



Careers in Genetics and the Biosciences

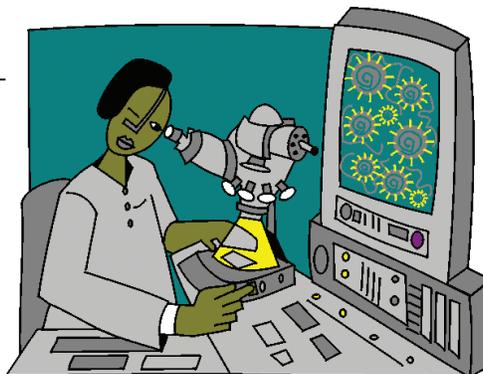
www.ornl.gov/hgmis/education/careers.html



The large, multidisciplinary Human Genome Project (HGP)—the effort to find all human genes and characterize a reference genome—promises to revolutionize the future so profoundly that the 21st has been dubbed the “biology century.”

Almost everyone will be affected by applications of information and technologies derived from the HGP era of the late 20th century. Entirely new approaches will be implemented in biological research and in the practice of medicine and agriculture. Genetic data will provide the foundation for research in many biological subdisciplines, leading to an unprecedented understanding of the inner workings of whole biological systems. The benefits of genomic research are, or soon will be, realized in such areas as forensics and identification science, ecology and environmental science, toxicology, toxic waste cleanup, and creation of new bioenergy sources and more efficient industrial processes, as well as in understanding the mysteries of evolution, anthropology, and human migration.

Among the fields that HGP research will impact are engineering, computer science, mathematics, counseling, sociology, ethics, religion, law, agriculture, education, pharmaceuticals, instrumentation, nuclear medicine, forensics, bioremediation, biofuels, and journalism. Cross-disciplinary students with solid backgrounds in science and one or more other fields such as journalism, law, business, and computer science will be needed to tackle the issues and applications arising from the HGP.



Commercialization of numerous applications in genomic science is fueling the burgeoning life sciences economic sector. Legislation and litigation increasingly will be concerned with genetics and intellectual-property issues pertaining to genetic information and technologies. Educators, the media, students, and the public need a good understanding of this “new genetics” and its implications so they can better communicate, teach, and help others make related career and personal decisions. Democratizing access to genetic science information should help maximize HGP benefits while protecting against misuse of the data. Every effort must be made to ensure that each person—regardless of race, citizenship, or national origin—enjoys the benefits of genomics research and its subsequent applications, including life improvements and excellent career possibilities. Society simultaneously must be protected from possible negative impacts such as the failure to preserve the privacy of individual genetic information.

Today, people in fields such as business, which traditionally did not require life sciences training, increasingly are finding that they need at least a working knowledge of the principles of biology and life science research and development. Presented below are some educational strategies for pursuing such cross-disciplinary careers, followed on the back page by a listing of some traditional and new bioscience career possibilities and Web sites for more information.

Preparing for a Career in the Biosciences

- ✓ Pursue a cross-disciplinary education. Biology problems are too big to be solved by only one discipline. People need science and technology basics, training in computer use and information technology, and education in bioethics to anticipate and present options for solving prickly social issues. Community and four-year colleges offer biology and related studies, including integrated science and technology programs that incorporate computer science, information technology, chemistry, biology, engineering principles, and bioethics.
- ✓ Contact your state’s biotechnology industry organization, or find its careers section on the Web.
- ✓ Talk to professionals from a wide array of disciplines. Don’t be shy; showing your interest will open doors.

- ✓ Gain experience in the biosciences industry via internships, volunteer work, work study, and co-op programs.
- ✓ Keep abreast of latest developments in the field by surfing the Internet for newspapers, technical magazines, and trade journals.

Government Internship Programs

- **Department of Energy Office of Science Internship Programs** (www.scied.science.doe.gov/scied/sci_ed.htm)
- **National Institutes of Health Training and Internship Opportunities** (www.training.nih.gov)
- **DOE National Laboratory Education and Internship Programs** (www-ed.fnal.gov/doe/doe_labs.html)

Possible Career Areas in Bioscience

Note: The biotechnology industry has doubled in the past few years. In 2001, there were 726,000 U.S. jobs in the field (191,000 direct; 535,000 indirect), and more opportunities are expected in healthcare, food production, and environmental cleanup (Ernst & Young, www.bio.org). In regard to the burgeoning drug industry based on genomics, the Consulting Resources Corporation's newsletter for biotechnology professionals said, "We expect the growing family of new genomics, proteomics, and bioinformatics technologies to dominate the next decade's developments in therapeutics by greatly improving the efficiency and speed of the entire drug discovery, testing, and approval process."

Medicine

- Medical genetics, genetic counseling, genetic nursing
- Gene testing, gene therapy
- Organ transplantation, fertility, and reproduction
- Public health
- Pharmaceutical industry and suppliers
- Pharmacogenomics
- Chemical, vaccine, medicine development and production
- Database development, operation, use
- Communication, work with regulatory agencies

Agriculture and Wildlife

- Genetic modification of foods and seeds
- Biopesticide and nutraceutical development

- Wildlife management: Identification, protection of endangered species
- Authentication of consumables such as wine, caviar

Computational Biology (including bioinformatics)

- Databases, analysis, modeling, data transfer
- Supercomputing
- Mathematics, statistics, actuarial field

Engineering Disciplines

- Bioprocessing chamber, vat design and production
- Toxic waste cleanup
- Instrumentation development
- Creation of new energy sources via engineering, life science research
- Biomedical engineering

Business

- Bioscience industry investment

- Marketing and sales
- Banking

Law and Justice

- Education
- Patent specialties
- Specialties in ethical, legal, and social issues
- Gene and paternity testing
- DNA forensics, laboratory and legal

History and Anthropology

- Use of genetics to study population-migration patterns
- Study of inheritance over evolutionary time

Military

- Soldier identification
- Pathogen identification
- Biological and chemical warfare protection
- Radiation-exposure assessment

Space Exploration

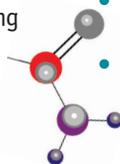
- Effects on humans
- Search for other life forms, evidence of life

Bench Science

- Sequencing of many organisms, including human
- Data analysis, computation
- Functional genomics
- Proteomics
- Human variation in health and disease
- Microbial genetics
- Environmental studies
- Education

Bioscience Communication

- Reporting, writing, editing
- Website development, maintenance
- Public relations
- Marketing
- Special events



More Information on the Web

- Careers in the Genetics Field from Genetics Societies (www.faseb.org/genetics/gsa/careers/bro-menu.htm)
- Bio (Biotechnology Industry Organization) Career Guide (www.bio.org/er/careers.asp)
- A World of Genetics Societies (www.faseb.org/genetics/)
- Biology Careers for the Next Century from Carolina Biological Supply Company (www.carolina.com/tips/97aug/tips897a.asp)
- Career Information from National Society of Genetic Counselors (www.nsgc.org/Careers/)
- Careers in Biotechnology from Access Excellence (www.accessexcellence.org/AB/CC/)
- Careers in Human Genetics from Genetic Professionals (www.kumc.edu/gec/prof/career.html)
- Careers in Microbiology from MicrobeWorld (www.microbe.org/careers/careers.asp)
- Functional Genomics Careers from *The Scientist* (www.the-scientist.com/yr2000/jul/prof_000724.html)
- Genetics: Educational Information (www.faseb.org/genetics/careers2.htm)
- Graduate Programs at School for Computational Sciences at Prince William (www.ib3.gmu.edu/programs.html)
- Guide to North American Graduate and Postgraduate Training Programs in Human Genetics (www.faseb.org/genetics/ashg/tpguide/tpg-menu.htm)
- Science Careers from *Science* (recruit.sciencemag.org/feature/advice/advice.shl)
- SciWeb Biotechnology Career Center (www.biocareer.com/index.cfm)
- Worldwide Programs in Bioinformatics and Computational Biology from The International Society for Computational Biology (www.iscb.org)

