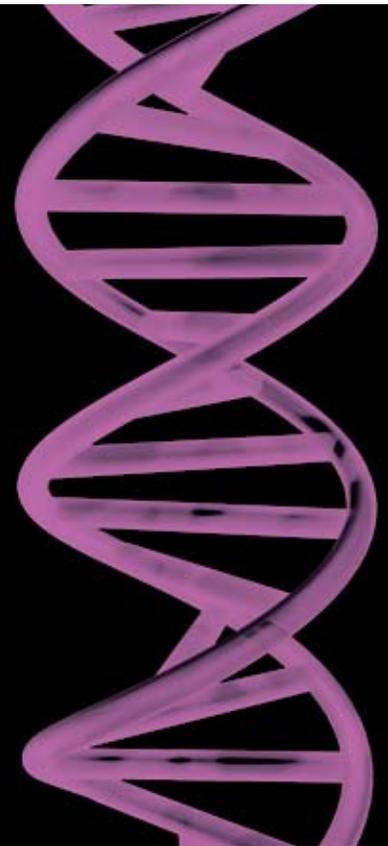


# GENETICS:

Your Passport to a World of Job Opportunities



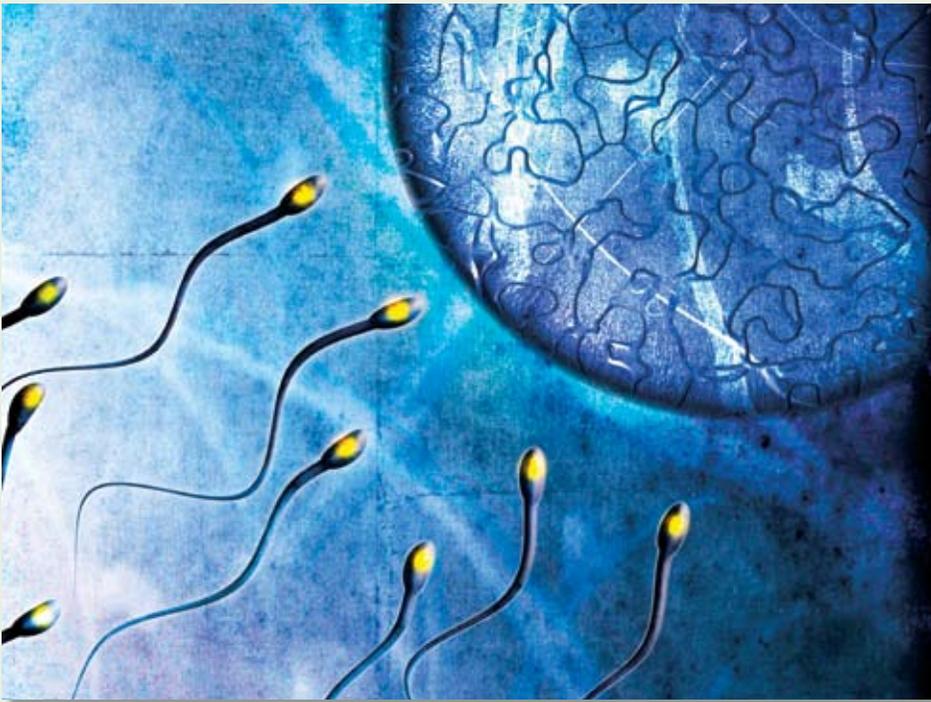
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## What is genetics?

Genetics is the study of DNA and INHERITANCE.

DNA is genetic information. Every cell of a living organism contains genetic information, which is organized into units called GENES. Genes are the individual instructions that allow organisms to develop and function. Each organism contains thousands of genes, which are organized into large, tightly packed structures called CHROMOSOMES. Chromosomes make it possible for so much DNA to fit inside a tiny cell.

DNA in the form of chromosomes is passed down from generation to generation, from parent to child. This is called INHERITANCE. Each individual has a unique combination of genes inherited from a mother and a father. People who are related to each other have genetic similarities. Only identical twins have exactly the same genetic makeup.

## Why is genetics important?

Genetics is fundamental to life. Changes at the DNA or chromosome level can have a large effect on an organism. These changes are often

called MUTATIONS. Mutations can be either good or bad. On the one hand, mutations can be harmful by disrupting basic functions or development of an organism. On the other hand, mutations can provide novel functions that help an organism survive and evolve. Mutations have allowed us to trace the migration of ancient man- from Africa into all of the other continents- by following DNA changes in different populations around the world. In other words, genetics can help us clarify history.

*Genetic technology can have many useful applications, such as:*

- Improving the nutritional content of crops and livestock
- Producing new medications and developing new therapies
- Diagnosing (or even predicting) genetic diseases
- Providing evidence for solving crimes or proving innocence
- Identification of soldiers or disaster victims

Did you know that DNA fingerprinting was used to help identify victims of the terrorist attacks of September 11, 2001? Families provided DNA samples from hairbrushes and toothbrushes of lost loved ones. Out of almost 2,000 people who perished when the Twin Towers fell, approximately 800 were identified by DNA evidence alone. The

same kind of forensic DNA analysis is being used to identify people who died in hurricane Katrina, and is also being used by our government to identify fallen soldiers in the war overseas in Iraq and Afghanistan.

Genetics is a buzz word and hot topic of today. Genetics has made its way into our entertainment industry. We hear about genetics in TV shows, movies and on the radio and read about it in newspapers and magazine articles, but how much do most people actually know about genetics? In reality, the public still lacks basic understanding about genetics and most people are not able to tell fact from fiction. Much work is needed right now to educate the public, and to integrate genetics into society in a responsible, productive, and meaningful way.

## Why consider a career in genetics?

Careers in genetics are rapidly gaining influence and importance. From the laboratory to law books; from medicine to the media; traditional and non-traditional jobs in genetics are constantly emerging. People with expertise in genetics will surely be in high demand in the near future.

Graduating from college with a degree in genetics is like having a passport to several different countries. A degree in genetics guarantees flexibility and access to a variety of career options and job settings. Genetics is no longer just a laboratory bench job (although that is one option). New roles in genetics include teaching, genetic counseling, journalism, forensics, public policy, patient advocacy, Web site design and management, and more. As genetics-related subject matter becomes increasingly popular in media and entertainment, creative jobs merging science and art are on the rise.

Genetics is the future. If you possess skills in genetics you have a strong advantage in the job market. Consider any area of interest along with genetics and you will most likely see an opportunity that is right for you.

# INCREASING DIVERSITY IN THE GENETICS FIELD

## Law + genetics

Knowledge about genetic information opens up issues about privacy, ethical use of information, and insurance policy. Concerns about stem cell research, embryo adoption, cloning, genetic testing, patent rights, and more are hotly debated topics. People with knowledge in genetics are crucial in helping shape policy and law around those issues.

*Job opportunities in genetics and the law include:*

- Bioethics
- Drug approval and regulation
- Health care and insurance policy
- Patent law
- Privacy issues and genetic discrimination

## Medicine + genetics

Genetics has a growing role in medicine. We are finding out that many diseases have a genetic basis. Research on gene therapy and personalized medicine is currently underway. However, you do not have to be a doctor to work in medical genetics. There are many opportunities in medical genetics for researchers, nurses, counselors, laboratory technicians and more.

*Job opportunities in genetics and medicine include:*

- Bio-genetic research and engineering
- Clinical genetics
- Fertility and reproductive genetics
- Forensic medicine
- Genetic counseling
- Genetic nursing
- Genomic medicine

## Computer science/math + genetics

Bioinformatics is a new field that combines computer science with biology. Computer software skills are needed to create programs and databases that can analyze vast amounts of biological information, such as the human genome sequence. Software skills are also needed in computational biology, which uses DNA sequence patterns to find new genes and predict gene function. The study of how whole sets of genes interact with each other and the environment is called genomics.

*Job opportunities in genetics and computer science/math include:*

- Bioinformatics software design
- Computational biology
- Database development and management
- Genomics
- Statistics

## Media + genetics

Most people learn about genetics from watching TV, listening to the radio, browsing the Internet, and reading the newspaper and magazines. Creative opportunities in genetics include writing and producing mainstream TV shows with science themes (The X-Files, CSI) and reporting for magazines (Newsweek, Time, Discover, Scientific American). On a more serious note, accurate representation of scientific information is important so the public is not misled or misinformed. The media is a powerful means for communicating genetics to the public.

*Job opportunities in media and genetics include:*

- Art (DNA jewelry, DNA music, visual art)
- Consulting/producing/writing (TV, movies, documentaries)
- Journalism (magazines, newspapers, research publications)
- Literature (fiction novels)
- Science writing (textbooks, educational materials)
- Web site development

## Government, politics + genetics

Actor Christopher Reeve, who was paralyzed after a horseback riding accident, was a strong advocate of stem cell research because of its potential to help others with spinal cord injuries such as his. Government officials with an understanding of genetics play a large role in supporting medical research, such as stem cell research. The government determines what kinds of research receive funding. Law writers and government officials who understand biology and genetics can have a large influence on scientific and medical advancements.

*Job opportunities in government, politics and genetics include:*

- Bioethics
- Drug approval process
- Legislature and public policy
- Research grant evaluation

## Public health + genetics

Public health is involved in improving and protecting the health of our large populations. This involves identifying potential environmental health threats, educating and promoting health and wellness in our community, and assessing health needs of the population. Public health is concerned with the social, psychological, biological, and public policy issues that affect the public. Public health promotes quality of care, health education, disease prevention, and appropriate use of technology.

*Job opportunities in public health and genetics include:*

- Education
- Environmental genetics
- Epidemiology
- Nutrition
- Health advocacy
- Research

## Business, industry + genetics

Pharmaceuticals and biotechnology are private industries involved in developing, producing and selling medications and genetic or medical tests. The research branch of industry requires skills in science, laboratory work, or manufacturing, while the business branch requires skills in management, law, finances, advertising, public relations, marketing, or even graphic design. While many of these jobs seem unrelated to genetics, employees trained in genetics have a better understanding of how their role meshes with the company's image and goals, which translates to a strong competitive advantage!

*Job opportunities business, industry and genetics include:*

- Advertising
- Business management
- Clinical trial coordinator
- Graphic design
- Marketing
- Patent rights
- Public relations
- Quality control
- Research and development

# INCREASING DIVERSITY IN THE GENETICS FIELD

## How to prepare for a career in genetics during high school

- Take advanced science courses in high school, such as college prep/AP biology and chemistry. This will help prepare you for rigorous college science courses.
- Apply to colleges that offer bachelor of science degrees in genetics. Some colleges offer degrees in biotechnology.
- If the school you want to attend does not have genetics as a major you can choose another biology-related major and supplement your education with additional genetics courses.
- Find a professional willing to mentor high school students. Ask if you can observe them at their job. It is a great way to find out if a particular career is right for you. Ask your parents or career counselor if they know someone who will be your mentor.

## How to prepare for a career in genetics during college

- Gain volunteer research experience. Find a professor doing research in a subject interesting to you. Ask to be an undergraduate volunteer researcher. Volunteer research looks great on your resume, especially if the work you're doing gets published in a science journal. You will also gain valuable skills that will help you land a future job.
- Research your career options. Find out what specific knowledge and skills you will need for careers of interest. Take elective courses that will supplement your knowledge and skills in these areas.
- If possible, find a mentor in your area of interest. Ask him or her about their career path and training. Mentors will have years of insight to share with you that won't be found in any career manual.

## Beyond college

After graduating college there are many entry-level positions for a bachelor of science degree in genetics.

1. Visit your college career center and look in newspaper listings to find out what kinds of jobs are out there.
2. Browse career Web sites such as [newscientist.com](http://newscientist.com), [monster.com](http://monster.com), or [hotjobs.com](http://hotjobs.com) to find interesting, non-traditional jobs.
3. Expand your resources and opportunities by joining a scientific community, such as the Genetics Society of America (GSA) or the Association of Genetic Technologists (AGT). Membership in a professional society also looks great on your resume.
4. If you are unsure what you want to do, apply for an internship or fellowship to try out a career or research project. The nice thing about internships is they are temporary and often paid!

## Helpful Web sites

- American College of Medical Genetics  
[www.acmg.org](http://www.acmg.org)
- American Society of Human Genetics  
[www.ashg.org](http://www.ashg.org)
- Association of Genetic Technologists  
[www.agt-info.org](http://www.agt-info.org)
- The Dolan DNA Learning Center  
[www.dnalc.org](http://www.dnalc.org)
- Genetic Alliance  
[www.geneticalliance.org](http://www.geneticalliance.org)
- Genetics Society of America  
[www.genetics-gsa.org](http://www.genetics-gsa.org)
- Information for Genetic Professionals  
[www.kumc.edu/gec/geneinfo.html](http://www.kumc.edu/gec/geneinfo.html)
- National Coalition for Health Professional Education in Genetics  
[www.nchpeg.org](http://www.nchpeg.org)
- National Society of Genetic Counselors  
[www.nsgc.org](http://www.nsgc.org)

## College courses recommended for genetics majors:

- Biochemistry
- Calculus
- Cellular and molecular biology
- Chemistry
- Classical genetics
- Developmental biology
- General Biology
- Human genetics
- Laboratory research experience (highly recommended – student research projects look great on your transcript!)
- Organic chemistry
- Statistics

## Advanced degrees

Careers in medical genetics, genetic counseling, law and public health often require post-graduate education. It is usually favorable to have a few years of work experience before applying to graduate school. You will also need to take special qualifying exams. For example, the Graduate Records Examination (GRE) is required for graduate research programs and the Graduate Management Admissions Test (GMAT) is required for business programs. Your college career center or departmental administrator should have more information on these types of exams.

## Advanced education for people with genetic degrees include:

- Business
- Genetic counseling
- Graduate research
- Journalism
- Law
- Medicine
- Public health
- Psychology