinator. This project addresses a problem closely related to both informatics and health sciences librarianship.

This program seeks hard-working and highly motivated graduates of an ALA-accredited program who are committed to a career in health sciences librarianship, and who have demonstrated potential for
Academics

Graduate Programs
Bioinformatics

The end of the 20th century has seen an explosion of information discovered from living organisms, especially in areas of molecular biology and genomics. The focus of bioinformatics is dealing with this information and turning it into useful knowledge. More ▸

Master of Science in Bioinformatics

Prerequisites
Experience needed in biology and computer science before enrolling

Requirements
Courses needed to achieve degree: electives, core courses ...

Ph.D. Minor in Bioinformatics

Students in relevant Ph.D. programs such as biochemistry and molecular biology, medical and molecular genetics, medicine, chemistry, or biology are the target audience for the Ph.D. Minor in Bioinformatics. More ▸

Bioinformatics Capstone Projects

- Completed Project List
- In-progress Project List

Bionformatics Research at IU
Information Technology Institute
Continuing Education

Bioinformatics Computing I - CMP 807

Course Description:

Bioinformatics is both a biological science and an Information Technology (IT) computational tool. This course introduces bioinformatics basics, effectively using biological research search engines and databases on the web, including PubMed, the Human Genome Project, NCBI BLAST databases and other genome project databases; sequence analysis, pairwise alignment, database searching, sequences, and protein structures.

Other topics will include standard computations for finding biological sequences, genome, and molecular structure databases; identifying genes and detecting patterns, modeling phylogenetic relationships, molecular structures, and biochemical properties; using the computer to organize data, conducting data analysis processes, and automated data handling.

The course will introduce fundamental programming concepts used in bioinformatics research, including Unix Shell Scripts and Perl basics. This course is intended for those interested in biology research and learning the basics of the bioinformatics field. This course assumes some basic familiarity with molecular biology, and familiarity with the web and databases, but assumes little or no formal computer science training.

Classes will be held in Montgomery College’s computer lab classrooms.

Prerequisites:

Introductory course in molecular biology or equivalent experience and one or more of the following: Programming Fundamentals (CMP 122), Introduction to Perl, C/C++ Level 1, or Fundamentals of Programming (CMP 065) or similar knowledge.

Technology update: The computer classrooms are equipped with USB ports for memory sticks which we recommend as the best storage device for your classwork. Memory sticks are also known as a USB memory drive, pen drive, jump drive, thumb drive, key drive, flash drive or memory drive. They come in sizes of 128MB, 256MB, 512MB, 1GB, or higher. The classrooms are also equipped with zip drives, and CD-RW drives. These options should enable you to save your class work.

Textbook:

Books may be purchased at the MC Bookstore or online. You will need to know the CMP#
Bioinformatics Methods and Techniques
Online Programs

With its power to convert vast amounts of biological data into knowledge, Bioinformatics unlocks the tremendous potential for understanding the human body, accelerating biomedical research, and developing new medical therapies.

This intensive online course explores the broad scope of bioinformatics, discussing the theory and practice of how these tools are built, and providing an understanding of their applicability and limitations to sequence analysis, functional genomics, and protein structure analysis and prediction.

**Course Objectives**
- To provide an analysis of the field of Bioinformatics
- To communicate the key methods in Bioinformatics and Genomics through coordinated lectures that cover major themes in the field
- To reinforce major topics in Bioinformatics and demonstrations using software programs
- To describe state-of-the-art research in Bioinformatics through presentations and demonstrations

**Intended Audience**
Professionals in the pharmaceutical and biotechnology industries including:
- Biologists
- Researchers
- Managers
## Comprehensive Inventory of Academic Bioinformatics Programs

[ils.unc.edu/bmh/bioinfo/Bioinformatics_Programs_Brief_12-14-04.htm](ils.unc.edu/bmh/bioinfo/Bioinformatics_Programs_Brief_12-14-04.htm)

### Degree-Granting Bioinformatics Programs in the United States as of 12/2004

<table>
<thead>
<tr>
<th>University</th>
<th>Degrees</th>
<th>Department(s)</th>
<th>Degree Requirements</th>
<th>Sampling of Research Interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona State University</td>
<td>Professional MS</td>
<td>The Sloan Foundation of Computational Biosciences in the Department of Life Sciences</td>
<td>30 credit hours of courses, 6 credits of internship, and 5 credit hours of professional development or advanced study. 42 credit hours total.</td>
<td>Computational algorithms for utilization of PET imaging in the study of Alzheimer's, design of algorithms for image deformation, reconstruction, and quantitative analysis; predictive molecular modeling</td>
</tr>
<tr>
<td>Baylor College of</td>
<td>PhD - Structural and</td>
<td>Graduate School of Biomedical Sciences</td>
<td>PhD: Collection of program-specific coursework, graduate school core curriculum, thesis M.P.H.D. first 2 years of med school (includes clinical clerkship), followed by grad school coursework, lab rotations, thesis completion finishing with final year of med school.</td>
<td>Computational models of tissue mechanics, molecular evolution, theory of protein folding, gene regulation, network analysis proteomics</td>
</tr>
<tr>
<td>Medicine</td>
<td>Computational Biology and</td>
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<tr>
<td></td>
<td>Molecular Biophysics, M.D./Ph.D.</td>
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<tr>
<td>Baylor University</td>
<td>BS of Informatics with</td>
<td>Department of Computer Science, Biology Department</td>
<td>124 credit hours required including Humanities, Computer Science and Biology, and Mathematics and Chemistry.</td>
<td>Parallel computation, component level design, metamorphic programming</td>
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<td></td>
<td>Bioinformatics major</td>
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<tr>
<td>Boston University</td>
<td>MS, PhD</td>
<td>Department of Bioinformatics</td>
<td>MS: 32 credits required and internship. PhD: (Post-Bachelor's) 64 credits required and exam (32 course credits, 16 research credits). (Post-Masters) 32 credits required (16 course credits, 16 research credits) and exam (For all: no less than &quot;B&quot; in core courses)</td>
<td>Systems biology, microscopy analysis, genomics and proteomic biotechnology, development and application of new chemical methods for mapping structure of DNA, RNA and DNA-protein complexes, etc</td>
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<td>MS Bioinformatics,</td>
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<td>MS</td>
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<tr>
<td>Name of Course</td>
<td>Place</td>
<td>Web Address (URL)</td>
<td>Course notes on Web site</td>
<td></td>
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<tr>
<td>--------------------------------------------------------------------------------</td>
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<tr>
<td>&quot;Genetics&quot; and &quot;Algorithms&quot; for the purpose of setting up interdisciplinary collaborations in Genomics</td>
<td>Wheaton College, Norton, MA</td>
<td><a href="http://genomics.wheatoncollege.edu">http://genomics.wheatoncollege.edu</a></td>
<td>Yes</td>
<td></td>
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<tr>
<td>Bioinformatics</td>
<td>University of South Australia, Australia</td>
<td><a href="http://adminfo.curtin.edu.au/teach/biochem/resources/Bioinformatics.html">http://adminfo.curtin.edu.au/teach/biochem/resources/Bioinformatics.html</a></td>
<td>No</td>
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<tr>
<td>Bioinformatics and Genomic Analysis</td>
<td>University of Arizona, USA</td>
<td><a href="http://www.bio.arizona.edu/courses/bioinformatics/default.html">http://www.bio.arizona.edu/courses/bioinformatics/default.html</a></td>
<td>Yes</td>
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<tr>
<td>Computational Biology</td>
<td>University of Washington, Washington, USA</td>
<td><a href="http://www.cs.washington.edu/education/courses/590H/">http://www.cs.washington.edu/education/courses/590H/</a></td>
<td>Yes</td>
<td></td>
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<tr>
<td>Biomathematics</td>
<td>Yale University, USA</td>
<td><a href="http://adminfo.cuh.yale.edu/course">http://adminfo.cuh.yale.edu/course</a></td>
<td>Yes</td>
<td></td>
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<tr>
<td>Molecular Bioinformatics</td>
<td>Uppsala University, Sweden</td>
<td><a href="http://www.ubu.se/research/bioinf/index.html">http://www.ubu.se/research/bioinf/index.html</a></td>
<td>No</td>
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<tr>
<td>Bioinformatics</td>
<td>University of Geneva, Switzerland</td>
<td><a href="http://www.unige.ch/~bioinfo/">http://www.unige.ch/~bioinfo/</a></td>
<td>No</td>
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<tr>
<td>Biomathematics</td>
<td>Curtin University of Technology, Australia</td>
<td>Under construction</td>
<td>Yes</td>
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<tr>
<td>Macromolecular Structure and Computational Molecular Biology</td>
<td>University of Melbourne, Australia</td>
<td><a href="http://www.worldwide.unimelb.edu.au/BE/subjects/521-203.html">http://www.worldwide.unimelb.edu.au/BE/subjects/521-203.html</a></td>
<td>No</td>
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<tr>
<td>Computational Biology</td>
<td>University of Pennsylvania, USA</td>
<td><a href="http://www.cbl.upenn.edu/UPCB/">http://www.cbl.upenn.edu/UPCB/</a></td>
<td>No</td>
<td></td>
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<tr>
<td>Computer Techniques in Protein and DNA Sequence Analysis</td>
<td>University of Queensland, Australia</td>
<td><a href="http://www.bioinformatics.org/Subjects/BC327/index.html">http://www.bioinformatics.org/Subjects/BC327/index.html</a></td>
<td>No</td>
<td></td>
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<tr>
<td>Bioinformatics</td>
<td>National Tsing Hua University, Taiwan</td>
<td><a href="http://www.bio.nthu.edu.tw/teachme/">http://www.bio.nthu.edu.tw/teachme/</a></td>
<td>Yes</td>
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<tr>
<td>Bioinformatics (BSc)</td>
<td>LaTrobe University, Australia</td>
<td><a href="http://bioreser">http://bioreser</a> biochem.latrobe.edu.au/bioinf/bioinf.html</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
Teaching Yourself

- Tutorials (NYU as an example)
- Current Awareness Resources
  - Scholarly publications
  - Trade magazine
- Books
- Librarians and Subject Specialists
Teach Yourself Bioinformatics on the Web

The Bioinformatics Training Resource

Bioinformatics is a computer intensive field, so it is quite natural to find that experts in this discipline tend to post a lot of useful information on the web. In fact most professors teaching bioinformatics courses, book authors, and creators of important algorithms have extensive web sites filled with tutorials and educational information. The challenge is to locate the resources that you need for your personal education, without spending months of your time surfing the web searching for these gems.

There is a clear need for an organized central resource that collect links to bioinformatics training material. The Bioinformatics Training Resource (BTR) is an attempt to fill this need.

The BTR is an organized collection of links to online tutorials, online courses, essays, book chapters, course syllabi, glossaries, bibliographies of key papers, etc. In short everything that interested scientists need in order to train themselves in the emerging discipline of bioinformatics.

There are a few drawbacks to attempting to learn from the experts. Some of the material listed here is of an highly technical nature, most presuming a thorough understanding of molecular biology, some even contain GASP mathematics!! Therefore, we have included some links to "Getting Started in Molecular Biology" and related subjects to help you get up to speed. There is also a section called "Getting Started in Bioinformatics" that contains material suitable for high school students and those unfamiliar with biology and/or computer science. In addition, there are links to several "online Glossaries" where biological and computing terms are thoroughly explained.

Another hazard of learning from computer experts is their tendency to use cutting edge technology. Some of the web pages listed in this collection contain information in Adobe PDF format, Microsoft PowerPoint, RealAudio, Quicktime, Microsoft Media Player, and PostScript. Here is a collection of links to resources where you can download software to tune up your computer for web browsing at the bleeding edge.

Please feel free to submit additional resources, comments/reviews of the resources, or general suggestions to improve the BTR website. Please send all comments to Stuart Brown (brown@med.nyu.edu) at New York University School of Medicine.
Background/Introductory material on Molecular Biology

Access Excellence (high school biology students and teachers)
Genetech
http://www.accessexcellence.org/index.html
About Biotechnology http://www.accessexcellence.org/AB/BC/
Winding your way through DNA http://www.accessexcellence.org/AB/WHW/index.html

An Introduction to Nucleic Acids
Helen M. Berman and Christine Zarebski, Rutgers Univ., NJ, USA
http://ndserver.rutgers.edu/NDB/archives/MAstro/index.html

Beginners Guide to Molecular Biology
Nathalie Castells-Brooks
Institute of Arabie Crops, Rothamsted, UK
http://www.cst.bbsrc.ac.uk/molbio/guide/

Tutorials in Molecular Biology (Shockwave movies)
Steve Scholzovsky
UCLA Undergraduate Biological Sciences Education Program
http://locusus.bio.ucla.edu/3tutorial/
A collection of Shockwave movies on a number of molecular biology topics including transcription, translation, electrophoresis, sequencing, PCR, the Lac operon, and the lambda life cycle. Very little text, very slow to download over a modem.

WWW Cell Biology Course
Mark Dalton, SGI Inc.
http://www.sgi.com/sci/cell.html

On-Line Biology Book (1995) - freshman biology - an awesome amount of content
Michael J. Farabee, Evergreen Mountain Community College
Getting Started in Bioinformatics

What is Bioinformatics?
Weizmann Institute of Science, Israel
http://bioinfo.weizmann.ac.il/gerda/bioinfo_intro.html

How to become a bioinformatics expert (1997)
Alexander Szypry
http://www.uni-mainz.de/~sroeschl/bc4tudy.html

A Short Introduction to Biocomputing
Christian Froesch
http://www.uni-mainz.de/~sroeschl/bc4example.html

Biocomputing in a Nutshell
ULF Reimer and Georg Fuellen, VSNS BioComputing Division
http://merlin.mber bcm.uc.edu/800/lec/c04/RttAR/ruar/welcome.html

Learning Biocomputing on the Internet
David T. Crooks, VSNS BioComputing Division
http://merlin.mber bcm.uc.edu/800/lec/c04/RttAR/ruar/tools.html

Pedestrian guide to analyzing sequence databases
An extensive book chapter that goes beyond the basics, but does not constitute a course in and of itself
Burkhard Rost and Reinhard Schneider (EMBL, Heidelberg, Germany)
http://www.embl-heidelberg.de/~rost/Papers/IRntergr/96.html

Why Biologists Should Not Treat Software as a Black Box
Joelle Thouard, VSNS BioComputing Division
http://merlin.mber bcm.uc.edu/800/lec/c04/RttAR/ruar/instr0duced.html
Subject Specialist Librarians’ Web Pages

Liaison Librarian to:

UF Genetics Institute

- College of Medicine
  - Molecular Genetics and Microbiology (joint app)
- Anatomy and Cell Biology
- Biochemistry and Molecular Biology
- Physiology and Functional Genomics
- MS, PhD and IDP students

Other Programs
- ICBR
- Department of Zoology (CLAS)
- Plant Molecular and Cellular Biology (IFAS / CLAS)

- About Your Liaison
- Background and Experience
- Other Liaison Librarians

Michele Tennant
Ph.D., MLIS
Bioinformatics Librarian

The Medical Library Association’s 2005 Academic Medical Librarian of the Year

352.846.0149
michele@library.health.ufl.edu

As your Liaison Librarian, Michele can:
- Provide assistance with literature searches, including those for grants and IACUC applications
- Provide information consultations or library orientations
- Receive recommendations for books, journals, audio-visuals or databases to be added to the HSC Libraries collections
- Guest lecture in your class, department meeting or journal club
- Develop and teach new information-related classes based on your recommendations
- Meet with you in person or over e-mail to discuss any of your information needs

Michele provides Liaison Librarian services to the groups listed above, and is the HSC Libraries’ genetics, molecular biology and bioinformatics information specialist. As Bioinformatics Librarian, she provides instruction in the use of bioinformatics resources and databases, particularly those available from the National Center for Biotechnology Information (NCBI)
Staying Current

- **About Biotech**
  - biotech.about.com/index.htm?terms=biotech

- **Bio-IT World**
  - www.bio-itworld.com/index.html

- **Chemical & Engineering News**
  - pubs.acs.org/cen/index.html

- **Nature**
  - www.nature.com/genomics/

- **Science**
  - www.sciencemag.org/content/vol291/issue5/507/index.shtml

- **The Scientist**
  - www.the-scientist.com/
Staying Current Nucleic Acids Research

- **1st January issue—Database Reviews**
  (became “Database Issue” 2004)
  - Reviews and updates of database developments
  - 40-50 articles per issue (1996 to present)
- **1st July issue—Web/Internet Reviews**
  (became “Web Servers Issue” 2004)
  - Reviews Web servers and services
  - 40-50 articles per issue (2003 to present)

- [nar.oupjournals.org/contents-by-date.0.shtml](nar.oupjournals.org/contents-by-date.0.shtml)
- Open access to all
Staying Current ~ Networking

- **ASIS&T SIG BIO**
  - [www.asis.org/AboutASIS/asissigs.html#SIG BIO](http://www.asis.org/AboutASIS/asissigs.html#SIG BIO)
  - [www.asis.org/AboutASIS/SIGEEmailLists/bio.html](http://www.asis.org/AboutASIS/SIGEEmailLists/bio.html) (How to subscribe)

- **MLA Molecular Biology & Genomics SIG**
  - Jennifer.Lyon@mcmail.vanderbilt.edu

- **Bioinformatics Support Network**
  - NAWBIS Instructors and Participants

- **CHMI NF-L (ACS) & STS-L (ALA)**
Frederick W. Stoss, MS (zool), MLS

Associate Librarian
Biological & Environmental Sciences and Mathematics

Science and Engineering Library
228-B Capen Hall
University at Buffalo
Buffalo, NY 14260-1672
716 645-2947 ext. 224
fstoss@buffalo.edu