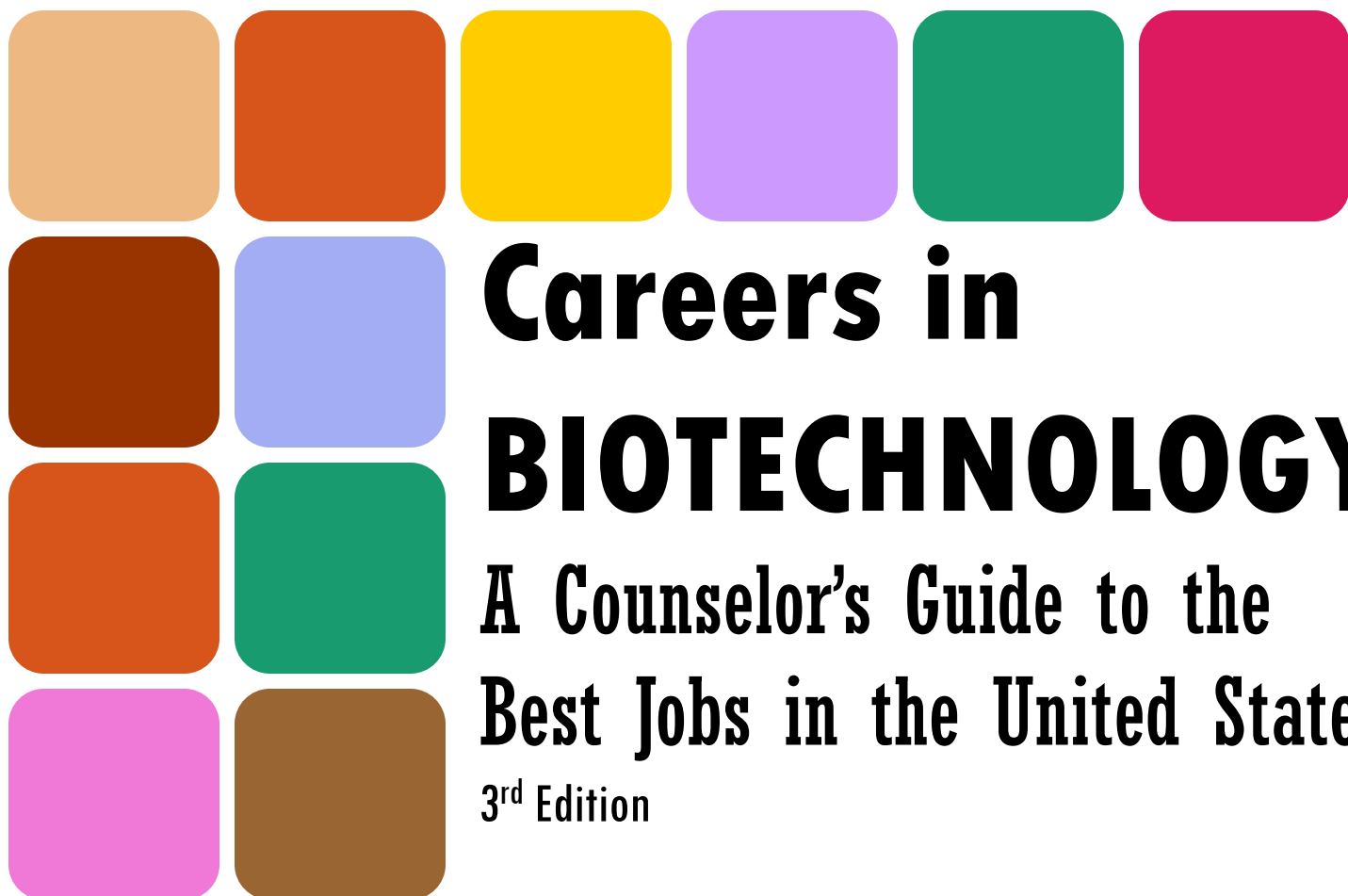




Careers in BIOTECHNOLOGY

A Counselor's Guide to the Best Jobs in the United States

3rd Edition

Animal Caretaker
Animal Technician
Bioinformatics Specialist
Clinical Research Associate
Documentation Coordinator
Forensic DNA Analyst
Greenhouse and Field Technician
Greenhouse and Field Worker
Health and Safety Specialist
Instrumentation/Calibration Technician
Laboratory Assistant
Laboratory Automation Specialist
Laboratory Support Worker
Laboratory Technician
Manufacturing Assistant
Manufacturing Technician
Material Handler
Quality Assurance Specialist
Quality Control Technician
Research Associate
Sales Representative
Scientist
Technical Service Representative

By
Gina Frierman-Hunt
Julie Solberg

California Community Colleges
Economic Workforce Development
California Applied Biotechnology Centers
Statewide Initiative and Hubs

cccbiotech.org

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Sponsored by:
California Community Colleges
Economic and Workforce Development Program
California Applied Biotechnology Centers and Hubs
www.cccbitech.org

and

Bio-Link, a National Science Foundation
Advanced Technology Education Center
www.bio-link.org



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For more information about the California Colleges Biotechnology Initiative, visit the website at

www.cccbitech.org

To obtain additional copies of this guide, contact your area regional biotechnology center.

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How to Use This Guide

How to use this guide

This guide is a quick information source for counselors, instructors and any other person interested in a biotechnology career. Most of the guide is about entry level jobs for people holding high school diplomas, associate or bachelor's degrees. Pages are easily photocopied or available in electronic format from www.cccbitech.org.

Chapters and subsections can be quickly referenced using the tabs.

Chapter 1: Biotechnology in the United States

- Why choose a career in biotechnology?
- Definition
- History
- Products
- Jobs and job locations
- Overviews of states with the highest number of biotech jobs

Chapter 2: Qualifications, Training and Interests

- Required skills
- Community College biotechnology programs
- Bioscience/related community college programs
- Interests, Education and Training
- Where to find a job
- Map of California Community College Applied Biotechnology Centers

Chapter 3: Best Jobs in Biotechnology

- A total of 23 entry-level and other jobs in alphabetical order
- Skill, Training, interests
- Wages
- Training programs at the Community College level

Chapter 4: Finding a Job

- Find biotechnology employers in each state
- How of fine a job
- List of web sites useful to job seekers

Chapter 5: Bibliography and Acknowledgements—References used for this edition of Careers in Biotechnology including people who kindly helped with information.

Chapter 6: Glossary—definitions of technical terms.

This section provides definitions of technical terms used in this book.

Chapter 1

Biotechnology in the United States

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Biotechnology in the United States

Why Choose a Career in Biotechnology? - *Because you can help save lives, cure diseases, help feed the hungry, help create a substitute for oil energy use, and be a pioneer in green technology.*

The people who work in biotechnology make discoveries at the forefront of science in the areas of

- drug discovery,
- food and fiber crop improvement,
- environmental protection and
- manufacturing (medical devices, biotech drugs and other bioscience products).

Biotechnology is a growing industry in United States offering excellent opportunities, pay and benefits. Many positions are available for people with a background in biological science with good laboratory and computer science skills.

What is Biotechnology? -

Definition: The use of advances in life science to create products and services for our world.

The products of biotechnology come from living things called organisms. The science of biotechnology is based on the DNA molecules located in the cells of each living organism. Only in the second half of the 20th century did scientists begin to learn how DNA controls the characteristics of living organisms (including plants, animals and bacteria and the viruses that infect them).

Major Event Timeline

1972—The “birth” of biotechnology is generally dated from 1972, when three scientists developed a modified DNA molecule by transplanting or “recombining” DNA from two different organisms. Before that, DNA had been moved between organisms that were the same.

1976—Genentech Incorporated was founded.

1982—Genentech was approved to sell the first biotech drug, human insulin.

Insulin occurs naturally in human beings except for people with diabetes. Before 1982, insulin was harvested from blood of other animals so supply was limited and expensive. Human insulin was developed by moving an insulin gene (a piece of DNA) from a human cell to cells of a bacterium called *E. coli*. Putting this human insulin gene into bacteria meant that the supply of insulin

could be greatly increased and would be less expensive.

To make enough insulin to sell, millions upon millions of bacterial cells with the human gene were grown in bioreactors, then the human insulin was harvested, bottled and sold.

This date marked the beginning of making profit from biotechnology. The San Francisco Bay Area, where Genentech Inc. began, remains one of the major centers of biotechnology in the United States.

U.S. and global biotechnology companies apply science to many areas to:

- develop medicines that help patients with AIDS, stroke, heart disease, asthma, cancer, diabetes and many other diseases.
- develop diagnostic tests used for pregnancy, AIDS, cancer and other conditions. The techniques of biotechnology are
- use in agriculture, industrial applications, forensics and security, mining, biofuels and environmental cleanup.
- Overlap between biotechnology and other areas include nanotechnology, anthropology, instrumentation, and supplies.

1980s—This decade produces hundreds of biotechnology advances too numerous to repeat here.

1988—Congress funded the Human Genome Project, one of the most ambitious undertakings of the biotechnology community. The purpose of this Project was to decode the entire genetic sequence of humans. Other countries became involved as well, as did a private company that wanted to patent human genes. Due to a race to complete the sequence with public and not private funds and prevent human gene patenting, the code was completed in just twelve years.

1998—the *C. elegans* worm genome sequenced.

2000—Government and private researchers announced the completed mapping the sequence of the human genome.

2001—Rice genome sequenced, the first food plant genome, which could help create nutrient rich rice to help feed people in developing countries.

2002—Japanese puffer fish genome sequenced

2003—Dog, chicken, laboratory rat, and chimpanzee genomes sequenced

2006—Malaria parasite genome sequenced, which is planned to lead to a better understanding of malaria and help scientists treat and prevent it.

2008—Duckbilled platypus genome sequenced

Other Biotechnology Breakthroughs

The 1990s...

- Human Genome project launched
- In vitro testing technique unveiled
- Flavrsavr tomato produced, first whole food produced through biotechnology
- First mammal cloned, Dolly the sheep
- Commercial genetically modified crops grown worldwide reach 5 million acres
- First complete animal genome, the *C. elegans* worm, is sequenced

In the 2000s...

- Genetically modified crops growth reaches 122 million acres in more than 18 countries including the United States
- First complete food plant, rice, is sequenced
- Japanese develop a biotech coffee bean that is naturally decaffeinated
- The United Nations endorses biotech crops
- Bioethanol for commercial biofuel production is achieved in Canada
- California voters pass Proposition 71 supporting embryonic stem cell research
- Human genome sequencing is completed

Cloning

Cloning is a way to create exact copies of genes, cells or entire organisms such as animals. The process is most commonly used to produce large quantities of viruses, yeasts and other microscopic organisms to make biotechnology drugs and products.

Animals that have been cloned

- 1997: the sheep “Dolly” and a Rhesus monkey
- 1998: Cow
- 2000: Pig
- 2001: Cat
- 2003: Mule, horse, deer
- 2004: Pet kitten

Use of viruses, yeasts and other cells for:

- Drugs helpful to human beings
- Drugs helpful to animals such as vaccines
- Harvesting large quantities of enzymes for many uses, such as laundry detergent and other processes

-
- Cloning techniques such as monoclonal antibodies for medicinal use, usually to make antibodies against specific diseases such as multiple sclerosis, prevent rejection of organ transplants, allergies and skin diseases.
 - Test cells for new medicines before testing on human beings or animals
 - Growing tissues such as blood vessel cells that could replace damaged blood vessels in people that had a heart attack, for instance.

Fermentation or Bio-manufacturing?

In a general sense, fermentation is the same technique used to make beer. The term “fermentation” is used for biotechnology processes, but these processes are also called bio-processing or biomanufacturing. These three terms are interchangeable.

Fermentation/Bio-processing/Bio-manufacturing characteristics and advantages:

- Grow large numbers of cells that have the gene for chosen product in a liquid bath (liquid media)
- Product may be pharmaceuticals, enzymes and other industrial products
- Can harvest large amounts of product from the large numbers of cells
- Stainless steel containers for the liquid in which the cells grow are large, ranging from several dozen gallons to thousands of gallons
- Must be kept sterile during the process. If not, the “batch,” or the particular product in one container, is lost

Controversy

Some of the uses of biotechnology are controversial in terms of the effects on the environment and ethical issues they raise. Biotechnology often develops new products that may affect society and the environment in unknown ways. These issues include:

- Using human embryo stem cells for medical research. Some people say human embryo stem cells are the “golden standard” for being able to treat various diseases and argue it is ethically sound to pull apart embryos for their stem cells. Others regard any embryo as human life since every human being must begin as an embryo. They point to non-embryo stem cells already treating 70 or more diseases and having the potential to treat even more.
- Cloning, which copies one animal one or more times and is currently banned for use to clone human beings in almost every country of the world
- Changing the genetic materials of life forms
- Using genetically modified plants in agriculture

Safeguards

Because the largest part of this industry is involved in creating drugs for human beings, much of this industry is highly regulated. The Food and Drug Administration (FDA) regulates pharmaceuticals, medical devices, food additives and whole foods. The

United States Department of Agriculture approves field tests for genetically altered plants. The Environmental Protection Agency regulates production of biotechnology pesticides, insecticides and fungicides. Many if not all bioethics groups oversee research that may be controversial.

How is Biotechnology Used?

Below is a brief overview of the industries in which biotechnology techniques and products are used. These include

- human health,
- agriculture and food,
- biofuels,
- environmental protection,
- forensics and security,
- industrial products,
- instrumentation and suppliers, and
- scientific research.

Human Health

The biotechnology pharmaceutical industry has grown immensely in the past 25 years. The first drug produced through biotechnology, human insulin, has been helping to save lives since 1982. Since then, the biotechnology industry has brought to market more than 200 new drugs and vaccines that treat and prevent diseases. More than 400 new biotechnology drugs are in the process of being tested to see if they can be brought to market.

Therapeutics

Drugs that treat diseases and vaccines that prevent diseases are known as therapeutics. Most biotechnology companies work in the area of therapeutics because of the benefit to human health and the potential for millions of dollars in profit. Bringing a drug to market also takes 12-15 years and millions of investment dollars.

New drugs have been developed that

- Treat cancer, AIDS, arthritis, asthma, heart disease, and hemophilia.
- Produce antibiotics, birth control pills, vitamins, and growth hormones.
- Treat the side effects of chemotherapy and give cancer patients a better chance for a cure.
- Prevent hepatitis, meningitis, diphtheria, pertussis and tetanus through vaccines.
- Grow skin replacements for burn victims and materials that help broken bones heal better.

Diagnostics

Tests and devices for diagnosing disease are called diagnostics. Hundreds of diagnostic tests have been created by the biotechnology industry, such as tests to:

- Find out if a woman is pregnant at home or in the medical office;
- Help diagnose prostate cancer or cholera or high cholesterol;
- Determine if women have a predisposition to breast cancer;
- Ensure that our blood supply is safe and doesn't carry diseases from blood donors, such as HIV or mad cow disease; and
- Find out if a baby in the womb have issues like Down syndrome or spina bifida.

Areas of Research

- Gene therapy works to cure genetic diseases by using modified viruses to deliver healthy copies of DNA to cells.
- New research in pharmaceuticals is looking at ways to transfer genes for an antibody, protein or enzyme into a plant, and use the plants to grow a drug. The crop becomes the mini-factory, the plants are harvested and the drug is purified from the harvest.
- Stem cells research is of interest since stem cells have the ability to develop into many different types of cells, such as a blood cell, a muscle cell or a brain cell. In the past 25 years, stem cell benefits have come from non-embryonic stem cells (sometimes called adult stem cells) with more than 70 products or procedures that successfully use these stem cells. Some scientists believe that stem cells could be used to treat spinal cord injuries, diabetes and Parkinson's disease. Controversy surrounds the idea of pulling apart human embryos to use their stem cells in research.

The area of human health will continue to be the most active field of biotechnology.

Agriculture and Food

Biotechnology has had an enormous impact on the agriculture and food industries, being used to improve crop yields and increase plants' resistance to disease, insects and drought; increase milk production; treat and prevent animal disease; and develop better ways of processing foods.

Crop Protection

Some examples of crop protection from biotechnology processes are:

- Using *Bacillus thuringiensis* toxins in plants to destroy insects. *B. thuringiensis*

is a bacterial species that naturally creates proteins that are toxic to insects, but do not affect other animals or plants. The gene that creates this toxin has been transferred into a variety of crops. When the insect eats a small amount of the plant, it dies.

- To make chemicals that animals use to attract mates, called pheromones. These are used to lure insects into traps and avoid the need to use pesticides.
- To create plants that are not affected by herbicides. With this protection, herbicide can be applied on the crop, and only weeds are killed. This reduces the need for cultivation and reduces the use of pesticides.

**Genetically Modified Crops
Grown Worldwide in 2007**

- 64% of soybeans (135 million acres)
- 14% of corn (56 million acres)
- 43% of cotton (37 million acres)

Food Production and Processing

Agriculture companies are also using biotechnology to improve production of meat and dairy products and to improve processing of other foods. Examples include:

- Using Bovine somato-tropin (BST), a hormone that helps to increase milk production.
- Cloning cows that are high milk producers or beef stock. In 2008, the FDA approved sale of beef and milk from cloned cattle.
- Reducing soy sauce fermentation from a few months to a few days.
- Improving the processing of cheese, cocoa and tea.
- Using industrial enzymes to process corn syrup to high fructose corn syrup, which is used in many food products such as sodas, sauces, salad dressings, tomato paste and ketchup.
- Developing preservatives to replace sulfur and nitrates.
- Developing healthier vegetable oils with reduced saturated fats

Nearly all of biotechnology research in the area of agriculture and food is carried out by divisions of big agriculture companies rather than biotechnology companies. Only two percent of biotechnology companies focus on agriculture.

Biofuels

Biofuels can replace gasoline or diesel fuels, reducing the United States' dependence on imported oil. Development of the biofuels industry is supported by the government. Biofuels may have fewer environmental impacts than gasoline products and may reduce greenhouse gas emissions.

Potential biofuels feedstock sources in the United States include:

-
- Corn syrup to ethanol using enzymes and fermentation methods,
 - Switchgrass, which could increase fuel production per acre of cropland, and
 - Agricultural waste such as corn stalks, wheat straw, garden waste or wood production residue.

Issues:

- Small amounts of biofuels are currently produced.
- Biodiesel and ethanol factories are mainly in the Midwest and a few other areas of the country.
- More energy is used to produce ethanol than is gained by producing it.
- Switchgrass and other green plant waste will not be profitable until the breakdown of the cellulose and lignin in green plants is simplified.

Environmental Protection

Biotechnology is being used today to help clean up many environmental hazards that have been caused by industrial waste. Bacteria and other microorganisms can

- Break down the oil and help clean up oil spills.
- Increase the speed of oil cleanup.
- Clean up some of the most contaminated hazardous waste sites.
- Can be used to clean up a variety of pollutants including difficult chemicals like poly-chlorinated biphenyls (PCBs).
- Help remove sulfur from coal and decrease air pollution when the coal is burned to create electric power.

Other uses of biotechnology include:

- Developing enzymes for use as a less dangerous and less polluting alternative to many solvents.
- Developing biosensors to detect and measure a variety of toxins in the environment, which provides a great benefit in environmental clean-up and homeland security.
- “Green” plastics that are made from plant materials rather than oil. Biorefineries convert plant materials into plastics using fermentation and enzymes that break down sugars and create the plastic. These plastic materials can be biodegradable and able to be composted. Bioplastics made from corn are already used for plastic bags by several national chains.
- Bioplastics can also be used to make fabric for clothing and bedding.
- Industrial biotechnology applications have led to cleaner processes for products such as paper, fabric, metals chemicals and minerals.

Forensics and Security

DNA fingerprinting, a biotechnology process, has improved criminal investigation, identity issues and forensic medicine. Forensic specialists

- analyze traces of tissue, hair, blood, or other body fluids found at a crime scene and match the DNA that is extracted to suspects or victims. Results can place a suspect at a crime scene and help prosecutors convict criminals. Such matches are used to help prosecute criminals and free innocent people.
- identify victims of natural disasters, war and terrorism.
- determine parentage based on DNA fingerprinting.

Advances in biotechnology are being used to improve national security. Researchers create ways to:

- Protect against bioterrorism.
- Prevent disease or poisons from being used as weapons.
- Use sensors to detect explosives, poisons or diseases that might be used as weapons, such as anthrax or smallpox.
- Develop treatments for people in case they are made ill by bioterrorism, such as vaccines against possible infectious agents used by terrorists.

Industrial Products

More industries are using enzymes or fermentation processes created by biotechnology to improve production, reduce costs and lessen environmental impacts. For instance,

- Industrial enzymes are used in contact lens cleaners.
- Enzyme-based bleaching in the paper industry is less polluting than traditional paper bleaching techniques.
- New paper manufacturing processes also use less water and other natural resources.
- Laundry enzymes are biodegradable and use warm water, instead of hot, to break down stains and get clothes cleaner.
- Biotech enzymes can replace chlorine bleach, which is much more harmful to the environment.
- Enzymes are used to create a “stone-wash” look in denim for jeans.
- Biocatalysts used in industrial processes can reduce waste products and purify chemicals.
- In food safety, new products include a plastic wrap that kills bacteria or instruments to detect harmful bacteria that can cause food poisoning.

Enzymes created by biotechnology can help industries reduce their use of energy. More

products are being created from corn and other plants to replace products traditionally made from oil. These include carpeting, food containers and clothing.

Instrumentation and Suppliers

New tools and machines are needed to use biotechnology to develop and produce:

- Diagnostic tests, drugs, agricultural and environmental products.
- New instruments and supplies.
- Products for biotechnology such as media for cell growth.
- Instruments such as autoclaves, sensors, glassware, DNA sequencing machines or DNA microchips.
- “Labs on chips,” which are tiny atom scale devices that can identify, measure, and sort DNA, proteins or other biological molecules. These chips are made of minute silicon structures built onto microchips and could be used to
 1. create genetic and diagnostic tests,
 2. laboratory instruments,
 3. tests for environmental pollutants, and
 4. many industrial uses.

Scientific Research

The science of biotechnology is being used to study ancient human, animal and plant remains and shed new light on history and the relationships between species.

- Scientists have recently extracted DNA from the fur of mammoths that died between 12,000 and 50,000 years ago and were frozen in the tundra of Siberia. This can be studied to help the scientists learn why mammoths became extinct.
- Anthropologists have studied the DNA of people living today to learn about where their ancestors came from.
- DNA analysis is used to learn about the evolution and migration of human beings from Africa to Europe, Asia and America.
- Bioinformatics is a specialized area of biotechnology that helps scientists organize and use the data collected from DNA sequencing and from studies of proteins. It is used to map genomes, identify genes, determine the structure of proteins and to discover and design new medicines and products. Scientists use this information to identify genes that might cause disease and to identify substances that might be useful in developing treatments for diseases. Bioinformatics has some unusual applications; scholars studying the evolution of language have used bioinformatics

programs to learn about how verbs in various languages change over time.

- Biotechnology can be used to track and protect wildlife populations. Scientists and environmental specialists also use genetics to study the relationship of different species and inbreeding issues raised within endangered species populations.
- Nanobiotechnology is a new technology that works at the scale of a single molecule or about a thousandth of a micron. It is the study and manufacture of super-small structures and tiny machines made on the molecular scale. These can be used to build structures that might be used in microchips for super-fast computers made of DNA rather than silicon. Nanobiotechnology could be used to miniaturize sensors and improve drug delivery.

Biotechnology Job Areas

Although biotechnology industries make many different products from vaccines to seeds to specialized equipment, many of the job duties and titles are similar across the industry. To understand the different job functions, the jobs can be grouped into five areas:

1. research and development (which includes research and development, laboratory support and technician jobs);
2. manufacturing and services;
3. quality and regulatory affairs;
4. sales and technical support; and
5. administration and management.

Jobs overlap and appear in more than one area since the same tasks may be needed in, for example, research and development or manufacturing.

1. Research and Development Jobs

Research and development is the process of discovering new products and developing them all the way to market. These two processes keep the biotechnology industry running by creating new products to sell. Many of the smallest startup biotechnology companies are only doing research and development, but they include small-scale manufacturing necessary to create and test a new product. Designing the methods and equipment to manufacture a product is

Research & Development Jobs

- Animal caretaker
- Animal technician
- Bioinformatics specialist
- Clinical research associate
- Forensic DNA analyst
- Greenhouse and field technician
- Greenhouse and field worker
- Instrumentation/calibration technician
- Laboratory assistant
- Laboratory automation specialist
- Laboratory support worker
- Laboratory technician
- Research associate
- Scientist

called “process development.” Large companies often have a “research and development” department and a “process development” department. Many of the people employed in this area have a Ph.D. or a master's degree.

Research and development jobs are in three categories in this Guide.

1. Entry-level positions such as animal caretaker, greenhouse and field worker, laboratory assistant, and laboratory support worker.
2. Technician-level jobs include animal technician, greenhouse and field technician, instrumentation/calibration technician, laboratory automation specialist and laboratory technician.
3. Higher level research and development jobs that usually require at least a bachelor's degree include bioinformatics specialist, clinical research associate, forensic DNA analyst, research associate and scientist.

2. Manufacturing and Services Jobs

Once a product is ready to be marketed, the full-scale manufacturing and production process begins. Before manufacturing begins, all government approvals, where necessary, must be in order and documented using Good Manufacturing Practices (GMPs) and Good Laboratory Practices (GLPs), both of which are legally mandated standards. The manufacturing process might include fermentation for production purposes in 20,000 liter containers, modified transgenic crops being grown so their seeds can be sold to farmers, or enzymes produced for cheese making.

Some industries provide a service such as crime laboratories. Other companies provide scientific instruments and supplies needed in biotechnology manufacturing.

Manufacturing & Services Jobs

- Forensic DNA analyst
- Greenhouse and field technician
- Greenhouse and field worker
- Instrumentation and calibration technician
- Laboratory automation specialist
- Manufacturing assistant
- Manufacturing technician
- Material handler
- Scientist

Quality and Regulatory Affairs Jobs

The quality assurance and control department ensures that a biotechnology product is manufactured correctly and functions as it should.

1. Quality assurance employees monitor the manufacturing process to ensure that equipment is working properly, measurements are accurate and processes are carried out correctly.

Quality and Regulatory Affairs Jobs

- Documentation coordinator
- Health and safety specialist
- Quality assurance specialist

-
2. Quality control employees test raw materials and final products to make sure they are suitable for sale.
 3. Regulatory affairs employees ensure that all government regulations are followed, working closely with the research and development, manufacturing, quality control and quality assurance departments. They also keep records to prove that products are made exactly as approved by the Federal Drug Administration (FDA).
 4. Health and safety specialists work to ensure that the workplace is safe for all employees and all safety regulations are followed. Research and manufacturing may use hazardous, infectious and radioactive materials, so this area is quite important.

Sales and Technical Support Jobs

Every product developed by the biotechnology industry must have a marketing plan and sales staff so that the company can sell the product.

A technical support team is essential in order to answer customer's questions and to troubleshoot any problems. Technical service representatives also help demonstrate, install and explain products to customers. Most of the people in these positions have a bachelor's degree and many have experience in biotechnology as well.

Sales and Technical Support Jobs

- Sales representative
- Technical service representative

Administrative and Management Jobs

Administrative and management jobs in are not described in detail in this book as they may not be unique to the biotechnology industry. Some management positions may require an unusual combination of scientific and business management skills.

Of course, biotechnology businesses need managers and administrative staff to keep the business running. These include jobs in finance and accounting, government relations, human resources, facilities management, information technology, graphics and writing and other areas.

Promotion is often from within the company. Most companies offer excellent educational benefits. Employees who use these benefits to add business expertise to a scientific background will have the best opportunities to fill management positions such as supervisors, managers, vice presidents and chief financial officers.

Administrative and Management Jobs (not unique to biotechnology)

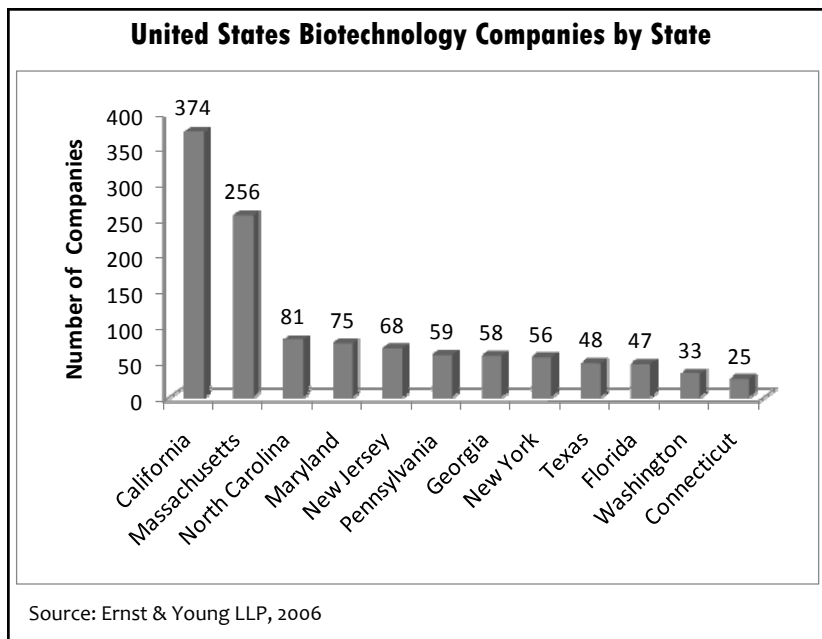
- Accountants
- Government relations representative
- Human resource specialists
- Facilities specialist
- Information technology specialist

Biotechnology Employment in the United States

In the United States, California and Massachusetts have the most biotechnology companies and jobs in biotechnology. In 2006, about 200,000 jobs existed in biotechnology companies in the United States, according to Ernst & Young Consulting. Ernst & Young conducts an annual survey of the biotechnology industry and is widely used as a benchmark when looking at the industry. However, Ernst & Young counts employees of “biotechnology-only” companies that are publicly owned. Their count misses small startup companies and departments in large companies that focus on agriculture, pharmaceuticals, medical devices, medical testing and clinical services.

With additional areas of interest, the industry is often called the bioscience industry and includes:

- Universities,
- Research institutions,
- Large pharmaceutical companies,
- Agriculture companies,
- Other industries that use biotechnology,
- Employment of 500,000 to 1.2 million people and
- 43,000 companies.



Of the more than 1400 biotechnology companies located in the United States (according to the Ernst & Young data), 630 of them are located in California (374) or Massachusetts (256). Of the other top states included in this report, the number of biotechnology

companies range from 81 to 25. Of course, the largest biotechnology companies have operations in more than one state.

All fifty states have industries that use biotechnology or bioscience and have biotechnology jobs. These industries include agriculture companies, pharmaceutical companies, bioscience companies and universities with biotechnology research programs that are located throughout the United States.

Top United States Biotechnology Companies*

Amgen, Thousand Oaks, CA
Biogen Idec, Cambridge, MA
Celgene, Summit, NJ
Genentech, South San Francisco, CA
Genzyme, Cambridge, MA
Gilead Sciences, Foster City, CA
MedImmune, Gaithersburg, MD
Sepracor, Marlborough, MA

*by revenue

Source: Ernst & Young, 2007

Top States in the U.S Biotechnology Industry (in Alphabetical Order)

California

California has more than 2,700 biotechnology companies (*BayBio: Impact 2009*), which means it has the largest number of both biotechnology companies and employees in the United States. The California Healthcare Institute estimates that there were nearly 80,000 people employed by “biopharmaceutical-only” companies in California in 2006. Thousands more work in biotechnology research at universities, research institutions, biotechnology companies that specialize in agriculture, industrial or instrumentation manufacturing. Total employment in biotechnology in California is probably between 100,000 and 150,000 people. Because many jobs are in non-biotechnology companies this number is only an estimate.

Most of the biotechnology companies in California are concentrated in Los Angeles, San Diego and San Francisco with a growing region in the Sacramento area. Biotechnology activities throughout the state have developed in areas near major universities. The ten campuses of the University of California, the twenty-three campus California State University system, and Stanford University are just some of the major universities located in California.

California

- 2,700 biotechnology companies
- 100,000 to 150,000 employees in biotechnology
- 3 regions of company concentration - Los Angeles, San Francisco and San Diego
- 7 top biotechnology companies have locations in CA
- 3 of the top are headquartered in CA
- 35 community college biotechnology programs in the state

California also has the largest community college system in the United States with 109 community colleges . Almost three dozen of these colleges offer programs in biotechnology and all 109 offer courses related to the field.

Some California company data:

- Three of the largest biotechnology companies are headquartered in California.
- Four other top biotechnology companies have operations in California.
- Amgen, the largest biotech pharmaceutical company and a leader in human therapeutics is headquartered in Thousand Oaks. It has additional facilities in Fremont and San Francisco.
- Genentech, considered one of the founders of biotechnology, is headquartered in South San Francisco, was founded in 1976 and has expanded to Vacaville and Oceanside. Genentech expects to open its first facility outside of California in 2010, a fill/finish facility in Hillsboro, Oregon.
- Gilead is a biopharmaceutical company headquartered in Foster City.
- Invitrogen is a company that specializes in antibody, biotech services, and cell culture and is headquartered in Carlsbad.
- MedImmune, a vaccine development company, is headquartered in Maryland but has three facilities in California – one in Santa Clara, a second in Mountain View and a third in Hayward.
- Biogen-Idec, headquartered in Cambridge, MA, has a facility in San Diego that includes only one of two community laboratories in the United States.
- Genzyme, also headquartered in Cambridge, has a facility for diagnostic manufacturing and gene therapy research located in San Diego.
- Celgene, a therapeutics company headquartered in New Jersey, has a facility in San Diego as well.
- Chiron, which is now a division of Novartis, is located in Emeryville.

Florida

Florida is also among the top ten states for biotechnology. While Ernst & Young only identifies approximately 50 biotechnology companies in Florida, a recent study done by Florida's Sid Martin Biotechnology Incubator, identified more than 140 biotechnology companies in Florida. About half of them employ fewer than 20 people. There are also more than 15 companies that have

Florida

- **More than 50 companies**
- **14,000 employees**
- **Main focus: therapeutics**
- **Other focuses include agriculture, bioinformatics and biofuels**

more than 100 employees.

Approximately 14,000 people are employed by these biotechnology companies. Most are in therapeutics (38%). Many other areas of biotechnology are represented in Florida, including agriculture, bioinformatics, environmental protection and biofuels.

Georgia

With almost 60 biotechnology companies, Georgia is one of the top biotechnology states according to Ernst & Young.

Although most of the companies have fewer than ten employees, a few have more than 100 employees. Most of the biotechnology companies in Georgia are located in three areas – Atlanta, Athens and Augusta, with more than half of them in the Atlanta area. Many of the companies in Georgia are focused on cancer research and vaccine development. A newer, but growing, interest in Georgia is biofuels. Abundant crop land and pine forests can provide the raw materials needed to create biofuels. As biofuels become a more important source of alternative energy, this industry is likely to grow.

Georgia

- Approximately 60 companies
- About 50% located in Atlanta area
- Concentration on cancer research
- Growing biofuels industry

Maryland

Although a small state, Maryland has approximately 75 biotechnology companies in three main regions in Maryland. The majority are located in the Montgomery region, while most of the others are located in either the Baltimore area or Fredericksburg. The majority of companies in Maryland focus on biotechnology drugs.

Maryland

- More than 75 biotechnology companies/375 bioscience companies
- 23,000 employees when bioscience is included
- 3 major regions – Baltimore, Fredericksburg and Montgomery
- MedImmune, one of the largest companies, headquartered in Maryland
- Created a tuition free lab associate training program

In addition to the biotechnology companies, there are a large number of bioscience companies located in Maryland. According to MDBio (the state's biotechnology industry organization), there were approximately 23,000 employees working in 375 bioscience companies in 2006.

MedImmune, one of the ten largest biotechnology companies in the United States, is headquartered in Gaithersburg with two other facilities in Maryland as well. Maryland has been working hard to attract biotechnology companies. In 1998 The BioTechnical Institute of Maryland, Inc. (BTI) was founded as a non-profit corporation. The BTI Laboratory Associates Program provides tuition-free training in basic laboratory skills creating an entry level work force for biotechnology companies in Maryland.

Massachusetts

Massachusetts has the second largest biotechnology industry in the United States after California. There are more than 250 biotechnology companies in Massachusetts and they employ between 20,000 and 30,000 people. Most of the biotechnology jobs in Massachusetts are located in the Boston metropolitan area. However, with limited real estate available in Cambridge and Boston, and continued growth in biotechnology, companies are opening facilities farther west in the state. Areas such as Worcester are seeing a rise in biotechnology companies.

The largest biotechnology industry sector in the state is pharmaceuticals. Many companies are working on new treatments for cancer and other diseases. Of the top biotechnology companies in the United States, there are four located in Massachusetts. Biogen Idec has its world headquarters in Cambridge, Massachusetts; has offices all over the world; and maintains a government relations office in Washington, D.C. Genzyme has its world headquarters in Cambridge, Massachusetts as well. Genzyme also has facilities located worldwide with additional manufacturing and research facilities located in the United States in Framingham, Massachusetts; San Diego, California; Ridgefield, New Jersey; and Santa Fe, New Mexico. Amgen, although headquartered in Thousand Oaks, California has a facility in Cambridge. Sepracor has located its world headquarters west of Boston in Marlborough, Massachusetts.

New Jersey

According to figures from Ernst & Young, nearly 70 biotechnology companies make New Jersey their home. Many companies focus on pharmaceutical biotechnology, discovering, testing and preparing new treatments for various forms of cancer and other illnesses. In 2005, 33% of biotechnology companies in New Jersey focused on cancer research. New Jersey was the first state to invest public funds in research using stem cells from pulled-apart embryos .

There are between 7,000 and 10,000 employees in biotechnology companies in New Jersey. One of the largest biotechnology companies in the United States, Celgene, is headquartered in Summit, New Jersey. Celgene has two more locations in New Jersey, one in Warren and one in Cedar Knolls. Genzyme, headquartered in Massachusetts, has a manufacturing plant located in Ridgefield, New Jersey.

Massachusetts

- 250 Biotech companies
- 20,000 to 30,000 jobs
- Biggest industry: Pharmaceuticals
- 4 of top companies located in state

New Jersey

- 70 companies
- 7,000 to 10,000 employees
- Celgene, one of the largest biotechnology companies, headquartered in Summit
- Genzyme manufacturing plant in Ridgefield
- Many companies specialize in oncology

New York

Estimates of the number of biotechnology companies in New York range from 55 to 110, depending on how the industry is defined. Approximately 6,000 people are estimated to be employed in the biotechnology industry in New York State. When all of the bioscience industry is taken into account, there are almost 40,000 bioscience jobs in New York.

New York is consistently one of the top five states in number of biotechnology patents granted each year. Eleven incubator and science parks are located throughout the state to assist in providing affordable space for biotechnology start up companies. The majority of biotechnology companies in New York are located in and around New York City that tend to be smaller companies averaging 40 employees in size. The larger companies are more often located near Albany, with those companies averaging more than 150 employees per company.

North Carolina

Biotechnology in North Carolina is concentrated in two major metropolitan areas, Raleigh-Durham and Winston-Salem. About 10,000 people are employed in more than 80 companies in just these two areas. Some estimates count almost 20,000 jobs in biotechnology in North Carolina. The largest numbers of companies focus on research and development of new biotechnology drugs. A number of companies in North Carolina are focusing on nanotechnology.

Another popular biotechnology focus is agricultural biotechnology. North Carolina has about 30 agricultural biotechnology companies with almost 2,500 employees. Two of the largest biotechnology companies in the United States have facilities in North Carolina. Both are in the Raleigh-Durham area. Gilead is headquarters in Raleigh-Durham and Biogen Idec, which is headquartered in Massachusetts, focuses on manufacturing in its North Carolina Facility located in Research Triangle Park.

Pennsylvania

Ernst & Young estimates that there are approximately 60 biotechnology companies in

New York

- 55 to 110 biotechnology companies
- More than 6,000 employees
- 11 incubator and science parks throughout the state
- Majority of companies located in New York City and Albany

North Carolina

- Companies concentrated in Raleigh/Durham and Winston/Salem
- More than 80 companies
- 10,000 to 20,000 employees when all biotechnology-related companies are included
- Gilead headquartered in Durham
- Biogen Idec research facility in Research Triangle Park

Pennsylvania

- Approximately 60 companies
- 5,000 to 7,000 biotechnology jobs
- MedImmune has two locations in Philadelphia area

Pennsylvania and between 5,000 and 7,000 biotechnology jobs. Adding in all bioscience jobs jumps the number to more than 30,000 jobs.

Pennsylvania has been instrumental in encouraging new companies to locate in Pennsylvania by creating nineteen Innovation Technology Centers in the state. In 2006, Pennsylvania funded the development of the Bucks County Biotechnology Keystone Innovation Zone. The zone provides resources and space for startup bioscience and biotechnology companies by bringing together small startup companies and universities.

MedImmune, one of the top biotechnology companies, has two locations in Pennsylvania. Both focus on vaccines and are located near each other in Philadelphia and Bensalem. In Pennsylvania, the largest company and employment concentration is in drug research and development.

Texas

Texas has a relatively small number of biotechnology companies (48 according to the Ernst & Young report). This state has many agriculture companies that focus on biotechnology. Employment is estimated to be more than 25,000. Texas has a large number of smaller companies involved in agricultural (plant and animal) biotechnology.

Cargill, one of the largest agriculture and food companies in the United States, provides more than 6,000 jobs in 24 communities throughout Texas. Cargill focuses on many areas of biotechnology including animal nutrition, crop development and food. Monsanto, one of the largest US agricultural companies with nine locations in Texas, is a leader in agricultural biotechnology. Monsanto interests include seed development and crop health. This is a good state to look at if one is interested in working with animals or plants. Texas also has the largest number of clinical trials of new drugs of any state.

Washington

Washington State has 33 biotechnology companies according to Ernst & Young, but 100 companies according to a state report. Many of the 100 are small companies with fewer than ten employees. Approximately ten of the biotechnology companies have more than 100 employees. Total biotechnology employment in Washington is still relatively small with only about 3,000 jobs. Many of the companies are located in the Seattle area. The industry is expanding throughout Washington. The Sirti Technology Center incubator opened in Spokane in 2006 to provide laboratory space to startup companies.

Texas

- **25,000 biotechnology related jobs**
- **Cargill, one of the largest biotechnology companies, has locations throughout Texas**
- **Has many companies focused on agriculture**
- **Monsanto, a major agricultural biotechnology company, has 9 locations in Texas**

Washington

- **33 companies**
- **3,000 employees**
- **Concentrated in the Seattle area**
- **Most companies are small**

Outlook for the Future

The biotechnology industry has experienced steady growth over the past decade, which is expected to continue. The increase in employment will mostly be in the area of bio-pharmaceuticals, which is by far the largest sector of the biotechnology industry. The growth of bio-pharmaceuticals is driven by the high amount of research devoted to this sector. As much as 90% of the money invested in biotechnology research is in the pharmaceutical sector.

The fastest growing biotechnology occupations:

- Animal technicians
- Computer engineers and database administrators
- Environmental science and protection technicians
- Laboratory technicians
- Scientists

Biotechnology occupations with the largest number of job openings in the next few years:

- Laboratory technician
- Manufacturing positions
- Computer engineers and database administrators
- Research associate
- Scientist

More than 400 new biotechnology drugs are in the clinical testing phase, the driving force behind industry growth. These drugs include treatments for cancer, hepatitis, diabetes, heart disease, Alzheimer's disease and many other diseases. As is usual with drug development, many of these will not make it through the trial process and will not be approved by the Food and Drug Administration for sale. Those biotechnology drugs, vaccines and diagnostic tests that are approved will lead to increased need for employees to manufacture, test, and sell the products.

Biofuels, another area of innovation and growth in the biotechnology industry. The continued rise in the cost of crude oil and gasoline is creating a market for these biofuel products.

- Ethanol and biodiesel could provide up to 30% of US energy needs by 2030, made from corn syrup, corn stalks or switchgrass and other crop waste such as wheat straw.
- Companies develop plants to produce more fuel from each acre of cropland.
- Fermentation factories exist and more are being built to produce ethanol, biodiesel and other products.
- Companies seek alternatives to other oil-based products. For example, there is an increased market for plastics made from plant materials such as corn. These products can also be biodegradable, and environmental benefit.

Agriculture is being transformed in other ways by biotechnology.

- Acreage of biotechnology crops around the world continues to increase because of the benefits.

-
- Better feed for animals, improved crops for biofuels and drugs to keep animals healthy.
 - Continued work on beneficial research and development , manufacturing activities and use of genetically modified crops throughout the world. The most common crops enhanced by biotechnology are soybeans, corn, cotton and canola.

Use of biotechnology in other industries

- Biodefense strategies funded by Congress to protect against bioterrorism and pandemic diseases will include vaccines, treatments for disease and detection.
- Nanotechnology is a developing field that will create commercial products in the future that may be related to computers, detections systems or drug delivery.
- More environmental applications of biotechnology are being developed to clean up hazardous spills.
- Industrial biotechnology applications have led to cleaner processes that produce less waste and use less energy and water.
- Biotechnology is used in industrial sectors such as chemicals, pulp and paper, textiles, food, energy, and metals and minerals.
- DNA fingerprinting, a biotechnology process, has dramatically improved criminal investigation and forensic medicine, as well as afforded significant advances in anthropology and wildlife management.

Employment Outlook

Overall, the number of biotech jobs is expected to increase between 2006 and 2016 at a rate that is faster than the average for all jobs, according to US Bureau of Labor Statistics. The number of people employed in the biotechnology industry continues to grow, as the existing companies hire more employees. Growth in US biotechnology company employment was about 6% between 2005 and 2006 to close to 200,000 employees.

- Significant job growth among life and medical scientists due to money devoted to research.
- Uses of biotechnology have been adopted in many industries will employ more people in companies that use biotechnology products or techniques, but are not strictly in the biotechnology industry.
 - Pharmaceuticals,
 - agriculture and food production, industrial products,
 - forensics and security. Forensic technician jobs are one of the fastest growing job areas in the United States.

Skills

Employers will continue to need workers with:

- Excellent science knowledge and laboratory skills

-
- The ability to work as a team member
 - As more products are approved by the FDA and are ready to market, the need for business, sales, manufacturing and management skills will also increase..

Location Factors

- Currently, California is the top state in biotechnology when measured by number of companies and number of employees. Although many states have developed initiatives to attract more biotechnology investment and companies, California is predicted to remain at the top of this field for many years to come.
- Because the cost of land, construction and labor varies by state and by locations within a state, biotechnology manufacturing companies often choose to build manufacturing facilities in areas with a lower cost of doing business.
- The research and development of biotechnology products is usually located near major city centers and universities.
- Manufacturing of products is often done in more suburban or rural locations.
- Some companies will choose to build their manufacturing facilities in different states due to lower costs from the state where the company headquarters is located.

Mergers and Licensing

- Some products are developed by one company and then licensed to, manufactured or marketed by another company. This company may be located in a different state or even in another country.
- When a company patents a product which is likely to become a licensed drug, that company is often acquired by or merged with another company.
- Some biotechnology companies enter into partnerships with a major pharmaceutical company for manufacturing. This makes it difficult to predict where increases in manufacturing of biotechnology products will occur in the United States. However, it is clear that manufacturing of biotechnology products will increase.

Chapter 2

Qualifications, Training and Interests

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Qualifications, Training and Interests

Introduction to the Tables

The tables in this Chapter present information about the jobs described in detail in Chapter 3 so you can look up the skills, training and education required for each job. The tables include:

Job Skills

Entry level skills sets are divided into basic, personal, and technical skills.

Community College Programs in Two Tables

The first table, “Community College Biotechnology Programs” lists biotechnology programs across the United States that offer either an associate degree or a certificate program in biotechnology. Programs are listed by state and the information was current as of Spring 2008.

The second table, “Related Community College Programs,” lists other types of programs that can be useful in training for a job in biotechnology. A map showing the location of the six California Community College Biotechnology Centers is included to assist users in the state with the greatest number of companies.

Interests

Client interests are matched with biotechnology jobs described in Chapter 3 in a grid with two interest inventories commonly used by counselors, the Campbell Interest and Skill Survey and the Strong Interest Inventory.

Education and Training

This table lists the usual minimum requirements to get an entry level job in the listed occupations along with other preferences, such as levels of training, education or experience that are not strictly required by employers, but are likely to give an applicant a better chance of landing the job.

Where to Find a Job

This table lists the types of companies within the biotechnology industry where each occupation may be found, to help job seekers know where to start looking.

Job Skills

The six job skills tables on the following pages list the minimum skills required for entry into each occupation, divided in basic, personal and technical skills.

The skills listed are those required for the entry level of the job and do not include those that may be desirable or needed for promotion.

The table includes a general lab skills category and not specifics because more information about specific lab skills can be found in the detailed job descriptions in Chapter 3.

The occupations have been divided into six groups by job functions:

1. Research and development,
2. Laboratory support,
3. Technical,
4. Manufacturing,
5. Quality and regulatory, and
6. Sales and technical support.

Job Skills

1. Research and Development

		Bioinformatics Specialist	Clinical Research Associate	Research Associate	Scientist
Basic	Advanced Math Skills	●	●	●	●
	Written & Oral Communications	●	●	●	●
Personal	Detail Oriented	●	●	●	●
	Observation Skills			●	●
	Organized	●	●	●	●
	Work as a Team	●	●	●	●
	Work Independently	●	●	●	●
	Work Well Under Pressure				●
Technical	Analyze/Evaluate Data	●	●	●	●
	Biotechnology Lab Procedures			●	●
	Computer Skills	●	●	●	●
	Driver's License		●		
	Knowledge of Life Sciences/ Chemistry	●	●	●	●
	Knowledge of SOPs, GMPs, GLPs	●	●	●	●
	Plan and Carry Out Research	●	●	●	●
	Problem Solving/Critical Thinking	●	●	●	●
	Record Keeping Skills		●		
	Technical Writing Skills	●		●	●
	Understand Technical Information	●	●	●	●

Job Skills

2. Laboratory Support

		Animal Caretaker	Greenhouse & Field Worker	Laboratory Support Worker	Laboratory Assistant
Basic	Advanced Math				●
	Basic Math	●	●		
	Read and Follow Instructions	●	●	●	
	Written & Oral Communications	●	●	●	●
Personal	Detail Oriented	●	●	●	●
	Lift up to 50 lbs	●	●	●	●
	Manual Dexterity			●	●
	Observation Skills	●	●		●
	Organized	●	●	●	●
	Perform Physically Demanding Work	●	●		
	Perform Routine, Repetitive Work	●	●	●	
	Work as a Team	●			●
	Work Independently	●			
Technical	Animal Care Skills	●			
	Biotechnology Laboratory Procedures				●
	Computer Skills				●
	Knowledge of Life Sciences/ Chemistry				●
	Knowledge of SOPs & GLPs				●
	Plant Care Skills		●		
	Record Keeping Skills	●	●	●	●
	Understand Technical Information				●

Job Skills

3. Technical

		Animal Technician	Forensic DNA Analyst	Greenhouse & Field Technician	Instrumentation/ Calibration Technician	Laboratory Automation Specialist	Laboratory Technician
Basic	Advanced Math Skills		●		●	●	●
	Basic Math	●		●			
	Written & Oral Communications	●	●	●	●	●	●
Personal	Detail Oriented	●	●	●	●	●	●
	Good Vision & Color Perception				●		
	Lift up to 50 lbs	●	●	●	●		●
	Manual Dexterity			●	●		
	Observation Skills	●	●	●	●	●	●
	Organized		●			●	●
	Perform Physically Demanding Work			●			
	Work as a Team	●	●	●		●	●
	Work Independently				●	●	●
	Work Well Under Pressure		●		●		
Technical	Analyze/Evaluate Data		●	●		●	●
	Animal Care Skills	●					
	Biotechnology Lab Procedures	●	●			●	●
	Certification May Be Required	●					
	Computer Skills	●	●	●	●	●	●
	Knowledge of Life Science & Chemistry		●	●		●	●
	Knowledge of Electronics				●		
	Knowledge of SOPs, GMPs, GLPs		●		●	●	●
	Plant Care Skills			●			
	Problem Solving/Critical Thinking		●		●	●	●
	Public Speaking		●				
	Record Keeping Skills	●		●	●		
	Understand Technical Information	●	●	●	●	●	●

Job Skills

4. Manufacturing

		Manufacturing Assistant	Manufacturing Technician	Material Handler
Basic	Advanced Math Skills		●	
	Basic Math	●		●
	Read & Follow Instructions	●		●
	Written & Oral Communications	●	●	●
Personal	Detail Oriented	●	●	●
	Lift up to 50 lbs	●	●	●
	Mechanical Ability	●	●	
	Organized		●	●
	Perform Physically Demanding Work			●
	Perform Routine, Repetitive Work	●		●
	Work as a Team	●	●	
	Work Independently		●	
Technical	Biotechnology Lab Procedures	●	●	
	Computer Skills	●	●	●
	Knowledge of Life Sciences & Chemistry	●	●	
	Knowledge of SOPs, GMPs, GLPs	●	●	
	Manufacturing Skills	●	●	
	Operate a Forklift			●
	Problem Solving/Critical Thinking		●	
	Record Keeping Skills	●	●	●
	Understand Technical Information	●	●	

Job Skills

5. Quality and Regulatory

		Documentation Coordinator	Health & Safety Specialist	Quality Assurance Specialist	Quality Control Technician
Basic	Advanced Math Skills		●	●	●
	Basic Math	●			
	Read & Follow Instructions	●			
	Written & Oral Communications	●	●	●	●
Personal	Detail Oriented	●	●	●	●
	Observation Skills			●	●
	Organized	●	●	●	●
	Work as a Team	●	●	●	●
	Work Independently	●	●	●	●
	Work Well Under Pressure		●		
Technical	Analyze/Evaluate Data			●	●
	Biotechnology Lab Procedures			●	●
	Certification May Be Required		●		
	Computer Skills	●	●	●	●
	Knowledge of Emergency Procedures		●		
	Knowledge of Health & Safety Regulations		●		
	Knowledge of Life Science & Chemistry			●	●
	Knowledge of SOPs, GMPs, GLPs	●	●	●	●
	Problem Solving/Critical Thinking	●	●	●	●
	Record Keeping Skills	●	●	●	●
	Technical Writing		●	●	
	Understand Technical Information		●	●	●

Job Skills

6. Sales and Technical Support

		Sales Representative	Technical Service Representative
Basic	Advanced Math Skills		●
	Basic Math	●	
	Written & Oral Communications	●	●
Personal	Customer Service Skills	●	●
	Detail Oriented	●	●
	Organized	●	●
	Sales Ability	●	
	Work as a Team	●	●
	Work Independently	●	●
	Work Well Under Pressure	●	●
Technical	Analyze/Evaluate Data		●
	Computer Skills	●	●
	Driver's License	●	
	Knowledge of Life Science & Chemistry	●	●
	Knowledge of SOPs, GMPs, GLPs		●
	Problem Solving/Critical Thinking		●
	Public Speaking	●	
	Record Keeping Skills		●
	Understand Technical Information	●	●

Community College Programs

This section includes two tables. The first table, “Biotechnology Programs in Community Colleges” lists biotechnology programs across the United States. These colleges offer either an associate degree or a certificate program in biotechnology. Some of the colleges do not have a full program, but offer a course on biotechnology in the biology department. Programs are listed by state and the information was current as of Spring 2008. We recommend going to each college website, and search within it for the biotechnology program.

Information and links to biotechnology programs at colleges are available at the Bio-Link website, www.bio-link.org.

The second table in this section “Related College Programs” shows other types of programs that can be useful in training for each occupation described in Chapter 3. These programs can lead to employment in the biotechnology field. The programs may lead to either an associate degree or a certificate.

This section also includes a map showing the location of the six California Community College Biotechnology Centers.

Community and technical colleges generally offer either a degree or courses in general science areas such as biology and chemistry. Therefore, the general science degree is not listed among the available programs. However, a degree in biology or chemistry can still prepare a student to enter the field of biotechnology in an entry-level position. Courses in computer word processing, database and spreadsheet skills that are useful in many jobs are also generally offered at all of the colleges.

In many cases, additional classes may prove useful to a job seeker. For example, many of the occupations require basic reading, writing and English communication skills. There are courses offered in these areas at all community colleges.

Some of the entry level jobs described in this book require a bachelor’s degree. All community colleges can prepare students to transfer to a four-year college, and some of the biotechnology programs specialize in preparing students for transfer.

Biotechnology programs are being added at a rapid rate in community colleges. The information in this chart was accurate as of Spring 2008. Check the individual colleges web sites for more information about individual programs.

Community College Biotechnology Programs

These tables list biotechnology programs in community colleges by state. The community and technical colleges listed in these tables had biotechnology programs or courses as of Spring 2008. Many colleges add programs or courses in biotechnology each year. Colleges may move from offering one or a few courses to offering a full associate degree or a certificate program. We recommend checking with each college to find out about current biotechnology programs. If a college is not listed here, it may have a new program. It is worth contacting a college to find out if they have recently added a biotechnology course or program.

There are various types of biotechnology programs listed in these tables. The *biotechnology*, *biological technician*, *laboratory science technology* and *molecular biotechnology* programs generally prepare students for positions as laboratory assistants, technicians or other jobs that require laboratory skills. The *biomanufacturing*, *biopharmaceutical manufacturing technology*, *bioprocessing* and *industrial biotechnology* programs prepare students for entry-level manufacturing assistant or manufacturing technician jobs in biotechnology. *Biomedical engineering technology* programs are designed to train students to work with scientific instruments in jobs such as instrumentation/calibration technician or laboratory automation specialist. There are also a number of more specialized programs such as *agricultural biotechnology*, *bioinformatics*, *biorenewable fuels technology*, *biotechnology forensics*, *environmental technology* and *stem cell research*. These programs will prepare students for positions in more specialized areas of biotechnology. *Bioscience* is a broader field than biotechnology that includes biology and such courses as biosafety, bioethics and other courses related to biotechnology.

There are many related programs that can help prepare a job seeker for careers in the biotechnology industry. Check the “Related Community College Programs” table in this chapter to see which community college programs are helpful for each career. Then, check with your local community college for those programs.

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs

College	City	College Website
Alabama		
Calhoun Community College	Huntsville	www.calhoun.edu
Arizona		
Chandler-Gilbert Community College	Chandler	www.cgc.maricopa.edu
Glendale Community College	Glendale	www.gc.maricopa.edu
Mesa Community College	Mesa	www.mccbiotechnology.net
Pima Community College	Tucson West Campus	www.pima.edu
South Mountain Community College	Phoenix	http://biosci.southmountaincc.edu
Arkansas		
Southeast Arkansas College	Pine Bluff	www.seark.edu
California		
American River College	Sacramento	http://web.arc.losrios.edu
Antelope Valley College	Lancaster	www.avc.edu
Bakersfield College	Bakersfield	www.bc.cc.ca.us
Berkeley City College	Berkeley	www.vista.peralta.edu
City College of San Francisco	San Francisco	www.ccsf.edu
College of Marin	Kentfield	www.marin.edu
College of San Mateo	San Mateo	www.collegeofsanmateo.edu
College of the Canyons	Santa Clarita	www.canyons.edu
Contra Costa College	San Pablo	www.contracosta.cc.ca.us
Evergreen Valley Community College	San Jose	www.evc.edu
Foothill College	Los Altos	www.foothill.edu
Fullerton College	Fullerton	www.fullcoll.edu

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	College Website
California, continued		
Glendale Community College	Glendale	www.glendale.edu
Laney College	Oakland	http://laney.peralta.edu
Los Angeles Mission College	Sylmar	www.lamission.edu
Los Angeles Pierce College	Woodland Hills	www.piercecollege.edu
Merced College	Merced	www.mccd.edu
Mira Costa College	Oceanside	www.miracosta.edu
Moorpark College	Moorpark	www.moorparkcollege.edu
Pasadena City College	Pasadena	www.pasadena.edu/
Ohlone College	Fremont	www.ohlone.edu
Riverside City College	Moreno Valley	www.rcc.edu/morenovalley
San Diego City College	San Diego	www.sdcity.edu/voctech/biol/
San Diego Mesa College	San Diego	www.sdmesa.edu
San Diego Miramar College	San Diego	http://www.sdccd.edu/
Santa Ana College	Santa Ana	www.sac.edu
Santa Barbara City College	Santa Barbara	www.sbccc.cc.ca.us
Skyline College	San Bruno	www.skylinecollege.edu
Solano Community College	Fairfield	www.solano.edu
Southwestern College	Chula Vista	http://www.swccd.edu/
Ventura College	Ventura	http://academic.venturacollege.edu
Colorado		
Community College of Aurora	Aurora	www.ccaurora.edu
Northeastern Junior College	Sterling	www.njc.edu
Red Rocks Community College	Lakewood	www.rrcc.edu

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	College Website
Connecticut		
Briarwood College	Southington	www.briarwood.edu
Gateway Community College	New Haven	www.gwcc.commnet.edu
Housatonic Community College	Bridgeport	www.hcc.commnet.edu
Middlesex Community College	Middletown	www.mxctc.commnet.edu
Naugatuck Valley Community Tech College	Waterbury	http://www.nvcc.commnet.edu
Delaware		
Delaware Technical and Community College	Newark	www.dtcc.edu
Florida		
Miami-Dade Community College	Miami	www.mdc.edu
Palm Beach Community College	Lake Worth	www.pbcc.edu
Santa Fe Community College	Gainesville	http://inst.santafe.cc.fl.us
Georgia		
Athens Technical College	Athens	www.athenstech.edu
Central Georgia Technical College	Macon	http://centralgatech.edu
Chattahoochee Technical College	Marietta	www.chattcollege.com
Gwinnett Technical College	Lawrenceville	http://www.gwinnetttech.edu
Illinois		
City College of Chicago Truman Campus	Chicago	www.trumancollege.cc

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	College Website
Indiana		
Ivy Tech Community College	Lafayette, Bloomington, South Bend, Terra Haute, Evansville, Indianapolis	www.ivytech.edu
Iowa		
Des Moines Area Community College	Ankeny	www.dmaccc.edu
Ellsworth Community College	Iowa Falls	www.iavalley.edu
Indian Hills Community College	Ottumwa	www.ihcc.cc.ia.us
Iowa Lakes Community College	Emmetsburg	www.iowalakes.edu
Kirkwood Community College	Cedar Rapids	www.kirkwood.edu
Northwest Iowa Community College	Sheldon	www.nwicc.edu
Western Iowa Tech Community College	Sioux City	www.witcc.edu
Kansas		
Johnson County Community College	Overland Park	www.jccc.net
Kentucky		
Jefferson Community and Technical College	Louisville	www.jefferson.kctcs.edu
Owensboro Community College	Owensboro	www.octc.kctcs.edu
Louisiana		
Bossier Parish Community College	Bossier City	www.bpcc.edu
Maine		
Capital Area Technical Center	Augusta	www.augustaschools.org
Kennebec Valley Technical College	Fairfield	www.kvcc.me.edu/
Southern Maine Community College	South Portland	www.smccme.edu

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	College Website
Maryland		
Baltimore City Community College	Baltimore	www.bccc.edu
BioTechnical Institute of Maryland	Baltimore	www.biotechmd.org
Cecil Community College	North East	www.cecil.edu
College of Southern Maryland	La Plata	www.csmd.edu
Community College of Baltimore County	Catonsville	www.ccbcmd.edu
Frederick Community College	Frederick	www.frederick.edu
Hagerstown Community College	Hagerstown	www.hagerstowncc.edu
Howard Community College	Columbia	www.howardcc.edu
Montgomery College	Germantown	www.montgomerycollege.edu
Massachusetts		
Bristol Community College	Fall River	www.bristol.mass.edu
Bunker Hill Community College	Boston	www.bhcc.mass.edu
Cambridge Biomedical Careers Program	Cambridge	www.justastart.org
Holyoke Community College	Holyoke	http://hcc.edu
Mass Bay Community College	Wellesley Hills	www.massbay.edu
Middlesex Community College	Lowell	www.middlesex.mass.edu
Mount Wachusett Community College	Devens Campus	www.mwcc.mass.edu
North Shore Community College	Danvers	www.northshore.edu
Quinsigamond Community College	Worcester	www.qcc.edu
Roxbury Community College	Roxbury Crossing	www.rcc.mass.edu
Springfield Technical Community College	Springfield	www.stcc.edu

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	Website
Michigan		
Delta College	University Center	www.delta.edu
Lansing Community College	Lansing	www.lcc.edu
Mid Michigan Community College	Harrison	www.midmich.cc.mi.us
Minnesota		
Anoka-Ramsey Community College	Coon Rapids	www.anokaramsey.edu
Minneapolis Community and Technical College	Minneapolis	www.minneapolis.edu
Minnesota West Community and Technical College	Worthington	www.mnwest.edu
Mississippi		
Mississippi Gulf Coast Community College	Gulfport	www.mgccc.edu
Missouri		
East Central College	Union	www.eastcentral.edu
Jefferson Community College	Hillsboro	www.jeffco.edu
St. Louis Community College	Florissant Valley	www.stlcc.edu
Nebraska		
Central Community College	Grand Island	www.cccneb.edu
Southeast Community College	Lincoln	www.southeast.edu
New Hampshire		
New Hampshire Community Technical College	Portsmouth	http://biotech.nhctc.edu
New Jersey		
Berdan Institute	Wayne	www.berdaninstitute.com
Bergen Community College	Paramus	www.bergen.edu

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	Website
New Jersey , continued		
Burlington County College	Pemberton	www.bcc.edu
Camden County College	Blackwood	www.camdencc.edu
County College of Morris	Randolph	www.ccm.edu
Raritan Valley Community College	Somerville	www.raritanval.edu
Union County College	Cranford	www.ucc.edu
New Mexico		
Central New Mexico Community College	Albuquerque	www.cnm.edu
Northern New Mexico Community College	Espanola	www.nnmc.edu
New York		
Finger Lakes Community College	Canandaigua	www.flcc.edu
Hudson Valley Community College	Troy	www.hvcc.edu
Monroe Community College	Rochester	www.monroecc.edu
Suffolk County Community College	Selden	www.sunysuffolk.edu
Tompkins Cortland Community College	Dryden	www.tc3.edu
North Carolina		
Alamance Community College	Graham	www.alamance.cc.nc.us
Asheville-Buncombe Technical Community College	Enka Campus in Candler	www.abtech.edu
Central Carolina College	Sanford	www.cccc.edu
Cleveland Community College	Shelby	www.cleveland.cc.nc.us
Fayetteville Technical Community College	Fayetteville	www.faytechcc.edu
Forsyth Technical Community College	Winston-Salem	www.forsythtech.edu

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	College Website
North Carolina, continued		
Gaston College	Dallas	www.gaston.edu
Guilford Technical Community College	Jamestown	www.gtcc.edu
Piedmont Community College	Roxboro	www.piedmontcc.edu
Rowan-Cabarrus Community College	Concord	www.rowancabarrus.edu
Southeastern College	Whiteville	www.sccnc.edu
Wake Technical Community College	Winston-Salem	www.ncbionetwork.org
North Dakota		
North Dakota State College Of Science	Wahpeton	www.ndscs.edu
Ohio		
Lakeland Community College	Kirtland	http://lakelandcc.edu
Owens Community College	Toledo	www.owens.edu
Sinclair Community College	Dayton	www.sinclair.edu
Stark State College of Technology	North Canton	www.starkstate.edu
Oklahoma		
Oklahoma City Community College	Oklahoma	www.ouccc.edu
Tulsa Community College	Tulsa	www.tulsacc.edu
Oregon		
Portland Community College	Portland	www.pcc.edu
Pennsylvania		
Community College of Allegheny County	Monroeville	www.ccac.edu
Lackawanna College	Scranton	www.lackawanna.edu
Lehigh Carbon Community College	Schnecksville	https://www.lccc.edu

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	College Website
Pennsylvania, continued		
Montgomery County Community College	Blue Bell	www.mc3.edu
Northampton Community College	Bethlehem, Tannersville	www.northampton.edu
Rhode Island		
Community College of Rhode Island	Warwick	www.ccri.edu
South Carolina		
Greenville Technical College	Greenville	www.gvltec.edu
Midlands Technical College	Columbia	www.midlandstech.edu
Tennessee		
Nashville State Community College	Nashville	www.nsccl.edu
Southwest Tennessee Community College	Memphis	www.southwest.tn.edu
Texas		
Amarillo College	Amarillo	www.actx.edu
Austin Community College	Austin	www.austincc.edu
Collin County Community College	Plano McKinney	www.ccccd.edu
Del Mar College	Corpus Christi	www.delmar.edu
Galveston College	Galveston	www.gc.edu
Montgomery College	Conroe	www.lonestar.edu
Northwest Vista College	San Antonio	www.accd.edu
Temple College	Temple	www.templejc.edu
Texas Bioscience Institute	Temple	www.texasbioscienceinstitute.com/

For information on specific biotechnology programs, go to the college website and search for Biotechnology or follow links to biotechnology programs from the Programs, Academics or Degrees link.

A source of direct links to college biotech programs is www.bio-link.org

Community College Biotechnology Programs, continued

College	City	College Website
Utah		
Dixie State College	St. George	www.dixie.edu
Salt Lake Community College	Salt Lake City	www.slcc.edu
Virginia		
Northern Virginia Community College	Manassas	www.nvcc.edu
Piedmont Virginia Community College	Charlottesville	www.pvcc.edu
Washington		
Bates Technical School	Tacoma	www.bates.ctc.edu
Seattle Central Community College	Seattle	http://seattlecentral.edu
Shoreline Community College	Seattle	www.shoreline.edu
Wisconsin		
Madison Area Technical College	Madison	http://matcmadison.edu

This two-page table tells which college program will help prepare a job seeker for each of the careers described in Chapter 3.

Related Community College Programs

	College Programs																		
	Agriculture	Animal Health Technology Veterinary Technology	Animal Science/Zoology	Bioinformatics	Biomedical Technology/Electronics	Biotechnology	Chemical Technology	Chemistry	Computer Science	Crop Science/Crop Production/Horticulture	EngineeringTechnology, Industrial Technology, Instrumentation	Food Science/Food Processing	Hazardous Materials Technology/Environmental Science	Life Sciences - biology microbiology, biochemistry	Logistics	Manufacturing Technology/ Biomanufacturing	Nursing	Plant Science/Botany	Quality Control
Animal Caretaker		●	●											●					
Animal Technician		●	●											●					
Bioinformatics Specialist				●	●	●			●					●					
Clinical Research Associate						●								●			●		
Documentation Coordinator						●			●						●	●			●
Forensic DNA Analyst				●		●		●						●					
Greenhouse and Field Technician	●					●				●								●	
Greenhouse and Field Worker	●					●				●								●	
Health and Safety Specialist								●			●		●	●		●			
Instrumentation/Calibration Technician					●	●					●			●					
Laboratory Assistant	●	●	●			●	●	●		●		●		●				●	
Laboratory Automation Specialist					●	●			●		●			●					

Related Community College Programs, continued

	College Programs																
	Agriculture	Animal Science/Zoology	Bioinformatics	Biomedical Technology/Electronics	Biotechnology	Chemical Technology	Chemistry	Computer Science	Crop Science/Crop Production/Horticulture	Engineering Technology, Industrial Technology, Instrumentation	Food Science/Food Processing	Hazardous Materials Technology/Environmental Science	Life Sciences - Biology Microbiology, Biochemistry	Logistics	Manufacturing Technology/Biomanufacturing	Plant Science/Botany	Quality Control
Laboratory Support Worker		●			●		●		●		●		●			●	
Laboratory Technician	●	●		●	●	●	●		●		●	●	●			●	
Manufacturing Assistant				●	●	●	●				●		●		●		●
Manufacturing Technician				●	●	●	●				●		●		●		●
Material Handler					●							●		●			●
Quality Assurance Specialist				●	●	●	●	●		●	●		●		●		●
Quality Control Technician				●	●	●	●	●		●	●		●		●		●
Research Associate	●	●	●		●	●	●		●	●	●		●			●	
Sales Representative					●		●						●				
Scientist	●	●	●		●	●	●		●		●		●			●	
Technical Services Representative				●	●	●	●			●			●				

California Community College Biotechnology Centers

Contact these Centers to learn more
about biotechnology programs in
California Community Colleges.

California Applied Biotechnology Centers (CalABC)

An initiative of the California Community College Economic Workforce Development Program



cccbiotech.org

This table gives a concise list of the minimum requirements to get an entry-level job in the listed occupations. Other preferences, such as levels of training, education or experience, are not required by employers, but are likely to give an applicant a better chance of landing the job.

Education and Training

	Minimum Requirements						Other Preferences				
	High School Diploma	Assoc. Degree/Certificate	Bachelor's Degree	Ph.D. Degree	Work Experience	Apprenticeship	Work Experience	Some College Courses	Assoc. Degree/Certificate	Bachelor's Degree	License or Certification
Animal Caretaker	●						●	●			●
Animal Technician		●					●				●
Bioinformatics Specialist			●		●		●				
Clinical Research Associate			●		●						●
Documentation Coordinator	●				●				●		
Forensic DNA Analyst			●				●				
Greenhouse and Field Technician		●			●					●	
Greenhouse and Field Worker	●				●				●		
Health and Safety Specialist		●			●					●	●
Instrumentation/Calibration Technician		●				●	●				●
Laboratory Assistant		●					●			●	
Laboratory Automation Specialist		●			●					●	
Laboratory Support Worker	●						●	●			
Laboratory Technician		●			●					●	
Manufacturing Assistant	●				●			●	●		
Manufacturing Technician	●				●				●	●	
Material Handler	●						●				
Quality Assurance Specialist		●			●					●	●
Quality Control Technician		●			●					●	●
Research Associate			●				●				
Sales Representative			●		●						
Scientist				●							
Technical Services Representative		●			●					●	

Interests

The table on the next page matches the occupations described in Chapter 3 with interest areas from two inventories commonly used by counselors, the Campbell Interest and Skill Survey and the Strong Interest Inventory. This table will assist counselors in directing clients to occupations in biotechnology that match the clients' interests. The areas are:

Realistic/Producing: People in this category are interested in working with objects and using tools. They have a mechanical ability and enjoy repairing equipment, and caring for plants and animals. They often prefer to work outdoors. They have good math and mechanical skills and are result oriented.

Investigating/Analyzing: This area includes people who have an interest in problem solving. They like to observe, analyze, evaluate and learn, and have a need to understand. Their interests include science, math, statistics and solving puzzles. Most people who work in laboratory jobs are in this area.

Artistic/Creating: People in this area have an interest in art, design, creativity and using their imagination. They enjoy being innovative and using intuition and like to work in unstructured situations using their imagination. These are people who create new products and new ideas, such as scientists.

Social/Helping: These are people who enjoy working with people to teach, inform or help. They are skilled in writing and communication. These are people who are compassionate and concerned and care about serving others. They often work in healthcare jobs.

Enterprising/Influencing: People are included here who like to influence, persuade, sell and lead. They like to make things happen and take charge. They are often leaders or managers and are good at sales, persuasion and public speaking.

Conventional/Organizing: This area includes people who like to work with data and carry out detailed instructions. They have clerical or numerical ability and are good at record keeping, efficiency and productivity. They enjoy office and clerical occupations.

Adventuring: People who enjoy risk taking and physical activities. They are excitement oriented and enjoy competition and teamwork. Health and safety specialists may enjoy the risky aspects of dealing with hazardous conditions.

Interests

	Interest Areas						
	Realistic/Producing	Investigating/Analyzing	Artistic/Creating	Social/Helping	Enterprising/Influencing	Conventional/Organizing	Adventuring
Animal Caretaker	●					●	
Animal Technician	●	●				●	
Bioinformatics Specialist	●	●				●	
Clinical Research Associate	●	●				●	
Documentation Coordinator						●	
Forensic DNA Analyst	●	●				●	
Greenhouse and Field Technician	●					●	
Greenhouse and Field Worker	●						
Health and Safety Specialist		●				●	●
Instrumentation/Calibration Technician	●	●					
Laboratory Assistant	●					●	
Laboratory Automation Specialist	●	●				●	
Laboratory Support Worker	●						
Laboratory Technician	●	●				●	
Manufacturing Assistant	●						
Manufacturing Technician	●	●					
Material Handler	●					●	
Quality Assurance Specialist		●				●	
Quality Control Technician		●				●	
Research Associate	●	●					
Sales Representative		●			●		
Scientist		●	●				
Technical Services Representative		●		●			

Where to Find a Job

This table matches each job described in Chapter 3 to the various industries that use biotechnology. It can help identify which industry is a good place to look for each job.

	Industry Employment Areas														
	Agriculture and Food	Biofuel Manufacturing	Bioinformatics Companies	Biotechnology Companies	Consultants	Environmental Services	Forensics	Government Agencies	Hospitals	Instrumentation and Supplies	Law Enforcement Agencies	Medical Testing and Laboratories	Pharmaceuticals	Universities, Research Institutes	Waste Management Companies
Animal Caretaker	●			●				●					●	●	
Animal Technician	●			●				●					●	●	
Bioinformatics Specialist	●		●	●				●					●	●	
Clinical Research Associate				●				●	●				●	●	
Documentation Coordinator	●			●				●	●	●		●	●	●	
Forensic DNA Analyst					●				●		●			●	
Greenhouse and Field Technician	●			●				●						●	
Greenhouse and Field Worker	●			●				●						●	
Health and Safety Specialist	●			●			●	●	●	●		●	●	●	●
Instrumentation/Calibration Technician	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Laboratory Assistant	●	●	●	●		●	●	●	●		●	●	●	●	
Laboratory Automation Specialist	●	●	●	●		●	●	●	●	●	●	●	●	●	
Laboratory Support Worker	●	●	●	●		●	●	●	●		●	●	●	●	●
Laboratory Technician	●	●	●	●		●	●	●	●		●	●	●	●	●
Manufacturing Assistant	●	●		●		●				●			●		
Manufacturing Technician	●	●		●		●				●			●		
Material Handler	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Quality Assurance Specialist	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Quality Control Technician	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Research Associate	●	●		●		●	●	●	●	●			●	●	
Sales Representative	●	●	●	●	●	●	●			●		●			●
Scientist	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Technical Service Representative	●	●	●	●		●	●	●	●	●		●	●		●

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Best Jobs in Biotechnology

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Laboratory Assistant	93
Laboratory Automation Specialist	97
Laboratory Support Worker	101
Laboratory Technician	104
Manufacturing Assistant	108
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Quality Control Technician	122
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Best Jobs In Biotechnology

Introduction

The majority of the detailed job descriptions on the following pages are for occupations that offer entry-level opportunities in biotechnology, and are open to people with a high school diploma, some college, an associate degree or a bachelor's degree. Some occupations that show a career ladder from entry level jobs to positions such as scientist or technical service representative.

The largest number of entry-level jobs are:

- laboratory support workers,
- laboratory assistants,
- manufacturing assistants,
- laboratory technicians,
- manufacturing technicians and
- research assistants.

Each job description includes:

1. detailed information about the job duties and work conditions;
2. wages, hours and benefits;
3. qualifications, skills and training;
4. basic, personal and technical skills sets required for this occupation;
5. career advancement opportunities and related jobs;
6. job titles;
7. hints on finding the job; and
8. a list of community college programs that are good preparation for each job.

Every attempt has been made to ensure that information presented is accurate as of Spring 2008. Since wages, labor market trends and even basic requirements for jobs change over time, instructors, counselors and job seekers to keep up to date on general economic trends and local employment situations. Web sites that include information about current jobs, employers and the biotechnology industry are included in **Chapter 4: Finding a Job**.

Wages

The information on wages gives a range of wages at several levels of experience within the median wages across the country. Some employers will pay less or more than the amounts indicated. Wages vary significantly by region of the country, urban or rural areas, training level, size and type of business, including private and public businesses.

-
- Good entry level job for someone who likes animals
 - Salary \$15,000 to \$30,000 per year
 - Few entry requirements, many employers require only a high school diploma, college courses or experience
 - Can gain experience as a volunteer at an animal shelter, zoo or veterinary office

Animal Caretaker

Job Description and Work Conditions

Animal caretakers are responsible for the daily care of laboratory or farm animals used in biotechnology research. The animals may include mice, rats, sheep, goats, pigs, cattle, cats, birds, fish, rabbits, hamsters, monkeys, dogs or frogs. Caretakers

- Feed and water the animals, clean and disinfect their cages, racks and pens.
- Examine the animals for signs of illness, provide grooming and baths, adjust the temperature and humidity of the animal quarters and maintain records to comply with regulatory standards and operating procedures.
- May also observe the animals, do minor clinical tasks, move animals and give medicine to animals by mouth or apply to the skin.
- May receive and stock food and other materials used in animal care.

Animal caretakers in agricultural biotechnology are responsible for:

- The daily care of farm animals raised for research purposes.
- Work on an experimental farm and perform routine tasks such as providing animals with food and water and keeping their environment clean.
- May assist with artificial insemination, births or milking.
- Keep detailed records on each animal's diet, weight, medications and food intake for research projects.

Duties are sometimes repetitious. The job may involve lifting, bending and stooping to clean animal quarters. Working closely with animals often requires working around strong or foul smells.

Wages, Hours and Benefits

- **Entry-level wages: \$15,000 to \$20,000 per year** (usually higher in high-cost-of living areas)
- **Experienced animal caretaker: \$17,000 to \$30,000 per year** (usually higher in high-cost-of living areas)

HOURS—Most animal caretaker positions are full-time, 40 hours per week. Since animals need to be cared for every day, many positions require some weekend, night, holiday or overtime hours. Part-time work is often available in this position.

BENEFITS —Biotechnology employers offer excellent benefit packages for full-time workers,

and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

An animal caretaker must enjoy working with animals, but also realize that most animals used in research are destined to end their lives as part of the research. An entry-level animal caretaker position usually requires a high school diploma. Some employers hire caretakers without a diploma who have previous experience. Some companies prefer applicants with some college courses in a veterinary technician or similar program. Up to two years experience working with animals may also be required. Experience may be gained in paid jobs or by volunteering at an animal shelter, zoo or veterinary office.

Career Advancement and Related Jobs

Technical Skills

- **Animal care skills—monitor, restrain, handle, care for**
- **Keep accurate and detailed records**

Personal Skills

- **Detail oriented**
- **Lift up to 50 pounds (animals, feed, supplies)**
- **Observation skills**
- **Organized**
- **Perform physically demanding work**
- **Perform routine, repetitive work**
- **Work as a team**
- **Work independently**

Basic Skills

- **Basic math**
- **Read and follow instructions**
- **Written and oral communication**

Caretakers may be promoted to laboratory animal technicians (see next job description). Technicians administer medications, perform lab tests, take specimens, record daily findings, may assist in procedures and work closely with scientists. Technicians often need certification from the American Association of Laboratory Animal Sciences. Information can be obtained from AALAS, www.aalas.org, 9190 Crestwyn Hills Drive, Memphis, TN 38125, 901-754-8620.

Other animal caretakers become veterinary technicians, which requires completion of a two-year college program. Veterinary technicians certification is handled by each state individually, generally through a state's Veterinary Medical Board. Addition information about registration is available from the American Association of Veterinary State Boards, www.aavsb.org, 4106 Central Street, Kansas City, MO 64111, 877-698-8482.

Other Job Titles Include

- Animal care specialist
- Animal handler
- Animal laboratory worker
- Assistant animal technician
- Laboratory assistant
- Veterinary assistant

Finding the Job

Positions are available with

- Biotechnology companies that use animals for research and development and in testing products.
- Pharmaceutical companies that develop drugs for animals and people.
- Agricultural and food companies.
- Universities, college and research institutes or government agencies such as the National Institutes of Health.

Jobs are often filled through employee referrals, walk-ins or by hiring volunteers. Job may be listed on company websites and on job listing websites. This type of entry level job may *not* appear on Internet job listings. Jobs at universities and research institutes may be filled by hiring students or student interns. Some jobs may be filled through employment agencies that specialize in biotechnology or science jobs.

Community or technical college programs that can help get positions as animal caretaker include:

- Animal health technology
- Animal science
- Life sciences
- Veterinary technology
- Zoology

Community College Programs

Community college courses are not generally required for animal caretakers. College courses or an associate degree can help in getting promotions and higher level jobs.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Animal Technician

- Good job for a person who likes to work with animals
- May require AALAS certification
- Usually requires associate degree in veterinary technician or similar field
- Salary \$19,000 to \$40,000 per year

Job Description and Work Conditions

Animal technicians assist scientists who use laboratory and farm animals in biotechnology research or product testing. They

- Work with a wide variety of animals such as rats, mice, sheep, goats, pigs, cattle, cats, birds, fish, rabbits, hamsters, monkeys, dogs and fish.
- Perform medical procedures on animals, give injections, care for research animals before and after surgery and may also perform some simple surgery.
- Assist in restraining the animal during examinations and inoculations.
- May participate in taking daily animal observations, breeding, and weaning.
- Keep detailed records of animals' health.
- Order and stock supplies for animal care.
- Obtain or breed the animals needed in laboratories, feed animals, clean their cages and provide other daily care.
- Clean and supply exam rooms and surgical suites, prepare treatment rooms for surgery and maintain and sterilize laboratory equipment. For research projects, animal technicians may need to maintain germ-free aseptic conditions.

Experienced technicians work closely with scientists on research projects and may train research personnel to perform experimental techniques on laboratory animals. They may write Standard Operating Procedures for the handling and care of animals.

Animal technicians may work in a laboratory or farm environment. Since animals need daily care, duties are sometimes repetitious. The job may involve lifting or bending and stooping to clean animal quarters. Working closely with animals often requires working around strong or foul smells.

Wages, Hours and Benefits

- **Entry-level wages: \$19,000 to \$25,000 per year** (usually higher in high-cost-of living areas)
- **Experienced animal technician: \$25,000 to \$40,000 per year**

HOURS—Most positions are full-time, 40 hours per week. Technicians may be required to work nights, weekends and holidays, since animals require daily feeding, care and monitoring. Part-time work is often available in this position.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

Animal technician positions usually require an associate degree in animal science, veterinary technology or a related program. Employers also prefer life science and math course work. Some animal technicians may be hired with a high school diploma and one to three years of animal care experience. More advanced positions may require a bachelor's degree in the biological sciences or three to five years of directly related experience.

Animal technicians must be able to care for animals, yet understand that most animals used in research are destined to end their lives as part of the research. They need basic veterinary nursing skills and knowledge of the care and common diseases of laboratory animals. They must have knowledge of the equipment and supplies used in animal testing and research.

Technical Skills

- **Animal care skills—monitor, restrain, care for, lift**
- **Biotechnology laboratory procedures**
- **Certification may be required**
- **Computer skills**
- **Record keeping skills—detailed and accurate**
- **Understand detailed technical instructions and procedures**

Personal Skills

- **Detail oriented**
- **Lift up to 50 pounds—feed, animals, supplies**
- **Observation skills**
- **Work as a team**

Basic Skills

- **Basic math**
- **Written and oral communication**

Many biotechnology employers prefer or require that applicants be certified by the American Association for Laboratory Animal Science (AALAS) as an Assistant Animal Laboratory Technician or a Laboratory Animal Technician. Information can be obtained from AALAS, www.aalas.org, 9190 Crestwyn Hills Drive, Memphis, TN 38125, 901-754-8620.

Some employers require workers to be Registered Veterinary Technicians. Certification is handled

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Other Job Titles Include

- **Animal care specialist**
- **Animal care technician**
- **Animal health technician**
- **Animal husbandry technician**
- **Laboratory animal technologist**
- **Veterinary technician**

Qualifications, Skills and Training

Animal technician positions usually require an associate degree in animal science, veterinary technology or a related program. Employers also prefer life science and math course work. Some animal technicians may be hired with a high school diploma and one to three years of animal care experience. More advanced positions may require a bachelor's degree in the biological sciences or three to five years of directly related experience.

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Some employers require workers to be Registered Veterinary Technicians. Certification is handled by each state individually, generally through a state's Veterinary Medical Board. Addition information about registration is available from the American Association of Veterinary State Boards, www.aavsb.org, 4106 Central Street, Kansas City, MO 64111, 877-698-8482.

Career Advancement and Related Jobs

Animal technicians may be promoted to supervisory positions or facility managers. Some animal technicians may choose to get a bachelor's degree and move into research positions such as laboratory technician or research associate. An animal technician may become a registered veterinary technician, which generally requires completion of a two-year program at a community or technical college.

Community or technical college programs that can help get positions as animal technician include:

- **Animal health technology**
- **Animal science**
- **Life sciences**
- **Veterinary technology**
- **Zoology**

Finding the Job

Positions are available with:

- Biotechnology companies that use animals for research and development and in testing products.
- Pharmaceutical companies that develop drugs for animals and people. agricultural and food companies.
- Universities, college and research institutes or government agencies such as the National Institutes of Health.

Job may be listed on company websites and on biotechnology, science, pharmaceutical or agriculture employment websites. Jobs may be filled through employee referrals, walk-ins or by hiring volunteers. Jobs at universities and research institutes are often filled by hiring students or interns. Some jobs are filled through employment agencies specializing in biotechnology or science jobs. Referrals from college employment offices can help students find jobs.

Community College Programs

Animal technicians usually require at least an associate degree in animal science, veterinary technology or a related field. Additional college courses can help in promotions and higher level jobs.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Bioinformatics Specialist

- A good job for a person who is interested in biology and has excellent computer skills
- Most jobs are in the pharmaceutical industry
- Requires a bachelor's or master's degree
- Entry-level salary \$45,000 to \$60,000 per year

Note: Bioinformatics as a tool is slowly becoming a necessity for many people working in biosciences, though bioinformatics specialist jobs still exist.

Job Description and Work Conditions

Bioinformatics is a great field for people who are interested in biology and like to work with computers. As researchers study the genes and DNA of humans, animals and plants, an enormous amount of information is gathered and stored in computer databases. Bioinformatics specialists design software that is used to gather, store, and study this information about genes, proteins and molecules in living things.

This information is used in many ways: perhaps to study the causes of disease and to identify drugs or treatments for diseases; by anthropologists to learn about human migration or to study different species of plants and animals; or to use DNA information to help law enforcement agencies track people who commit crimes.

Bioinformatics specialists help scientists in fields of genomics and proteomics, which analyze information about genes and proteins, writing software and designing databases for analyzing genes and proteins. In the field of “data mining,” they work on the process of sorting through huge databases and picking out relevant information. They also design databases that can merge information from several sources. Much of this information is shared via the Internet, so web design is also a part of this field.

Bioinformatics specialists often work as a team with scientists and other programmers. They use their background in computer science and life science to design computer programs that biochemists, molecular biologists and other scientists can use in research. Some bioinformatics specialists write the documentation that explains how to use the programs they develop.

Bioinformatics specialists spend much of their time working on a computer in an office. They usually work in offices at private companies, universities and other places where research is carried out.

Wages, Hours and Benefits

- **Entry-wages:** \$45,000 to \$60,000 per year
- **Experienced bioinformatics specialist:** \$60,000 to \$100,000 per year

HOURS—Most positions are full time, 40 hours per week, but sometimes overtimes is required. Wages are generally higher in regions where the cost of living is higher.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time

workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

Employers require at least a bachelors degree in computer science, molecular biology, genetics, biochemistry or a related field, and many positions require a master's degree or Ph.D. Those computer science degrees must have courses in biology. Those with a biological science background need computer experience. Employers usually require two to five years experience in a bioinformatics, genomics or molecular biology laboratory. People who have a bioinformatics degree that combines biological science and computer science are in demand. Most jobs involve the design and use of computer programs to store, manage, retrieve and analyze large amounts of DNA

Technical Skills

- **Analyze/evaluate data**
- **Advanced computer skills**
- **Knowledge of life science/chemistry**
- **Knowledge of SOPs, GMPs, GLPs**
- **Plan and carry out research**
- **Problem solving/critical thinking**
- **Record keeping skills**
- **Technical writing skills**
- **Understand technical information**

Personal Skills

- **Detail oriented**
- **Organized**
- **Work as a team**
- **Work independently**

Basic Skills

- **Advanced math skills**

sequence data, so extremely strong computer programming skills are essential.

Bioinformatics specialists need knowledge of a variety of specialized computer programs, databases and programming languages such as HTML, Perl, JAVA and C++. They use operating systems such as UNIX and Linux and databases such as Oracle.

Many positions also required knowledge of web design.

The specific computer programs that are required vary by job duties and the employer. Skills in advanced math, computer graphics and computational biology are also needed. Employers look for people who are good at solving problems. Bioinformatics specialists must have good communication skills and be able to work as a team member with both computer scientists and biologists.

Career Advancement and Related Jobs

Bioinformatics specialists may move into higher level scientist positions that supervise other science staff or manage entire projects. They can also move into company management positions. Some plan and administer programs for research activities. Some scientists create a program or product and start a business to develop and sell it.

Finding the Job

Bioinformatics specialists work at private biotechnology and bioinformatics companies, law enforcement agencies, pharmaceutical companies, agriculture, universities, colleges and research institutes. Several government research facilities do bioinformatics research, such as the National Institutes of Health and the U.S. Department of Energy Office of Science, which is the founder of the Human Genome Project.

Jobs are on the Internet, especially biotechnology company sites and web sites dedicated to biotechnology, science or pharmaceutical employment. Employment agencies specializing in scientific jobs, referrals from employees or college professors and college employment offices are other sources of job leads.

Other Job Titles Include

- Bioinformaticist
- Bioinformatics analyst
- Bioinformatics programmer
- Bioinformatics scientist
- Bioinformatics software engineer
- Informatics developer
- Programmer analyst
- Research assistant

Community College Programs

Most bioinformatics employers require at least a bachelor's degree in biology, biochemistry, engineering or computer science. All community colleges offer programs that can prepare students for transfer to a four year college.

A student interested in bioinformatics can supplement a biotechnology program with computer science classes to improve their prospects of getting a job in bioinformatics.

Community and technical college programs that help prepare students for bioinformatics careers include:

- Bioinformatics
- Biomedical technology or electronics
- Biotechnology
- Computer science
- Life sciences

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

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- Excellent job opportunities in drug development
 - Usually requires a bachelors degree or registered nurse training
 - Many jobs require lots of travel
 - Entry-level salary \$35,000 to \$45,000 per year

Clinical Research Associate

Job Description and Work Conditions

Clinical research associates (CRAs) administer and monitor the clinical trials of new drugs that are created using biotechnology. They are in high demand. A new drug must be tested on animals and people to find out if it is safe and effective. This process is called “the clinical trials process.” A drug cannot be sold in the United States until it is approved by the FDA, which has strict requirements on exactly how the clinical trials are carried out.

Clinical research associates

- Monitor each trial site to ensure that the protocol is followed correctly and visit each site regularly to monitor data collection.
- Meet with researchers to discuss the progress of a trial and to help correct any problems that may have occurred.
- Maintain records of clinical trials on paper and on computers, following very strict requirements so the company and FDA get accurate information.
- Maintain safeguards on the privacy of each person in a clinical trial.
- Assist in writing data collection forms, publications, papers or abstracts. Experienced CRAs work on analyzing the collected data and evaluating the results.

Experienced clinical research associates may

- Work with scientists to design the research study that tests a new drug and may help write research protocols.
- Recruit and train investigators who carry out clinical trials.
- Help the investigators to set up the trial and make sure they have the materials they need to carry it out.

Some clinical research associates work from home, while others have an office at the company that employs them. Clinical research associates spend most of their time visiting the individual doctor’s offices, hospitals or universities where research is going on. Three or four days each week are usually spent in travel. This may involve regional, national or international travel, depending on where the drug is tested.

Wages, Hours and Benefits

- Entry-level wages: \$35,000 to \$45,000 per year
- Experienced clinical research associate: \$40,000 to \$80,000 per year

Highly experienced clinical research associates may earn up to \$95,000 per year. The pay varies considerably depending on experience, type of employer, educational background and regional cost of living. Private companies usually pay higher wages than government agencies or universities. CRAs usually receive an automobile allowance since travel is required.

HOURS—Most employees work full time, averaging 40 hours per week during regular business hours. Some overtime may be needed to meet deadlines.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

Most employers require a bachelor's degree in biological science or a health field or a background as a registered nurse with an associate or bachelor's degree. Employers usually require two to five years related experience. Some entry-level positions are available for clinical trials assistants, which usually involve tracking and filing the documents for a clinical

Technical Skills

- Know FDA requirements for drug development and experimental trial design
- Know government regulations, GCPs, GLPs and ICH.
- Understand research methods and laboratory practices.
- Analyze/evaluate data
- Have advanced computer skills, especially with databases
- Hold a valid driver's license
- Know life sciences/chemistry
- Know SOPs, GMPs, GLPs
- Plan and carry out research
- Have good problem solving/critical thinking skills
- Have excellent record keeping skills
- Understand technical information

Personal Skills

- Detail oriented and have problem solving skills
- Organized
- Work as a team
- Work independently

Basic Skills

- Advanced math

trial. Clinical trial assistants may be hired with a high school diploma and 2 years experience.

Most positions require a driver's license because considerable travel is involved. Some employers prefer certification from the Association of Clinical Research Professionals, www.acrpnet.org, 500 Montgomery Street, Suite 800 Alexandria, VA 22314, 703-254-8100, or the Society of Clinical Research Associates, www.socra.org, 530 West Butler Avenue, Suite 109, Chalfont, PA 18914, 800-762-7292.

Career Advancement and Related Jobs

Clinical research associates may begin their career as a clinical trials assistant, a registered nurse or in a research or medical records position. They may advance to senior clinical research associate positions, and then move into management or research and development jobs. Some clinical research associates specialize in certain areas of research, such as oncology, cardiology or HIV/AIDS. With a master's degree they may become project designers or work for contract research organizations.

Finding the Job

Clinical research associates may work for a biotechnology or pharmaceutical company or a contract research organization (CRO) that is contracted by the drug developer to carry out the clinical trial. CRA positions are available with manufacturers of medical devices, government agencies, hospitals and universities.

CRA positions are listed on the Internet at company websites or on websites dedicated to pharmaceutical, science or medical employment. Some professional associations provide job listing services on the Internet to their members. Jobs come from employee referrals, by directly contacting employers, or are filled through employment agencies in the biotechnology or health fields.

Community College Programs

Clinical research associate positions usually require at least a bachelor's degree. Many community colleges have transfer agreements with four year colleges and universities. An associate degree in registered nursing may be acceptable.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Other Job Titles Include

- Clinical research & regulatory assistant
- Clinical research assistant
- Clinical research coordinator
- Clinical research monitor
- Clinical research technician
- Clinical trials assistant
- Clinical trials monitor

Community or technical college programs that can help applicants prepare for a career as a clinical research associate include:

- Biotechnology
- Life sciences
- Nursing

Documentation Coordinator

- Entry-level job for high school graduate or associate degree
- Requires attention to detail and ability to keep track of paperwork
- Experience needed can be gained in food processing or pharmaceutical industry
- Salary \$24,000 to \$50,000 per year

Job Description and Work Conditions

Accuracy and attention to detail are two of the most important skills for someone considering the position of documentation coordinator. A documentation coordinator

- Is responsible for keeping track of the numerous forms, reports, records and other documents created by biotechnology companies.
- Is an employee of a company that manufacture pharmaceuticals. The FDA regulates this industry to ensure that drugs are manufactured and formulated properly.
- Keeps track of the documents that show products are manufactured properly from approved materials and of documents needed for approval from the FDA. These document must be kept up-to-date and accurate.
- Is responsible for making sure all records are prepared properly and available to appropriate personnel.

Responsibilities may vary depending on the size of the company and the products the company develops. Documentation coordinators might be required to track and file various documents such as Good Manufacturing Practices (GMPs) guidelines; that GMP records are properly kept; Standard Operating Procedures (SOPs); training records, regulatory documents; develop distribution schedules and distribute documents to appropriate personnel..

A documentation coordinator works with computers and computer databases, copiers, faxes and scanners. Documentation coordinators usually work in the regulatory affairs or quality assurance department offices and must work independently and with teams.

Wages, Hours and Benefits

- **Entry-level wages: \$24,000 to \$28,000 (usually higher in high-cost-of living areas)**
- **Experienced documentation coordinator: \$26,000 to \$50,000 per year**

Wages are lower for documentation coordinators with a high school degree and higher for those with a bachelor's or associate degree.

HOURS—Documentation coordinators usually work a standard 40-hour workweek, Monday through Friday. This is usually a full-time job. However, some part-time opportunities may exist.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees. Benefit packages usually include vacation,

holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

When hiring for a documentation coordinator position, most employers look for a high school diploma and at least one to four years of relevant experience. Some employers prefer to hire applicants who have an associate degree, but require either no experience or up to 2 years relevant experience. Employers generally require clerical or manufacturing experience or knowledge of a particular industry, such as the pharmaceutical or food production, and respect knowledge of Standard Operating Procedures (SOPs) and Good Manufacturing Practices (GMPs).

In those companies that are regulated by the federal government, such as pharmaceuticals and food companies, knowledge of the FDA regulations is also helpful. Pharmaceutical companies may look for people with knowledge of medical terminology and coursework in medical record management.

Technical Skills

- **Good computer skills—word processing, database, spreadsheet, document management, scanning**
- **Knowledge of SOPs, GMPs, GLPs**
- **Problem solving/critical thinking**
- **Excellent record keeping skills**
- **Proofreading**
- **Strong organizational skills**
- **Able to lift and carry up to 35 pounds**

Personal Skills

- **Good attention to detail**
- **Organized**
- **Work as a team**
- **Work independently**

Basic Skills

- **Basic math**
- **Read and follow instructions**

Career Advancement and Related Jobs

Many biotechnology companies promote from within as employees gain experience in the company or continue their college education, using the education benefits provided by the

company.

From documentation coordinator, employees can advance to a number of different positions in quality assurance or regulatory affairs such as document control associate, documentation specialist or technical writer. A bachelor's degree is usually required for these positions. In a pharmaceutical company opportunities might also include medical writer or medical editor. In the regulatory affairs area advancement opportunities include regulatory affairs specialist, regulatory information manager, regulatory specialist, regulatory affairs associate, regulatory compliance associate or regulatory affairs manager.

Finding the Job

Most jobs are in biotechnology and pharmaceutical companies. Documentation coordinators usually work in the quality assurance or regulatory affairs departments, and most are employed by larger companies. Similar positions exist in the agriculture and food industry, hospitals and government agencies.

Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, medical, pharmaceutical or science employment. Some positions are filled through temporary agencies that specialize in biotechnology, pharmaceutical and medical jobs. Other jobs are filled through referrals from employees and walk-in applicants. Referrals from employees or college professors and college employment offices are other sources of job leads.

Other Job Titles Include

- Document control associate
- Document processor
- Documentation associate
- Quality systems documentation clerk
- Records and image technician

Community College Programs

Most documentation coordinator jobs do not require college coursework, though some do prefer an associate degree. However, college courses or an associate degree can help in getting promotions and higher level jobs.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help get positions as a documentation coordinator include:

- Biomanufacturing
- Biotechnology
- Computer science
- Industrial biotechnology
- Logistics
- Manufacturing technology
- Quality control

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- This is a career in criminal justice that uses biotechnology techniques
 - Requires background check
 - Bachelors degree in biological science needed for entry level jobs
 - Entry-level salary \$30,000 to \$50,000 per year

Forensic DNA Analyst

Job Description and Work Conditions

Forensic science includes DNA analysis as well as information from plants, insects, weather, archeology, geology and other sciences to help resolve legal issues. Forensic DNA analysts work in crime labs to extract and match DNA from samples that are used as evidence to solve crimes or establish who may be relatives of a person. DNA samples from crime scenes can help identify and convict people who have committed crimes or to free people imprisoned for crimes they did not commit. Some forensic DNA analysts help identify victims of war, terrorism or natural disasters.

Forensic DNA analysts work to create a DNA “profile” or “fingerprint” that is unique for every individual. DNA evidence usually is used to identify people, but might also be used on animals, plants or even bacteria or viruses.

Forensic DNA profiling has several steps.

- Samples of tissue, blood, urine, saliva, feces or other materials are prepared.
- DNA is extracted from samples and increased to an amount sufficient to test and profile.
- A profile requires using extraction robots, PCR instruments or thermal cyclers, capillary electrophoresis instruments and other laboratory equipment.
- Results of the tests are compared to DNA profiles from known people.

Forensic DNA analysts

- Maintain detailed documentation of test techniques and laboratory results.
- Do accuracy laboratory work to ensure that the results can be used in court.
- Properly collect and store evidence. Custody of DNA evidence must be documented at every stage of analysis in order to ensure that the evidence is not lost or tainted during the testing process.
- Write reports about their findings and provide expert testimony in court about the findings of their laboratory work. .

The work usually takes place in a forensic or crime laboratory. In crime laboratories with few employees, the work may be more varied, including a variety of laboratory tests and skills. In labs with many employees, specialization is more common.

The work is indoors, in a comfortable, clean working environment. Some work requires

working with samples of a variety of human tissues or remains. Some jobs may involve working at crime scenes.

Wages, Hours and Benefits

- **Entry level wages: \$30,000 to \$50,000 per year** (usually higher in high-cost-of living areas)
- **Experienced forensic DNA analyst: \$45,000 to \$80,000 per year**

Supervisors and heads of laboratories can earn from \$70,000 to \$100,000 per year. Analysts with more experience or a master's degree will earn higher wages than those with a bachelor's degree. Private forensic companies may pay more than government positions for specialized positions. Contract positions that require travel offer higher pay, especially if the travel is to dangerous locations, such as war zones or areas of civil conflict.

HOURS—In general, technicians have regular weekday hours. However some forensic DNA analysts are on call 24 hours per day. Generally, additional pay is given when on call.

BENEFITS—Government agencies usually offer excellent benefit packages for full-time workers, and some offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance and retirement plans. Most private companies offer profit sharing and stock ownership plans as well. Education assistance plans may be available and may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

Most employers look for:

- A bachelor's degree in biology, genetics, biochemistry or molecular biology.
- Coursework in statistics, population genetics and crime detection and investigation.
- Up to two years of experience may be required, but there are entry level jobs for recent college graduates.
- Laboratory experience may be a substitute for education.
- Higher level jobs may require a master's degree plus two to four years experience.

Because this position involves working with law enforcement, people with a history of drug use, bad credit or a criminal record *cannot* be hired as

Technical Skills

- Analyze/evaluate data
- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs & GLPs
- Problem solving/critical thinking
- Public speaking
- Understand technical instructions

Personal Skills

- Detail oriented
- Lift up to 50 lbs.
- Observation skills
- Organized
- Work as a team
- Work well under pressure

Basic Skills

- Advanced math
- Written and oral communication

forensic DNA analysts. Pre-hire screening usually includes a drug test, a background investigation including credit, criminal and driving history, and may include a polygraph (lie detector) examination. A security clearance may be needed for some jobs. Many jobs require applicants to be United States citizens.

DNA analysts need hands-on laboratory experience which may be gained through coursework, experience or internships. Technicians will operate a variety of precision laboratory equipment such as electrophoresis and PCR/thermal cyclers.

Analysts need excellent math skills at least through advanced algebra and be able to follow detailed, technical instructions, carry out experiments precisely and analyze the resulting scientific data. The ability to work carefully and accurately at tasks that are often repetitive is needed. At all levels, problem solving skills are important.

Forensic DNA analysts need good writing skills, since the laboratory notes are used in court. Excellent public speaking skills are needed when testifying in court cases. Strong computer skills especially database, word processing and spreadsheet skills are also needed. Some positions require a driver's license when travel is required.

Career Advancement and Related Jobs

- DNA laboratory supervisory and management jobs may require a master's degree and three to six years experience, such as team leader, technical manager, section supervisor and higher level management positions.
- Additional crime laboratory supervisory jobs are available with training and experience in a variety of forensic techniques such as fingerprinting, chemical analysis, firearms/toolmarks, footwear/tire marks, trace evidence or toxicology.
- Some DNA analysts obtain additional education and specialize in forensic archaeology or anthropology.
- Research scientist positions that work to develop new DNA identification techniques usually require a Ph.D.
- Some forensic DNA analysts provide validation services to crime labs to ensure that equipment and processes used to identify DNA work according to specifications.

Finding the Job

- Most forensic DNA analysts work for local or state police departments or federal law enforcement agencies such as the FBI.
- Some forensic DNA analysts work for private forensic laboratories, medical examiners or coroners offices, hospitals, universities, toxicology laboratories or as independent forensic science consultants.

Other Job Titles Include

- Crime lab scientist
- Forensic biologist
- DNA analyst
- Forensic DNA scientist
- Forensic laboratory technician
- Forensic scientist

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- Consultants may travel locally, nationally or internationally.
 - Local and state police departments hire recent college graduates as entry level forensic DNA technicians.

Most employers advertise openings on the Internet, at government or company sites or other Internet job listing sites. They also recruit new employees through newspaper advertisements and employee referrals. Jobs are also listed at college employment centers, and instructors frequently refer students for jobs. Student interns may be offered a permanent position after graduation. An excellent resource for job seekers is the American Academy of Forensic Sciences, www.aafs.org, 410 North 21st Street Colorado Springs, CO 80904, 719-636-1100.

Community College Programs

Forensic DNA analyst jobs generally require a bachelor's degree in biology, genetics, biochemistry or molecular biology. All community colleges offer programs that can prepare people holding higher degrees for work in forensics, or can prepare students for transfer to a four year college.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community and technical college programs that help prepare students for forensic DNA analyst careers include:

- Bioinformatics
- Biological technician
- Biotechnology
- Chemistry
- Criminal justice
- Laboratory science technology
- Life sciences

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- A good job for someone who wants to work with plants
 - Requires an associate or bachelor's degree in a life science
 - Salary \$23,000 to \$50,000 per year
 - With a bachelor's degree, can move to supervisory positions or other jobs in agriculture area

Greenhouse and Field Technician

Job Description and Work Conditions

Biotechnology researchers develop plants that resist diseases, drought and pests. Some plants are genetically modified to be more nutritious or to increase yield. Scientists also work to create plants that can “grow” pharmaceutical products.

A greenhouse or field technician is responsible for the more technical aspects of growing and caring for plants that have been created through genetic engineering. Greenhouse and field technicians help grow plants and seeds for research to test the results of recombining DNA.

Greenhouse and field technicians:

- Usually work for large agriculture companies or agricultural research stations attached to colleges and universities.
- Plant seeds, pollinate flowers, water and weed the plant beds, plant rooted plants, and nurture root cuttings to encourage growth for potential planting and harvesting.
- Apply pesticides, fertilizers and other chemicals, for which they may need state certification. Their responsibilities also include routine maintenance and repairs of greenhouses and farm equipment.
- Must be especially careful because the plants with which they work are the products of genetically modification research or other specialized experiments. These plants may be unique. Careful tending is needed so they survive and research can be completed.
- Are responsible for making detailed observations about plants' growth, productivity and pest or disease problems. After collecting this information, they enter it into a computer database and assist in the interpretation of results.
- May supervise other greenhouse or field workers.
- May also be involved in plant tissue culture, a procedure that creates new plants from small pieces of fully grown plants rather than from seeds.

Greenhouse technicians work in greenhouses or in large buildings that provide space for growth chambers, which are small indoor greenhouses. In a growth chamber, the greenhouse technician controls the level and timing of light, temperature, humidity, water, soil and nutrients that each plant receives. The technician monitors the growth chamber and keep records of conditions and plant growth.

Field technicians work outdoors in all types of weather. The work is physically demanding, including walking, standing and bending for many hours each day. Getting dirty is part of this job, especially when working with soil doing jobs such as potting plants and field work. Heavy lifting is often required. Field technicians work with larger trials of crops from genetically modified seed grown outdoors. They set up irrigation equipment and operate farm and field equipment.

Wages, Hours and Benefits

- **Entry-level wages: \$23,000 to \$35,000 per year** (usually higher in high-cost-of living areas)
- **Experienced greenhouse and field technician: \$30,000 to \$50,000 per year**

HOURS—Greenhouse and field technicians usually work 40 hours per week. They are often required to work some weekend and holiday hours because plants need to be cared for every day. Field technicians often have longer hours during planting and harvesting seasons.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and sometimes to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

When hiring entry-level greenhouse and field technicians, employers prefer a bachelor's degree in agriculture, agronomy, plant science, biology, botany or another life science and an interest in working with plants. Employers also hire people with an associate degree in plant science, crop science, or botany and three or more years experience as a greenhouse or landscape worker.

Field technicians need experience working with farm and field equipment such as tractors, forklifts or harvesting equipment. They also need knowledge of crop production, farming, plant care, pay attention to detail, have the ability to understand and follow directions, and possess good verbal and written skills for preparing reports. They may need to lift up to 50 pounds.

Computer data entry skills are needed to keep track of data. If the position includes working with pesticides, a special license or certificate may be necessary.

Technical Skills

- Analyze/evaluated data
- Computer skills
- Knowledge of life sciences/chemistry
- Plant care skills
- Record keeping skills
- Understand technical information

Personal Skills

- Detail oriented
- Lift up to 50 pounds
- Manual dexterity
- Observation skills
- Perform physically demanding work
- Work as a team

Basic Skills

- Basic math
- Written and oral communication

Career Advancement and Related Jobs

- A greenhouse or field technician with a bachelor's degree may be promoted into the position of plant science associate, who supervises field workers and technicians.
- The next career step is greenhouse or field coordinator, assistant farm manager or farm manager, who would be in charge of all the greenhouse or field operations such as maintenance, space allocation and installing new equipment. Many companies promote from within to these types of jobs. Most companies offer excellent education benefits that employees can take advantage of to improve their advancement potential.
- With a master's degree and many years of experience or a Ph.D., the career path may lead to scientist positions.

Finding the Job

Greenhouse and field technician jobs are found in agriculture and food companies, biotechnology companies specializing in agriculture, at greenhouses or agricultural research stations at universities and at some government agencies, such as the United States Department of Agriculture.

Positions are frequently listed on the Internet, especially on biotechnology or agriculture company sites and web sites dedicated to biotechnology, agriculture or science employment. Some positions are filled through employment agencies that specialize in biotechnology or science jobs. Other jobs are filled through referrals from employees, walk-in applicants, college professors and college employment offices.

Other Job Titles Include

- Field technologist
- Greenhouse assistant II or III
- Plant tissue culture technician
- Research assistant
- Seed production technician
- Seed research assistant
- Soil media technician

Community College Programs

Community colleges offer a variety of programs related to plant science and care. For jobs that require a bachelor's degree, an associate degree in life science or biotechnology will prepare students for transfer to a four year college, as will other skills for those already holding higher degrees.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific courses. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help get positions as a greenhouse and field technician include:

- Agricultural biotechnology
- Agriculture
- Biotechnology
- Botany
- Crop production/Crop science
- Plant science

Greenhouse and Field Worker

- Entry-level position with few requirements
- Requires high school diploma and interest or experience in caring for plants
- Salary \$13,000 to \$30,000 per year
- Can take advantage of education benefits, take college courses and move into greenhouse and field technician positions

Job Description and Work Conditions

People who are interested in plants and enjoy working with their hands might enjoy being a greenhouse and field worker in biotechnology research. Greenhouse and field workers like working with plants and must be comfortable working in the dirt. While greenhouse and field workers perform a wide range of tasks, their main responsibility is to care for plants used in biotechnology research. They provide support to the scientists and laboratory technicians who work to improve crops or use plants for other types of research.

Some of the responsibilities of a greenhouse and field worker include:

- Planting seeds and small plants, watering, weeding the plant beds, and nurturing root cuttings to encourage growth for potential planting.
- Tend small number of plants indoors in greenhouses or work with larger trials of crops from genetically modified seed that are grown outdoors.
- Field workers set and run sprinklers and other outdoor irrigation systems to water the plants and fields. Field workers also operate and maintain the machinery and equipment involved in plant growing such as tractors, mowers, sprayers and other power tools. They also protect plants from animals.
- Making and recording detailed observations on a plant's growth progress, its productivity, or its pest problems.
- Must be especially careful because the plants with which they work may be the products of genetic modification research or other specialized experiments. These plants may be unique and careful tending is needed to make sure they survive so that the research can be carried out.

Greenhouse and field workers work outdoors in hot and cold weather or indoors in greenhouses that are often hot and humid. They may also work in growth chambers, which are small greenhouses where the environment is completely controlled.

The work is physically demanding, including walking, standing and bending for many hours each day. Getting dirty is part of this job, especially when working with soil doing jobs such as potting plants and field work. The work may involve using fertilizers, pesticides and other chemicals and requires attention to safety. Heavy lifting is often required.

Wages, Hours and Benefits

- Wages range from \$13,000 to \$30,000 per year (usually higher in high-cost-of living areas)

HOURS—Most greenhouse and field workers are employed full-time. Weekend work is common, since plants need to be cared for every day. During planting and harvesting seasons, greenhouse and field workers may work more than 40 hours per week. There are some seasonal positions for field workers.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books and flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Most employers look for a high school diploma and an interest in plants. A high school biology, botany or plant science course is also useful.
- One to three years experience in agriculture, horticulture or gardening is usually required.
- Some employers prefer to hire people with an associate degree, usually with classes in a relevant area such as plant science, crop science, or botany.
- An associate degree in a life science area with relevant plant courses would be helpful for career advancement.

Greenhouse and field workers must be:

- Physically fit.
- Pay attention to detail.
- Have the ability to understand and follow directions; and
- Possess good verbal and written skills.

Some employers prefer applicants with computer skills such as data entry. If the position includes working with pesticides, a special license or certificate may be necessary. A driver's license may be required. Ability to lift 50 pounds or more is usually necessary.

Field workers usually need knowledge and experience working with farm and field equipment such as tractors, forklifts or harvesting equipment. They also need knowledge of crop production, farming and plant care.

Career Advancement and Related Jobs

- This is an entry-level position in a career ladder that requires additional education in order to advance. Many companies promote from within to these types of jobs, providing

Technical Skills

- Plant care skills
- Record keeping skills

Personal Skills

- Detail oriented
- Lift up to 50 pounds
- Observation skills
- Organized
- Perform physically demanding work
- Perform routine, repetitive work

Basic Skills

- Basic math
- Read and follow instructions

opportunities to employees in the entry-level positions.

- Most companies require a bachelor's degree or an associate degree and work experience to move up to positions such as greenhouse technician, greenhouse coordinator or greenhouse manager.
- Field workers may move up to field crew leader.
- Field technician, assistant farm manager or research assistant, would usually require a bachelor's degree. Most companies offer excellent education benefits and employees should consider these benefits when looking at advancement potential.
- Senior greenhouse and field positions in the research and supervisory area require at least a bachelor's degree.

Finding the Job

These jobs are found in agriculture and food companies, at greenhouses, farms, and agricultural research stations associated with colleges and universities and at some government agencies, such as the United States Department of Agriculture.

Jobs are often filled through employee referrals or walk-ins. Jobs may be listed on company websites, however this type of entry level job may not appear on Internet job listings. Jobs at universities and research institutes are often filled by hiring students or interns. Some jobs are filled through employment agencies that specialize in biotechnology or science jobs. Referrals from college professors and college employment offices are other sources of job leads.

Other Job Titles Include

- Field crew assistant
- Field crew member
- Greenhouse assistant
- Greenhouse helper
- Seed technician

Community College Programs

Community college courses are not usually needed for greenhouse and field worker jobs. College courses or an associate degree can help to get promotions.

Students interested in these programs and courses should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants get positions as greenhouse and field workers include:

- Agricultural biotechnology
- Agriculture
- Biotechnology
- Botany
- Crop science/crop production
- Horticulture
- Plant science

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- Good job for someone able to work under pressure in case of accident or hazardous spill
 - Usually requires a bachelor's degree
 - Salary \$40,000 to \$80,000 per year
 - Small number of positions, but biotech companies take safety very seriously

Health and Safety Specialist

Job Description and Work Conditions

A health and safety specialist plays a key role in ensuring that the biotechnology workplace is safe. One of the most exciting aspects of this job is being part of the emergency response team, which would include responding to hazardous spills, workplace accidents, fires, power outages, earthquakes, floods or any other emergency conditions. Since biotechnology laboratories and manufacturing plants work with hazardous chemicals and live bacteria and viruses, safety is essential. The role of the health and safety specialist can vary widely with the type of work performed in the biotechnology company. Health and safety specialists also work to protect the environment from hazardous spills, air and water pollution and radiation exposure.

Many health and safety specialists

- Are responsible for training other staff regarding safety regulations and emergency procedures. All employees in biotechnology companies must be trained in safe work practices and emergency procedures as required by company, state, and federal regulations.
- May perform the training or may coordinate other staff members or outside contractors to provide the training.
- Keep records of each employee's safety training and schedule safety drills and refresher courses as necessary.
- Write health and safety policies and procedures for the company. , health and safety specialists
- Respond, investigate, write reports and work to find ways to prevent future problems if an accident occurs.
- Are responsible for the safe use, storage, treatment, recycling and disposal of chemicals, biological materials or other waste materials and may also work directly with waste disposal contractors and keep accurate records of all waste removal and disposal.
- Inspect labs to make sure regulations are followed.

Health and safety specialists usually work indoors in laboratory or manufacturing settings. They may be required to work with hazardous materials, especially in the case of a spill or accident. Specialized protective clothing is sometimes required in this case. They may order,

inspect and maintain safety equipment and conduct monthly lab inspections.

Wages, Hours and Benefits

- **Entry-level wages: \$40,000 to \$50,000 per year** (usually higher in high-cost-of living areas)
- **Experienced health and safety specialists: \$50,000 to \$80,000 per year**

HOURS—Almost all health and safety specialists work 40 hours per week. Some jobs may be part-time, on-call, approximately 20-30 hours per week. Willingness to work overtime is important for job entry and in emergency situations. Many positions require specialists to be on call 24 hours a day for emergency response.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Employers prefer to hire applicants with a bachelor's degree in environmental science, safety, engineering, chemistry or hazardous material technology. Some positions accept degrees in life science or human resources.
- Most biotechnology employers look for applicants with one to two years experience as a safety technician, chemical or waste handler or inspector.
- An associate degree with college level chemistry courses and two to four years experience in toxic material handling in a lab or industrial setting is accepted in some jobs.
- A health and safety specialist must have very strong oral communication skills and be able to work with people at all levels of the company, especially in a crisis situation.

Technical Skills

- Certification may be required
- Computer skills
- Knowledge of emergency procedures
- Knowledge of health & safety regulations
- Knowledge of SOPs, GMPs, GLPs
- Problem solving/critical thinking
- Record keeping skills
- Technical writing
- Understand technical information

Personal Skills

- Detail oriented
- Organized
- Work as a team
- Work independently
- Work well under pressure

Basic Skills

- Advanced math
- Written and oral communication

- Written communication skills are also necessary since record keeping and report writing are essential parts of this job.
- Other qualifications employers look for include computer skills (spreadsheet, database and word processing), basic math and, in some cases, ability to operate equipment such as forklifts and company vehicles.
- Some jobs require lifting up to 50 pounds.
- Some employers prefer to hire certified health and safety specialists. Information on certification is available from the Institute of Hazardous Materials Management, www.ihmm.org, 11900 Parklawn Drive, Suite 450, Rockville, MD 20852, 301-984-8969; or from the Board of Certified Safety Professionals, www.bcsp.org, 208 Burwash Avenue, Savoy, IL 61874, 217-359-9263.

Career Advancement and Related Jobs

- A person may start as a waste handler or safety technician and receive either on-the-job training or a one year specialized certificate program in a field such as environmental hazardous materials technology while working.
- They then can become more specialized, be promoted to supervisory positions or become inspectors for government agencies such as the Occupational Safety and Health Administration or the Environmental Protection Agency.
- With appropriate background and experience the career ladder might also lead to field chemist and related positions. Promotion is often in-house and performance based.

Other Job Titles Include

- Biosafety specialist
- Compliance officer
- Environmental health and safety specialist
- Environmental health and safety technician
- Environmental health inspector
- Hazardous materials technician
- Health and safety officer
- Safety technician

Finding the Job

- Health and safety specialists and hazardous materials technicians are employed in *all areas* of biotechnology research and manufacturing.
- They work at agriculture and food companies, biotechnology companies, pharmaceutical companies, forensic laboratories and instrumentation manufacturers. They also work for hospitals, research institutes, universities and colleges.
- Waste management firms that have contracts with biotechnology companies and the suppliers of chemicals and other materials also hire health and safety specialists.
- In smaller companies, the tasks of a health and safety specialist may be part of another job

in the research and development, manufacturing or human resources area. Related jobs include inspectors who work for government agencies such as the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency and local health departments.

Applicants find out about jobs through Internet advertising, especially company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture and food or medical employment. Positions are also filled through employment agencies specializing in scientific jobs. Referrals from college professors and college employment offices are other sources of job leads. Many also fill openings by hiring walk-in applicants and referrals from employees.

Community College Programs

- Employers prefer to hire someone with a bachelor's degree for health and safety specialist positions.
- Often, skills for people already holding higher degrees can be obtained from a community or technical college.
- An associate degree that fulfills transfer requirements to a four year college is a good preparation.
- Many community colleges have transfer agreements with four year colleges and universities.

Community or technical college programs that can help applicants get positions as health and safety specialists include:

- **Biomanufacturing**
- **Bioprocessing technology**
- **Chemistry**
- **Engineering technology**
- **Environmental science**
- **Hazardous material technology**
- **Human resources**
- **Industrial biotechnology**
- **Life sciences**
- **Manufacturing technology**

Students interested in these programs and courses should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

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- A good job for a person with training or experience in electronics and an interest in biotechnology
 - Need certificate in instrumentation or associate degree in electronics, engineering or computers
 - Salary \$30,000 to \$60,000 per year
 - Problem solving skills important

Instrumentation/ Calibration Technician

Job Description and Work Conditions

Instrumentation/calibration technicians play an important and unique role in the biotechnology industry. These technicians work in all areas of biotechnology installing, inspecting, troubleshooting, maintaining and repairing the complex specialized equipment used in research and manufacturing.

Duties include:

- Calibrating instruments and performing validation studies to ensure that equipment is operating properly.
- In businesses that manufacture pharmaceuticals, validation studies are needed to ensure that equipment is operating exactly as planned to comply with government regulation of the process. This ensures that the drugs are pure and meet safety requirements.
- Using calculators, computers, testing devices and laboratory equipment. They also use electronic and mechanical instruments and engineering handbooks and other reference materials.
- Analyzing results and develop tests to ensure equipment is in proper working order.
- Perhaps developing specialized equipment needed to solve problems in the biotechnology industry.
- Being in charge of ordering and maintaining the spare parts inventory so that all instruments and machines can be repaired quickly and efficiently.
- Keeping detailed records and a maintenance log accurately recorded as part of every process the instrumentation/calibration technician performs.
- Technicians may also work as field service representatives, installing or maintaining specialized biotechnology instruments at a customer's worksite. As a field service representative, technicians may provide training to a customer's employees and advise them of proper procedures to use while running the equipment.

Instrumentation/calibration technicians work in research and development, production, or quality assurance departments. They may perform work in "clean rooms" where the temperature, humidity and dust content of the air are carefully controlled. All workers in clean

rooms wear masks, gloves, and protective clothing to ensure against contamination. The work may require lifting up to 50 pounds and working in tight or confined spaces, at heights or outside in all types of weather. Technicians may be exposed to a variety of chemicals.

Wages, Hours and Benefits

- **Entry level wages: \$30,000 to \$45,000 per year** (usually higher in high-cost-of living areas)
- **Experienced instrumentation/calibration technician: \$40,000 to \$60,000 per year**

HOURS—The standard work week for an instrumentation/calibration technician is 40 hours per week, Monday through Friday. Many companies, especially manufacturing plants that operate 24 hours per day, employ technicians on swing and night shifts, which usually pay more. Field service technicians may have the opportunity for additional overtime by being "on-call" to repair machinery during their off-time hours. This type of overtime is usually paid at time and one-half or double time.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Most employers require an associate degree in industrial engineering, engineering technician or electronics/instrument technology.
- Some employers also require one to three years experience.
- Technicians need to learn hands-on skills as well as math, electronic theory, electrical circuitry and digital and microprocessors computers.
- Knowledge of life science is also useful.
- Some employers accept experience in lieu of a degree.
- A four-year electronics technician apprenticeship program is also accepted by most employers.

Technical Skills

- Computer skills
- Knowledge of electronics
- Knowledge of SOPs, GLPs, GMPs
- Problem solving/critical thinking
- Record keeping skills
- Understand technical information

Personal Skills

- Detail oriented
- Good vision and color perception
- Lift up to 50 pounds
- Manual dexterity
- Observation skills
- Work independently
- Work well under pressure

Basic Skills

- Advanced math
- Written and oral communication

- An instrumentation/calibration technician must understand the electrical and mechanical aspects of the equipment and the biotechnology process in which it is used.
- Computer skills and knowledge of computer-aided manufacturing technology are also important.
- An applicant for a technician position should be detail oriented and be able to take the initiative to work independently.
- As a technician, a person must have good written and oral communication skills and be able to follow technical instructions in various forms including written, verbal, or technical schematics.
- Knowledge of GMPs and GLPs is important.
- Some employers prefer instrumentation/calibration technicians to be certified. Information about certification is available from the American Society for Quality, www.asq.org, 600 North Plankinton Avenue, Milwaukee, WI 53203, 800-248-1946; or from the National Institute for Certification in Engineering Technology, www.nicet.org, 1420 King Street, Alexandria, VA 22314, 888-476-4238.

Career Advancement and Related Jobs

- Instrumentation/calibration technicians who demonstrate skill and leadership ability may be promoted to supervisory or management positions.
- Some technicians may be interested in working in the field of laboratory automation, specializing in robotic and automated equipment controlled by computers.
- Instrumentation/calibration technicians may move into jobs that train other technicians and staff, such as instrumentation training specialist or managerial positions such as calibration, metrology and instrumentation manager. This often requires a bachelor's degree.
- Those who continue their education and earn a bachelor's degree or higher degree in engineering may advance to a wide range of professional engineering positions. Some may become technical service representatives or sales representatives for companies that manufacture instrumentation.

Other Job Titles Include

- Calibration lab technician
- Calibration specialist
- Electrical Instrumentation technician
- Electronics engineering technician
- Engineering technician
- Validation technician

Finding the Job

Applicants can find technician positions in every part of the biotechnology industry. Many work for companies that manufacture the scientific instruments used in the biotechnology industry. Technicians work in manufacturing plants or in research and development departments in biotechnology and pharmaceutical companies. They find positions in related companies such as agriculture and food processing, forensic laboratories, biofuel

manufacturing or pollution control agencies. Jobs are also available at hospitals, colleges, universities, research institutes and at government agencies.

- Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment.
- Some positions are filled through employment agencies that specialize in biotechnology, pharmaceutical or science companies.
- Other jobs are filled through referrals from employees and walk-in applicants.
- Referrals from college professors and college employment offices are other sources of job leads.

Community College Programs

An associate degree in electronic technology or biomedical electronics is good preparation for this position. It is also useful to take some life science courses or courses geared specifically toward biotechnology.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in Chapter 2.

Community or technical college programs that can help applicants get positions as instrumentation/ calibration technicians include:

- **Biomedical technology/engineering**
- **Biotechnology**
- **Electronic technology**
- **Engineering technician**
- **Industrial biotechnology**
- **Industrial technology**
- **Instrumentation**
- **Life sciences**
- **Manufacturing technology**

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- Entry level position in research and development for a person with college level courses in biology and chemistry
 - Many job openings for those with good laboratory skills
 - Good opportunity for advancement to laboratory technician
 - Salary \$20,000 to \$33,000 per year

Laboratory Assistant

Job Description and Work Conditions

Laboratory assistant is the true entry level position in the area of scientific research. Laboratory assistants

- Help researchers in the more routine and simple aspects of a project and prepare the materials used in experiments.
- Assist in discovering and testing new drugs, improving food crops and creating new industrial products.
- Are well supervised while they perform routine tests and well-defined procedures under close supervision.
- Weigh and measure chemicals used in a laboratory and preparing media, the mixture of chemicals needed to grow cells.
- Work with cells of animals, plants, bacteria or viruses.
- Sometimes prepare solutions and buffers for experiments.
- Maintain laboratory equipment and make sure supplies are available. They may also clean and sterilize glassware and keep the laboratory area clean.

A very important part of any laboratory position is making detailed measurements and observations using a variety of scientific equipment and keeping accurate records of their work.

- Under the direct supervision of research staff, more experienced assistants may also write reports or summaries of their work.
- A laboratory assistant must be able to follow Standard Operating Procedures (the exact steps to be taken in a scientific experiment) and Good Laboratory Practices.
- As laboratory assistants gain experience, they can be expected to carry out added responsibilities.
- With the experience and education, some laboratory assistants are specialized and trained to assist in more complex procedures such as preparing tissue cultures, protein purification, gel electrophoresis, growth of bacteria, plasmid preparation, or preparation of protein extracts. They may be required to use more advanced equipment or techniques to conduct research.

The work usually takes place in a laboratory at a private company, hospital, university or

research institute. Laboratory assistants frequently use hazardous chemicals and they may also use radioactive substances. They may work with disease causing organisms. Following safe work procedures is crucial to ensure the safety of employees and the success of the work. Laboratory assistants may work in a clean room where the temperature is cold and special clothing is worn to maintain sterile conditions. Some work outdoors, especially if working in agriculture.

Wages, Hours and Benefits

- **Wages range from: \$20,000 to \$33,000 per year (usually higher in high-cost-of living areas)**

HOURS—Most positions in this area are full-time. There are also positions available for part-time laboratory assistants. Some jobs may require working evenings and weekends, since some experiments or procedures run overnight or on weekends. Many laboratory assistant positions at colleges and research institutes are set aside as part-time jobs for students. Most biotechnology companies have internship programs (paid or unpaid) for students at the lab assistant level. These are usually part-time during the school year and full-time in the summer.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Laboratory assistant positions usually require at least an associate degree with a specialty in biotechnology or a life science.
- Math, chemistry and life science courses are essential. Some laboratory assistant jobs with simpler duties require a high school diploma, some college courses in biology and chemistry plus two to four years experience in a laboratory.
- Many companies will hire a laboratory assistant with a specialized certificate in biotechnology from a community college.
- Some prefer to hire assistants who already have a bachelor's degree in biology, biochemistry or molecular biology.
- Hands-on laboratory skills are very important in getting this position. The key

Technical Skills

- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs & GLPs
- Record keeping skills
- Understand technical information

Personal Skills

- Detail oriented
- Lift up to 50 lbs.
- Manual dexterity
- Observation skills
- Organized
- Work as a team

Basic Skills

- Advanced math
- Written and oral communication

skills a laboratory assistant needs are record keeping, work area organization, weighing and pipetting. These can be gained from laboratory skills classes, internships or previous experience working in a lab. Lifting up to 35 pounds may be required.

- Attention to detail is essential, as are good written and oral communication skills.
- Applicants with computer knowledge including database, spreadsheet and word processing experience are preferred.

Career Advancement and Related Jobs

- The laboratory assistant position is an excellent position in which to start a biotechnology career.
- With two or more years experience and an associate or bachelor's degree or concurrent enrollment in a bachelor's degree program, laboratory assistants may be promoted to laboratory technician.
- Promotion to research associate requires a bachelor's or master's degree. With a Ph.D., the career path could lead to a staff scientist position or other positions within the company.
- Advancement might also include specialization in a particular phase of research, such as media preparation or fermentation.
- A lab assistant can also move into the manufacturing area of a company as a manufacturing assistant or technician.
- Experienced lab assistants may also choose to move into the quality control/quality assurance field.

Finding the Job

Internships are often the first step for students to find laboratory assistant positions. This gives a student valuable experience, and also lets the employer meet a prospective job seeker

- Jobs are found in all areas of biotechnology research and development, including pharmaceuticals, agriculture and food, biofuels, environmental services, forensics and industrial products.
- here are also positions available at universities, colleges and research institutes.
- Positions are available at government agencies that conduct or regulate biotechnology research such as the FBI, National Institutes of Health, Department of Agriculture, Food and Drug Administration and Department of Health and Human Services.
- Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, medical, agriculture or science employment.

Other Job Titles Include

- Assistant media preparation technician
- Laboratory technical assistant
- Laboratory technician
- Media assistant
- Laboratory associate

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- Some positions are filled through employment agencies that specialize in biotechnology and science jobs.
 - Other jobs are filled through referrals from employees and walk-in applicants.
 - For jobs requiring college coursework, referrals from college professors and college employment offices are other sources of job leads.

Community College Programs

- Laboratory assistant positions usually require either an associate or bachelor's degree. For those already holding such degrees, community and technical colleges offer the courses in hands-on skills that a person may lack.
- Community colleges offer a variety of associate, certificate and transfer programs that prepare students for laboratory assistance positions. In addition, many community colleges have transfer agreements with four year colleges and universities.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants get positions as laboratory assistant include:

- **Agricultural biotechnology**
- **Agriculture**
- **Animal health technology**
- **Animal science**
- **Biological technician**
- **Biotechnology**
- **Chemical technology**
- **Chemistry**
- **Crop science**
- **Food science**
- **Laboratory science technology**
- **Life sciences**
- **Plant science**
- **Veterinary technology**
- **Zoology**

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- Excellent opportunities in research and development
 - Emerging area in biotechnology careers
 - Combines laboratory skills with computer and robotics knowledge
 - Salary is \$30,000 to \$60,000 per year

Laboratory Automation Specialist

Job Description and Work Conditions

In the past, most tasks in a biotechnology laboratory were carried out by laboratory technicians or assistants, who did each step in a research project by hand. Now, much of the work in biotechnology laboratories may be done by automated equipment and robots that are controlled by computers.

Laboratory automation specialists work with this specialized equipment.

- A common task using laboratory automation is high throughput screening (HTS). HTS is an automation technique used in biotechnology to conduct many tests very rapidly. It is used for screening new substances for drugs or other products or to find genes that might be worth studying.
- Laboratory automation is also used for DNA sequencing. Laboratory automation technologies also make some research safer by creating equipment that handles toxic or infectious materials.
- Laboratory automation involves working with the computers that control robots, automated laboratory equipment, liquid handling devices, and detectors.
- Laboratory automation specialists need an interest in biological science and lab work as well as excellent computer skills.
- Entry-level laboratory automation technicians usually perform routine tests using a variety of automated equipment.
- More experienced laboratory automation scientists or specialists plan experiments, program equipment and select which equipment is used. They analyze the data created by the automated equipment and give recommendations on further tests when promising results are found.

Automation specialists also work for the companies that manufacture automated laboratory equipment. They design the equipment and write computer programs that control how it runs. They also help scientists design and select the automated equipment for laboratories, help install it and train lab workers in how to use it. Automation specialists may also troubleshoot and repair equipment.

- Laboratory automation specialists usually work in a laboratory at a private company, hospital, university or research institute.
- The work environment may be a laboratory or office. Much of the time is spent at a

computer terminal and working directly with laboratory equipment.

- They frequently use hazardous chemicals and they may also use radioactive substances. They may work with disease causing organisms.
- Following safe work procedures is crucial to ensure the safety of employees and the success of the work.
- They may work in a clean room where the temperature is cold and special clothing is worn to maintain sterile conditions.

Wages, Hours and Benefits

- **Wages range from \$30,000 to \$60,000 per year (usually higher in high-cost-of living areas)**

Entry-level automation technicians earn wages at the lower end of this range. Wages vary quite a lot depending on the type, size and location of the employer and the level of education and experience. Larger companies usually pay more and universities tend to pay less.

HOURS—In general, laboratory automation specialists have regular weekday hours. However, some laboratory automation specialists work irregular hours to monitor equipment and may be on call for repairs. Overtime is paid or additional pay is given for certain shifts.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Entry level laboratory automation technician positions may be filled by applicants with an associate degree and one to two years experience.
- Most laboratory automation specialist positions require a bachelor's degree in biology, chemistry, biochemistry, engineering or computer science. Some employers prefer a master's degree.
- One to four years experience with laboratory science, computing, automation or robotics is also generally required.

Technical Skills

- Analyze/evaluate data
- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences & chemistry
- Knowledge of SOPs & GLPs
- Problem solving/critical thinking
- Understand technical information

Personal Skills

- Detail oriented
- Observation skills
- Organized
- Work as a team
- Work independently

Basic Skills

- Advanced math
- Written and oral communication

-
- Hands-on laboratory experience or computer programming experience is also required and may be gained through coursework, experience or internships.
 - Experience with a variety of precision laboratory equipment is required, depending on the job and industry.
 - Laboratory automation specialists need excellent math skills, at least through advanced algebra.
 - They must be able to follow detailed, technical instructions, carry out experiments precisely and analyze the resulting scientific data.
 - The ability to work carefully and accurately at tasks that are often repetitive is needed. At the upper levels, problem solving skills are important.
 - They need an understanding of Standard Operating Procedures (SOPs), and Good Laboratory Practices (the regulations that govern how laboratories operate).
 - They need good writing skills.

In addition it is important that these specialists have excellent computer skills and experience using a variety of computer programming languages in order to program automated laboratory equipment. They also need database, word processing and spreadsheet skills.

More information about the field of laboratory automation is available from the Association for Laboratory Automation, www.labautomation.org, 330 West State Street, Geneva, Illinois 60134, 888-733-1252.

Career Advancement and Related Jobs

- Entry level laboratory automation technicians may be promoted to specialist, research assistant or research associate positions with several years of experience.
- Laboratory automation specialist or research associate require at least a bachelor's degree in biology, chemistry, biochemistry, computer science or engineering. Some specialist jobs require a master's degree.
- To move from senior research associate to scientist position, a Ph.D. is usually needed.
- In an equipment manufacturing company, laboratory automation specialists may move into product director, project leader, or a management position.
- Laboratory automation technicians and specialists may also move to technical service representative, sales representative, and quality assurance or quality control positions.

Other Job Titles Include

- Automation biologist
- Automation Technician
- Automation tester
- Bio-automation specialist
- Laboratory Automation Scientist
- Laboratory technology specialist
- Research Assistant
- R & D Technologist
- Research instrumentation specialist

Finding the Job

Laboratory automation specialists can find job opportunities in a wide variety of biotechnology research and development areas that use automated equipment.

- Positions are available with companies that design automated equipment and the computer programs that are used with them.
- Positions are also available with biotechnology manufacturing and research companies, forensics and security companies, agriculture and food processing companies, biofuel companies, pharmaceutical companies, hospitals and clinics, colleges, universities and research institutions and government agencies.
- Laboratory automation specialist positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment.
- Some positions are filled through employment agencies that specialize in biotechnology and science companies.
- Other jobs are filled through referrals from employees and walk-in applicants.
- Referrals from college professors and college employment offices are other sources of job leads. Student interns may be offered a permanent position after graduation.

Community College Programs

- Entry level laboratory automation technician positions may be filled with applicants who have an associate degree.
- However most openings are at the specialist level, which generally requires a bachelor's degree.
- People already holding post baccalaureate degrees can find the appropriate hands-on coursework at community and technical colleges.
- Courses in both life science and computer science is essential.
- Many community and technical colleges have transfer agreements with four year colleges and universities.
- Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings.
- Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants get positions in the laboratory automation area include:

- **Biomedical technology/engineering**
- **Biomanufacturing**
- **Biopharmaceutical manufacturing**
- **Biotechnology**
- **Computer science**
- **Electronics**
- **Engineering technology**
- **Industrial biotechnology**
- **Life sciences**

-
- A true entry level job in biotechnology laboratories
 - Requires high school diploma
 - Good opportunities for advancement in larger companies for those with college science background
 - Salary \$16,000 to \$25,000 per year

Laboratory Support Worker

Job Description and Work Conditions

Laboratory support workers care for the important glass and plastic ware used in laboratories. Without their work, other lab workers cannot trust results of experiments and products. If the glassware that a laboratory needs is not available, it will hold up entire days of work. Lab support workers

- Wash, dry, sterilize and restock glassware and plastic ware.
- Pick up used glassware from laboratories and bring it to the glass-washing facility.
- Carefully and completely clean the glassware and sterilize it using an autoclave.
- Test cleaned glassware for sterility, then return it to the laboratories and place it on proper shelves.
- Keep records of the equipment that is used and cleaned.
- Document the use of equipment and maintain the glass-washing facility, keeping it clean and organized.
- Perform routine maintenance of glass-washing equipment.
- May be responsible for keeping inventory of glassware and making sure that glassware supplies are ordered when needed.
- May clean labs and order routine supplies. It is especially important to keep on schedule.

A laboratory support worker works under the direct supervision of other trained staff. This position may require considerable time standing, stooping and lifting. Glassware pick-up and restocking may involve pushing a utility cart. They may work in a clean room which requires special protective clothing.

Wages, Hours and Benefits

- **Wages range from \$16,000 to \$25,000 per year (usually higher in high-cost-of living areas)**

HOURS—Most positions are full time, 40 hours per week, Monday to Friday. Some part-time or shift work may also be available.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life

and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Many people have entered the biotechnology field as a lab support worker.

Qualifications, Skills and Training

- This position requires a high school diploma.
- Most companies look for a dependable worker with a good work ethic for this true entry-level job.
- Some companies also look for six months to two years experience in a manufacturing or laboratory setting.
- Many companies look for high school or college level coursework in life science, math and chemistry.
- Interested persons should be detail-oriented, have good written and oral communication skills and be able to understand and follow directions in an accurate and thorough manner.
- Laboratory support workers must be able to maintain accurate records and read, prepare and date labels.
- Computer experience in spreadsheet, word processing or email programs may be desirable in some positions. Ability to lift up to 30 pounds may be required.

Career Advancement and Related Jobs

- This is an entry-level position in biotechnology where many people get a start.
- Although the duties of the job require only a high school diploma, many companies fill the position with people who have some college or an associate degree.
- Career advancement usually requires an associate or bachelor's degree.
- With an associate or bachelor's degree, this is a job that can lead to a position as a laboratory assistant, laboratory technician or manufacturing assistant.

Technical Skills

- Record keeping skills

Personal Skills

- Detail oriented
- Lift up to 50 lbs.
- Manual dexterity
- Organized
- Perform routine, repetitive work

Basic Skills

- Read and follow instructions
- Written and oral communication

Other Job Titles Include

- Clean room technician
- Cleaning technician
- Equipment preparation technician
- Glasswasher
- Laboratory aide
- Laboratory assistant
- Laboratory helper
- Laboratory support technician

Finding the Job

- Jobs are available in biotechnology companies, agriculture and food companies, forensic laboratories, universities and colleges, research institutes, hospitals, government agencies such as the Department of Agriculture, National Institutes of Health, companies that specialize in environmental services and industrial product manufacturers.
- Positions are frequently filled through word of mouth or walk in applicants.
- Jobs may be listed on the Internet, especially on biotechnology company sites, but entry level jobs are sometimes not listed.
- Some positions are filled through temporary agencies that specialize in biotechnology and science companies.
- University jobs are often filled through student work-study programs. Students often learn of these jobs from instructors or college employment offices.
- Community and technical college instructors often know where to find these jobs.

Community College Programs

Community college courses are not generally required for laboratory support workers. However, college courses or an associate degree can help in getting promotions and higher level jobs.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs and courses that can help applicants get higher level biotechnology positions :

- **Animal science**
- **Biotechnology**
- **Chemistry**
- **Crop science/crop production**
- **Food science/food processing**
- **Life sciences**
- **Plant science**

Laboratory Technician

- Large number of job openings in biotechnology companies
- Need excellent laboratory skills and a college science background
- Salary \$23,000 to \$60,000 per year
- With bachelor's degree, excellent opportunities for advancement

Job Description and Work Conditions

Laboratory technicians work on experiments and procedures in biotechnology research. With their strong scientific background, laboratory technicians work directly with scientists on projects that seek to cure diseases, improve crops or clean up environmental pollution.

Responsibilities differ depending on the type of laboratory in which a technician works.

- In the pharmaceutical industry, technicians work on developing and testing new drugs.
- In the field of agriculture, technicians may genetically modify a plant by "shooting" pieces of DNA into a leaf using high pressure gas.
- Technicians may also test for environmental pollution in soil or water samples.
- Some work in the area of agriculture or food science to improve crops or find treatments for animal diseases.

Generally, laboratory technicians:

- Must be able to follow directions with great accuracy. These directions often are in the form of Standard Operating Procedures (SOPs), which give the exact steps to follow in a laboratory.
- Take great care to keep the work area clean since any contamination of cell cultures with foreign material can ruin an experiment.
- Are aware of and follow Good Laboratory Practices (the regulations that govern how laboratories operate).
- Use recombinant DNA techniques on plants, animals, bacteria or viruses. DNA technicians perform experiments, analyze data and produce graphs using computer software.
- Must have knowledge of molecular biology and be able to perform basic molecular biology procedures. These methods include polymerase chain reactions (PCR), cloning, sequencing, plasmid preparation and tissue culture work. They often work with gels, solutions and sequencers.
- Maintain cultures of a specific line of cells that are being used in an experiment. Some laboratory technicians work with plants and animals as part of the experiments they carry out.

Entry-level laboratory technicians usually perform routine tests and well-defined procedures under close supervision. They may also perform other assignments such as equipment maintenance, stocking supplies and laboratory cleaning.

With more experience, a technician may handle more unusual or specialized procedures. They may also interpret data, calculate and record results, develop conclusions, troubleshoot and recommend changes to procedures under the supervision of a scientist. In some cases they may help develop new procedures or techniques.

- They usually work in a laboratory at a private company, hospital, university or research institute.
- They frequently use hazardous chemicals and they may also use radioactive substances.
- They may work with disease causing organisms and must follow safe work procedures.
- They may work in a clean room where the temperature is cold and special clothing is worn; or in labs; or outdoors, especially if working in agriculture.

Wages, Hours and Benefits

- **Entry level wages: \$23,000 to \$35,000** (usually higher in high-cost-of living areas)
- **Experienced laboratory technician: \$30,000 to \$60,000**

Laboratory technician wages vary a lot depending on the type, size and location of the employer and the level of education and experience of the technician. Technicians with a bachelor's degree will earn higher wages than those with an associate degree. The highest wages are earned by laboratory technicians with many years of experience. Larger companies usually pay more and universities tend to pay less.

HOURS—In general, technicians have regular weekday hours. However some laboratory technicians work irregular hours to monitor experiments that cannot be completed during regular working hours. In large hospitals, independent laboratories that operate continuously, and some production/manufacturing settings, shift work is common. In some cases, overtime is paid or additional pay is given for certain shifts.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Most employers look for a bachelor's degree in biology, biochemistry or molecular biology when hiring laboratory technicians.
- Some positions accept degrees in chemistry, chemical engineering, biomedical engineering, environmental science, genetics, food science, microbiology or other related majors.

- Some employers will hire applicants with an associate degree in biotechnology, but usually require two or more years experience as a laboratory assistant.
- Hands-on laboratory experience is crucial to this position and may be gained through coursework, experience or internships.
- The most common basic laboratory skills that employers look for are record keeping, work area organization, weighing and pipetting.
- Technicians also need to be able to operate a variety of precision laboratory equipment, depending on the job and industry.
- Technicians need excellent math skills, at least through advanced algebra.
- They must be able to follow detailed, technical instructions, carry out experiments precisely and analyze the resulting scientific data.
- The ability to work carefully and accurately at tasks that are often repetitive is needed. At all levels, problem solving skills are important.

Technical Skills

- Analyze/evaluate data
- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs & GLPs
- Problem solving/critical thinking
- Understand technical information

Personal Skills

- Detail oriented
- Lift up to 50 lbs.
- Observation skills
- Organized
- Work as a team
- Work independently

Basic Skills

- Advanced math
- Written and oral communication

Laboratory technicians need good writing skills, since the laboratory notes can be considered legal documents, especially when working on new drugs in the pharmaceutical industry. In addition it is important that technicians have strong computer skills especially database, word processing and spreadsheet.

Career Advancement and Related Jobs

- Laboratory technicians are often promoted into this position from a laboratory assistant job when they are enrolled in a four year college or earn a bachelor's degree.
- From here, with several years of experience, they may move into the research assistant or research associate position. The research associate position requires a bachelor's degree and may require a master's degree in biology, biochemistry, molecular biology or another related field.
- To move from senior research associate to staff scientist, a Ph.D. is usually needed.
- Most biotechnology companies offer excellent education benefits, including tuition reimbursement, to help an employee to gain the needed training to move to the next level job.
- Laboratory technicians may also move to positions such as technical service representative, sales representative, manufacturing technician, quality assurance or quality control positions.

Finding the Job

Laboratory technicians can find job opportunities in

- Biotechnology manufacturing and research companies,
- Agriculture and food companies,
- Pharmaceutical companies,
- Environmental services companies,
- Product manufacturers and biofuel companies.
- Hospitals, universities, colleges and research institutes.
- Government agencies involved in biotechnology research and regulation like the

FBI, National Institutes of Health, Department of Agriculture, Department of Health and Human Services, Food and Drug Administration and the Department of Agriculture.

New technicians may find a first job through employment agencies specializing in the biotechnology industry. Students are often hired to fill laboratory technician positions at colleges and universities. Temporary placements often lead to permanent jobs. Most employers advertise openings on the Internet, at their company sites or Internet sites dedicated to biotechnology, science, pharmaceutical or medical employment. Employees are also recruited through referrals from employees. Jobs are also listed at college employment centers, and instructors frequently refer students for jobs. Student interns may be offered a permanent position after graduation.

Community College Programs

Laboratory technicians usually need a bachelor's degree, but some employers will hire applicants with an associate degree with a biotechnology major or specialization. Many community colleges offer either programs or courses in biotechnology. An associate degree with a life science major is excellent preparation for transfer to a four year college to earn a bachelor's degree. Many people with higher degrees obtain hands-on skills at community and technical colleges for this job.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. For more information see **Chapter 2.**

Other Job Titles Include

- Agricultural and food technician
- Assay analyst
- Biology technician
- Chemical laboratory technician
- DNA sequencing technician
- Laboratory assistant
- Laboratory technologist
- Media preparation technician
- Process development technician
- Product development technician
- Research and development technician
- Science technician
- Technical assistant

Community or technical college programs that can help applicants get positions as a laboratory technician include:

- Agriculture/Agricultural biotechnology
- Animal science
- Biological technician
- Biomedical technology
- Biotechnology
- Chemical technology
- Chemistry
- Crop science
- Environmental science
- Food science
- Laboratory science technology
- Life science
- Plant science

Manufacturing Assistant

- Entry level position in manufacturing for a person with a high school diploma
- With college courses, opportunities to advance in manufacturing or research and development areas
- Jobs in every area of biotechnology
- Salary \$18,000 to \$30,000 per year

Job Description and Work Conditions

A manufacturing assistant works on manufacturing the products of biotechnology. The duties of each job vary depending on the type of manufacturing being done.

- Most manufacturing assistants work in large scale product manufacturing, often in pharmaceuticals.
- Some may work in small scale pilot plants, creating smaller amounts of products used for testing safety and effectiveness or a best manufacturing method.
- Manufacturing assistants work with fermentors or bioreactors that are used to produce drugs or enzymes for industry use, or food products such as soy sauce.
- They may help produce biodiesel and ethanol from plants.
- Some work at companies that specialize in instruments or supplies.

Manufacturing assistants usually work in one of three main areas.

1. Fermentation: in a clean room, they weigh and measure chemicals and raw materials for the manufacturing process and monitor the fermentation process.
2. Aseptic Fill: they set up and operate equipment used to manufacture and package final products, such as operating the machine to fill a sterile tube or bottle.
3. Packaging and Labeling: they package final products in boxes and operate machines that attach safety seals.

Biotechnology manufacturing jobs are usually divided into “upstream” processes, the early part of manufacturing when proteins are produced by cells in the fermentation process, and “downstream” processes, to fill and package the final product for sale.

- They clean equipment and perform routine maintenance to ensure that equipment remains in good working order.
- They must maintain accurate and detailed records.
- They may work in a clean room environment where conditions include 50-degree temperatures and wear specialized clothing to maintain a sterile environment.
- Their work may involve standing for many hours each day.
- They may be exposed to disease causing bacteria or viruses or poisonous chemicals. Safety procedures are crucial.

Wages, Hours and Benefits

- **Wages range from \$18,000 to \$30,000 per year (usually higher in high-cost-of living areas)**

HOURS—Most manufacturing is done in batches on a rotating schedule. Manufacturing plants usually operate 24 hours a day and shift work is common. Companies often hire temporary employees during periods with large production runs.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- When hiring for a manufacturing assistant position, employers usually require a high school diploma or GED, and most prefer high school math and science classes.
- Some companies prefer an associate degree in a life science field such as biotechnology, biology, microbiology, biochemistry or biomanufacturing.
- Employers usually look for people with one to two years of experience in either a sterile manufacturing environment or other related manufacturing work. Experience in food, cosmetics or pharmaceutical manufacturing is preferred.
- Manufacturing assistants must be certified in Good Manufacturing Practices (GMPs) and Standard Operating Procedures (SOPs), although many employers will train applicants in GMPs and SOPs upon hiring them.
- Knowledge of computer database, spreadsheet or word processing programs may be required for some jobs.

Technical Skills

- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs, GLPs, GMPs
- Manufacturing skills
- Record keeping skills
- Understand technical information

Personal Skills

- Detail oriented
- Lift up to 50 lbs.
- Mechanical ability
- Perform routine, repetitive work
- Work as a team

Basic Skills

- Basic math
- Read and follow instructions
- Written and oral communication

Career Advancement and Related Jobs

- Manufacturing assistants with an aptitude for the manufacturing process may be promoted to manufacturing technician.
- A bachelor's degree in a life science and experience are required to be promoted to positions such as manufacturing associate, senior manufacturing technician, supervisory or

management positions.

- Manufacturing assistants who have college coursework in science may have the opportunity to move into laboratory assistant positions in the research and development area.
- Some manufacturing assistants may move into quality control or quality assurance positions. A background in manufacturing may also be a good background for people interested in positions as a sales representative or technical service representative.

Finding the Job

Jobs are located in every area of biotechnology that sells a product, including pharmaceuticals, food and agriculture, instrumentation, biofuel, environmental services, industrial enzymes and other products of biotechnology. Some jobs are available in research and development companies to work at pilot plants to test products and manufacturing techniques; but for pilot plants, employers usually prefer to hire people with experience.

Most employers advertise openings on the Internet at their company sites or other Internet sites dedicated to jobs in pharmaceutical, scientific or biotechnology companies. Job seekers frequently find first jobs through employment agencies specializing in biotechnology, pharmaceutical or science jobs. Companies fill jobs from employee referrals and walk-in applicants. Students often learn of jobs from college instructors or college employment offices. Students interns may be hired into permanent positions after completing their college program.

Community College Programs

- Community and technical college courses are not generally required for manufacturing assistant positions.
- Some employers prefer some college courses or an associate degree.
- College courses or an associate degree can also help in getting promotions to manufacturing technician and higher level jobs.
- Students interested in these programs should check with representatives of the local community or technical college to find out

Other Job Titles Include

- Aseptic fill assistant
- Cell culture and fermentation assistant
- Cell lab operator
- Manufacturing operator
- Media preparation assistant
- Operator
- Packaging and filling inspector
- Production assistant
- Purification assistant

Community or technical college programs that can help applicants get positions as a manufacturing assistant include:

- Biomedical technology/engineering
- Biopharmaceutical manufacturing
- Bioprocessing
- Biotechnology
- Biotechnology manufacturing
- Chemical technology
- Chemistry
- Food science
- Industrial biotechnology
- Life sciences
- Quality control

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- A good job for a person with science background and interest in working in a manufacturing environment
 - Usually requires at least some college with science and math classes
 - Salary is \$25,000 to \$60,000 per year
 - Excellent opportunities for advancement

Manufacturing Technician

Job Description and Work Conditions

Manufacturing technicians are the people who actually make the products that are sold by biotechnology companies. Manufacturing technicians work in many different industries and produce a wide variety of products. In all of these areas, manufacturing technicians work in large scale manufacturing plants or at pilot plants where small amounts of a product are made to be used for testing, research, or clinical trials.

- They work for pharmaceutical companies that make drugs or diagnostic/testing kits for diseases.
- They produce enzymes to manufacture products such as laundry detergents.
- They make food products such as soy sauce, high fructose corn syrup and food additives.
- They work for companies that make equipment, supplies and biological materials.
- A growing area of biotechnology is the biofuel industry, where they make biodiesel and ethanol from plants.

Manufacturing technicians may work on one or several of many steps in biotechnology manufacturing. Entry level technicians usually work under close supervision. An experienced manufacturing technician may oversee production and be able to troubleshoot and work in a less supervised environment. Biotechnology manufacturing jobs are usually divided into “upstream” processes, the early part of manufacturing when proteins are produced by cells in the fermentation process, and “downstream” processes, to fill and package the final product for sale.

1. Fermentation: in a clean room, they weigh and measure chemicals and raw materials for the manufacturing process and monitor the fermentation process. They sterilize equipment to be used in growing the cells in the fermentor. They oversee the work of manufacturing assistants.
2. Aseptic Fill: they set up and operate equipment used to manufacture and package final products, such as operating the machine to fill a sterile tube or bottle.
3. Packaging and Labeling: they package final products in boxes and operate machines that attach safety seals.

Manufacturing technicians use a wide variety of equipment, include automated and robotic equipment.

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- They also perform routine maintenance on the equipment, general laboratory work and maintain the facilities used in these processes.
 - Technicians ensure that batches of a product contain the proper ingredients and quantities.
 - They monitor the equipment during the production phase to make sure that it is running according to Standard Operating Procedures and Good Manufacturing Practices. This helps avoid mistakes which are costly to the company in supplies, lost time and the lost cost of the product that cannot be sold. This is particularly important in the pharmaceutical industry. A drug must be produced using the exact procedures that have been approved by the FDA.

Wages, Hours and Benefits

- **Entry level wages: \$25,000 to \$40,000 per year (usually higher in high-cost-of living areas)**
- **Experienced manufacturing technicians: \$35,000 to \$60,000 per year**

Wages are quite variable, and often depend on the amount of education the company requires. Wages for manufacturing technicians with a bachelor's degree and biotechnology courses are usually higher. Highly experienced manufacturing technicians may earn more than \$60,000 per year, with a bachelor's degree and many years experience.

HOURS—Most manufacturing positions are full-time, 40 hours per week. Some manufacturing plants work 24 hours, seven days a week, so shift work is required. Biotechnology companies frequently hire manufacturing technicians in temporary positions.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Entry requirements for manufacturing technician positions are variable.
- Some employers hire technicians with a high school diploma and two to four years of experience as a manufacturing assistant.
- Others require college coursework or an associate degree in biotechnology or a related science major and one to three years experience.
- Specialized coursework in a college-level biotechnology program is very helpful, even for people who have a bachelor's degree in a related field.
- Math coursework through algebra is generally required.
- Some employers prefer manufacturing technicians to have a bachelor's degree. Experience in manufacturing or a laboratory is usually required.

- Attention to detail is extremely important in this job.
- Knowledge of laboratory practices and of Good Manufacturing Practices (GMPs) and Standard Operating Procedures (SOPs) are essential to all manufacturing technicians.
- Strong oral and written communication skills and accurate record keeping are also essential.
- These jobs often require the ability to lift between 30 to 50 pounds and stand for long periods of time.
- Computer skills including database, spreadsheet, word processing and Internet use are important in many positions.

Career Advancement and Related Jobs

- Manufacturing technicians may move to manufacturing associates, manufacturing research associates, lead technicians and supervisory positions in manufacturing.
- Others move into process development, production planner or scheduler positions. With experience, they may move to quality control or quality assurance technician positions.
- of these positions require an associate or bachelor's degree and several years experience.
- Some manufacturing technicians move to technical services representative or sales positions.
- Others move into research and development positions such as laboratory technician, or with a bachelor's degree, research associate.

Finding the Job

Jobs are located in every area of biotechnology that sells a product, including pharmaceuticals, food and agriculture, instrumentation, biofuel, environmental services, industrial enzymes and other products of biotechnology.

There are some jobs available in research and development companies to work at pilot plants to test products and manufacturing techniques. When hiring for pilot manufacturing plants, employers usually prefer to hire people with experience, which can be obtained at the larger manufacturing plants.

Positions are frequently listed on the Internet, especially on biotechnology company sites and

Technical Skills

- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs & GMPs
- Manufacturing skills
- Problem solving/critical thinking
- Record keeping skills
- Understand technical information

Personal Skills

- Detail oriented
- Lift up to 50 lbs.
- Mechanical ability
- Organized
- Work as a team
- Work independently

Basic Skills

- Advanced math
- Written and oral communication

web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment.

New technicians frequently find first jobs through employment agencies specializing in biotechnology, medical or science jobs.

Other jobs are filled through referrals from employees and walk-in applicants. Temporary placements often lead to permanent jobs.

For jobs requiring college coursework, referrals from college professors and college employment offices are other sources of job leads. Student interns are frequently hired into permanent positions.

Community College Programs

Most employers look for some college courses or an associate degree in biotechnology for manufacturing technician jobs. Some employers prefer a bachelor's degree. All community colleges offer transfer programs to four year colleges. College courses or an associate degree can also help in getting promotions to higher level jobs.

People already holding associate or higher degrees often enroll in community and technical college courses to obtain the industry-required hands-on skills.

People interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Other Job Titles Include

- Aseptic fill technician
- Assay analyst
- Bioprocess technician
- Cell culture and fermentation technician
- Chemical process technician
- Formulation and fill technician
- Manufacturing associate
- Manufacturing operator
- Packaging technician
- Plant technician
- Process operator
- Process technician
- Production associate
- Purification technician

Community or technical college programs that can help applicants get positions as a manufacturing technician include:

- Biomedical technology/engineering
- Biopharmaceutical manufacturing
- Bioprocessing
- Biotechnology
- Biotechnology manufacturing
- Chemical technology
- Chemistry
- Food science
- Industrial biotechnology
- Life sciences
- Quality control

-
- **Entry level job** requires high school diploma, strength to lift packages
 - Can advance to various positions by taking advantage of education benefits
 - A good way to learn about a company's products
 - Salary \$16,000 to \$25,000 per year

Material Handler

Job Description and Work Conditions

The material handler position is an excellent entry-level position for high school graduates. After learning about the products a company develops, material handlers can move into many different jobs within a biotechnology company.

- Material handlers usually work in a warehouse setting, either packaging and loading finished biotechnology products for outside distribution or unpacking and checking arriving packages to ensure contents are accurate and in good condition.
- In loading and unloading trucks, material handlers may be exposed to weather conditions. They may also work in cold rooms or freezers where products are stored. Products may include chemicals or other hazardous materials, so following safety procedures is extremely important.
- Many products that are shipped by biotechnology companies need to be in controlled environments and must be shipped and received within a limited amount of time. This includes shipping some items at room temperature and others so they stay cold or frozen until delivered.
- The material handler must be able to understand instructions so orders are packed correctly and shipped by the appropriate method. Some perishable items will need to be shipped for same day or next day delivery, while other types of equipment or chemicals may be shipped by other methods.
- Administrative tasks are involved with this position as well, including filling out purchase order forms, checking goods against purchase orders and invoices, maintaining paperwork and keeping track of inventory.
- Keeping the work area clean and organized is required.
- The material handler is responsible for rejecting unsatisfactory goods when necessary.
- All material handlers are expected to be able to lift heavy objects and stand for long periods of time.
- Most are required to operate a variety of power and mechanical equipment including hand trucks, forklifts, mailing machines and loading conveyors. Bar code scanners and computers are used to track inventory.

Wages, Hours and Benefits

- **Wages range from \$16,000 to \$25,000 per year** (usually higher in high-cost-of living areas)

Material handlers with many years of experience may earn up to \$30,000 per year.

HOURS—The standard workweek for material handlers is 40 hours per week, Monday through Friday. Many companies, especially manufacturing plants that operate 24 hours per day, employ material handlers on swing and night shifts, which usually pay more.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- The entry-level material handler position requires a high school diploma or equivalent and up to two years of warehouse or shipping experience.
- Most companies look for a dependable worker with a good work ethic.
- Material handlers must be able to follow detailed instructions, keep accurate records, meet deadlines and follow standard company policy and safety regulations.
- The successful job seeker will have the ability to speak, read and write English and be able to perform basic math functions.
- The ability to lift up to 50 pounds and perform physically demanding work is essential. Prior experience as a forklift operator and certification may be desirable.
- Experience in computer operations and applications is usually needed.
- Training in chemical handling/dispensing and hazardous materials are preferred.
- A driver's license is required for some positions.

Technical Skills

- Basic computer skills
- Operate a forklift
- Record keeping skills

Personal Skills

- Detail oriented
- Lift up to 50 pounds
- Organized
- Perform physically demanding work
- Perform routine, repetitive work

Basic Skills

- Basic math
- Read and follow instructions

Career Advancement and Related Jobs

Material handlers who take advantage of company education benefits can obtain an associate degree and have a variety of advancement options. They may become material or inventory specialists responsible for inventory control procedures. The material specialist assumes the lead role in coordinating the day to day activities of the warehouse. Material specialists are

responsible for ensuring that incoming deliveries are correct and then distributing raw materials within the company.

By obtaining an associate degree in a life science or in biotechnology, a material handler may be able to transfer into the research and development area of a company as a lab support person or lab assistant. By continuing their education to receive a bachelor's degree, a person can advance to the lab technician or research associate level. A material handler may also be able to move into a manufacturing assistant position such as packaging and filling operations. By obtaining an associate degree in business administration or logistics with basic science, the advancement path might lead toward a supervisory or management role in shipping and receiving or in logistics within a biotechnology company.

Finding the Job

- Positions are available at every type of biotechnology companies involved in both manufacturing and research and development, including pharmaceutical companies, agriculture and food companies, local and state law enforcement agencies, private forensic laboratories, instrumentation manufacturing companies, environmental services companies and industrial product manufacturers.
- Material handlers work at universities, colleges, research institutes and hospitals. Positions are available at government agencies such as the Food and Drug Administration, Department of Agriculture or National Institutes of Health.
- Employers often fill these jobs through referrals from current employees and walk-in applicants. Some employers advertise openings on the Internet at their company sites or other Internet job listing sites, although entry level positions such as material handlers are sometimes not included on websites. Job seekers may find first jobs through temporary agencies specializing in the biotechnology industry. These often lead to permanent jobs. Students often learn of jobs from college instructors or college employment offices.

Other Job Titles Include

- Inventory specialist
- Material specialist
- Order filler
- Packer
- Shipping & packaging operator
- Shipping & receiving specialist
- Warehouse worker

Community College Programs

Community college courses are not generally required for material handlers. However, college courses or an associate degree can help to get promotions or higher level jobs. All community colleges offer courses in reading, writing and math skills, which are required for entry-level jobs in this field.

Students interested in these programs and courses should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants move into higher level jobs include:

- Biotechnology
- Hazardous materials technology
- Life sciences
- Logistics
- Quality control

Quality Assurance Specialist

- Good career using laboratory, biotechnology and data analysis skills in a manufacturing environment
- Usually requires a bachelor's degree
- Excellent promotional opportunities
- Salary is \$40,000 to \$80,000 per year

Job Description and Work Conditions

Quality assurance specialists monitor the process of manufacturing biotechnology products to ensure that the process is carried out properly. Quality assurance is an important job in every biotechnology industry, especially in the pharmaceutical industry where companies must comply with laws and regulations that have been developed to protect the public. When the FDA approves a drug to be sold, it not only approves the composition of the drug, it also approves the exact process by which the drug is made and the equipment used to produce the product. Accurate record keeping is a very important aspect of all quality assurance specialists' jobs. Gathering and analyzing data, preparing reports and making recommendations for changes and improvements are all part of this job.

Quality assurance specialists

- Work in biotechnology manufacturing to ensure that company standards and government regulations are followed.
- Check equipment to make sure it is operating properly within required specifications. This includes monitoring such things as sterilization, operating temperatures and water quality.
- Verify that the equipment is properly installed and maintained.
- Inspect storage areas to make sure conditions are appropriate to protect the quality of the materials that are stored.
- Work in "process validation" where they check that every step in the production process is followed precisely as written in Good Manufacturing Practices (GMPs).
- Document and sign off every step of the manufacturing process as well. If there are differences from the established practices, they must document when and why they occurred.
- Quality assurance computer validation technicians specialize in testing computers that are used in the manufacturing process. They make sure that the computer programs work exactly as planned and do not lose or change data.

Quality assurance specialists may work in laboratories, manufacturing facilities or storage areas. Quality assurance specialists may perform work in "clean rooms" where the temperature, humidity and dust content of the air are carefully controlled. All workers in clean rooms wear masks, gloves, and protective clothing.

Wages, Hours and Benefits

- **Entry-level wages: \$40,000 to \$60,000 per year** (usually higher in high-cost-of living areas)
- **Experienced quality assurance specialists: \$50,000 to \$80,000 per year**

Some entry level positions for quality assurance inspectors and validation technicians pay \$25,000 to \$40,000 per year. Salaries will be higher for those with more experience, and for supervisory positions.

HOURS—Some overtime, weekends and evening work might be required. Shift work may be involved in the manufacturing setting.

BENEFITS—Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

- Most employers require a bachelor's degree in biology, biochemistry, engineering or computer science and up to three years related experience.
- Some employers will accept an associate degree plus two to four years experience in a manufacturing environment. In some cases, education may be substituted for experience if the student has taken courses that involve laboratory work.
- Some entry-level quality assurance inspector and validation technician positions require a high school diploma and one to two years experience in manufacturing.
- Good lab skills, attention to detail and excellent organizational skills are needed for this job.

Those with experience in Good Manufacturing Processes or other areas of quality control have the best chances for employment.

Computer validation positions require knowledge of computer programs and systems.

- Employers look for candidates who are able to follow instructions, understand procedures, and work independently as well as in a team.

Technical Skills

- Analyze/evaluate data
- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/ chemistry
- Knowledge of SOPs, GMPs, GLPs
- Problem solving/critical thinking
- Record keeping skills
- Technical writing
- Understand technical information

Personal Skills

- Detail oriented
- Observation skills
- Organized
- Work as a team
- Work independently

Basic Skills

- Advanced math
- Written and oral communication

-
- A strong focus on detail and quality is essential.
 - Oral and written communication skills are important, so that quality issues and recommendations are explained clearly and communicated to supervisors and management.
 - Experience in the compliance and documentation area is often required.

Some employers prefer to hire quality assurance specialists who are certified. Information about certification is available from the American Society for Quality, www.asq.org, 600 North Plankinton Avenue, Milwaukee, WI 53203, 800-248-1946.

Career Advancement and Related Jobs

- Some entry level positions exist for validation technicians or quality assurance inspectors.
- Generally, a bachelor's degree is needed to advance to quality assurance specialist, though some companies will promote with a high school diploma or associate degree and several years of experience.
- From quality assurance specialist, a worker can move into a more advanced and eventually a supervisory position.
- On the manufacturing side of biotechnology, the possibility of advancing without further education is much higher than on the research side where advancement usually requires a bachelor's or master's degree.

A person in quality assurance who is interested in other aspects of biotechnology such as management, marketing or research might gain experience and/or continue their education and move into one of these areas.

Finding the Job

- Quality assurance positions are found in all areas of biotechnology.
- The largest number of quality assurance jobs are found in biotechnology companies that manufacture pharmaceuticals.
- Positions are available with agriculture and food companies, biofuel manufacturers, local and state law enforcement agencies, private forensic laboratories, instrumentation manufacturing companies, companies that specialize in environmental services and industrial product manufacturers.
- Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment.
- Some positions are filled through employment agencies that specialize in biotechnology, pharmaceutical, medical or science companies.

Other Job Titles Include

- Quality assurance associate
- Quality assurance inspector
- Quality assurance technician
- Quality auditor
- Quality systems validation technician
- Validation specialist
- Validation technician

-
- Other jobs are filled through referrals from employees and walk-in applicants.
 - For jobs requiring college coursework, referrals from college professors and college employment offices are other sources of job leads.
 - Employees may be promoted into quality assurance from positions such as manufacturing technician or laboratory technician.

Community College Programs

Quality assurance specialist positions usually require at least a bachelor's degree. Many community colleges have transfer agreements with four year colleges and universities. An associate degree is accepted for some jobs.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants get positions in the quality assurance field include:

- Biomedical technology/engineering
- Biopharmaceutical manufacturing
- Bioprocessing
- Biotechnology
- Biotechnology manufacturing
- Chemical technology
- Chemistry
- Computer science
- Food science/food processing
- Industrial biotechnology
- Instrumentation
- Life sciences
- Quality control

Quality Control Technician

- An essential job in all areas of biotechnology manufacturing
- Usually requires laboratory or manufacturing experience
- Requires skills in investigation and attention to detail to make sure product is manufactured properly
- Salary is \$30,000 to \$60,000 per year

Job Description and Work Conditions

Quality control (QC) technicians in biotechnology companies are responsible for inspecting and testing the raw materials and products of biotechnology to make sure that they meet required levels of quality. A career in quality control is a good one for people who are good at research and investigation and are detail oriented. Those who have good laboratory skills and manufacturing or laboratory experience have the best prospects. Quality control technicians are responsible for data collection and analysis of results. They must keep excellent records of the results of their inspections.

Quality control technicians are involved at every stage of the manufacturing process. Some technicians examine raw materials and equipment components received from a supplier. They monitor air, surfaces and workers to ensure clean or sterile conditions are maintained. Others test goods during the manufacturing process and the finished products. Quality control technicians also check the final packaging, sealing and labeling of products. Technicians often provide the on-site expertise needed to verify that these materials and components meet specified requirements. They perform a wide variety of tests for quality before, during and after the manufacturing process. Quality control technicians also help write Standard Operating Procedures (SOPs) and work to improve quality control procedures.

There are several specialties within the area of quality control. QC biochemistry technicians test raw materials to make sure they meet quality standards. They test raw and manufactured materials in storage for stability to ensure they have not degraded over time and to determine shelf life. QC microbiology technicians test the manufacturing and laboratory environment and equipment to make sure that it is not contaminated by microorganisms. QC chemical technicians specialize in chemical analysis.

Quality control technicians work in laboratories, manufacturing facilities or storage areas. They may work in "clean rooms" where the temperature, humidity and dust content of the air are carefully controlled. All workers in clean rooms wear masks, gloves, and protective clothing to ensure against contamination.

Wages, Hours and Benefits

- Wages range from \$30,000 to \$60,000 per year

Some quality control technicians work a standard 40 hour workweek, Monday through Friday. During production, quality control technicians may need to be

present 24 hours a day, seven days a week. Therefore, shift work is common. Night shifts and weekend work often earn higher pay. Wages are generally higher in regions where the cost of living is higher.

Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills, and Training

Most employers prefer applicants to have a bachelor's degree in chemistry, biochemistry or biotechnology and one to two years of experience in a pharmaceutical or biotechnology manufacturing or laboratory job. Some employers hire people with an associate degree and two to four years laboratory or manufacturing experience.

For an entry level position as a quality control inspector, a high school diploma and two to four years experience in manufacturing at a biotechnology company is generally sufficient.

Employers look for people who have good laboratory, analytical and problem solving skills. Attention to detail is extremely important. Strong oral and written communication skills are essential so that quality issues, results and recommendations are explained clearly. More advanced positions often require technical writing skills. Excellent math skills are needed. Computer skills such as database, spreadsheet and word processing are also required

Quality control technicians need to know about regulations that affect the biotechnology industry and must be able to keep up with changing regulations by various government agencies. Strong knowledge of Good Manufacturing Practices (GMPs), Good

Technical Skills

- Analyze/evaluate data
- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs, GLPs & GMPs
- Problem solving/critical thinking
- Record keeping skills
- Understand technical information

Personal Skills

- Detail oriented
- Observation skills
- Organized
- Work as a team
- Work independently

Basic Skills

- Advanced math
- Written and oral communication

Laboratory Practices (GLPs) and Standard Operating Procedures (SOPs) is essential.

Some employer prefer to hire quality control technicians who are certified. Information about certification is available from the American Society for Quality, www.asq.org, 600 North Plankinton Avenue, Milwaukee, WI 53203, 800-248-1946.

Career Advancement and Related Jobs

Quality control technicians with a bachelor's degree and four to six years experience can be promoted to quality control analyst. With five to ten years experience, they may move into supervisor or manager positions.

Quality control technicians who have an associate degree or a high school diploma can take advantage of the education benefits that most biotechnology companies offer and obtain a bachelor's degree while gaining experience in the quality control area. A bachelor's degree in engineering can lead to jobs in the field of quality control engineering.

Finding the Job

Quality Control jobs are found in biotechnology companies that develop or sell all types of products and services. Positions are available with biotechnology companies, pharmaceutical companies, agriculture and food companies, local and state law enforcement agencies, private forensic laboratories, instrumentation manufacturing companies, biofuel manufacturers, companies that specialize in environmental services and industrial product manufacturers. There are some similar positions with government regulatory agencies such as the Food and Drug Administration.

Other Job Titles Include

- Quality auditor
- Quality control associate
- Quality control inspector
- Quality control technical specialist
- Quality technician
- Quality specialist

Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment. Some positions are filled through employment agencies that specialize in biotechnology, medical or science companies. Other jobs are filled through referrals from employees and walk-in applicants. For jobs requiring college coursework, referrals from college professors and college employment offices are other sources of job leads. Employees may be promoted into quality control from positions such as manufacturing technician or laboratory technician.

Community College Programs

A bachelor's degree is generally required for quality control technicians. Some employers hire people with a specialized biotechnology associate degree, especially if they have a previous college degree or related experience. Many community colleges have transfer agreements with four year colleges and universities. For jobs that require a

bachelor's degree, students can begin their education at a community college and transfer to a four year college for their bachelor's degree.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants get positions as quality control technicians include:

- **Biomedical technology/engineering**
- **Biopharmaceutical manufacturing**
- **Bioprocessing**
- **Biotechnology**
- **Biotechnology manufacturing**
- **Chemical technology**
- **Chemistry**
- **Computer science**
- **Food science/Food processing**
- **Industrial biotechnology**
- **Instrumentation**
- **Life sciences**
- **Quality control**

Research Associate

- Opportunity to work independently on scientific experiments
- Requires a bachelor's degree
- Salary is \$30,000 to \$70,000 per year
- Most positions are at private companies, universities and research institutes

Job Description and Work Conditions

Research associates are directly responsible for designing and carrying out the experiments and protocols used in a research project. They assist on projects that are designed and directed by a scientist. Research associates are involved in many areas of scientific study. These include sequencing DNA from a human, animal, plant or other source, or recombining DNA from different organisms to create a new or improved product such as a drug or a better crop plant. The work may relate to research and testing that supports clinical trials of a new drug. The research may work towards developing processes to manufacture these new products in a safe, economical, and efficient manner. If working in agriculture, research associates may be responsible for growing crops in fields or greenhouses that are used in research. Associates also may work on research on biofuels, anthropology or forensics.

Specific responsibilities of a research associate might include developing Standard Operating Procedures (SOPs), the exact steps used in the laboratory. In the laboratory, research associates use a wide variety of laboratory instruments, computers, and may work with automated or robotic instruments. Research associates may also supervise laboratory technicians or assistants.

Research associates make detailed observations of procedures and experiments and must keep accurate and detailed records of all activities. They interpret the data using scientific knowledge and statistical analysis. They then write reports detailing their findings. During product development, research associates are often involved in troubleshooting and developing new protocols. A senior research associate may be in charge of a large project or laboratory. A research associate may be responsible for projects that can lead to a product which can be patented. They may be asked to make presentations at scientific conferences and write articles for journals. It is important for them to keep up-to-date on current research in their field.

Research associates usually work in a laboratory environment and usually spend time in an office as well. Some also work in manufacturing or with instrumentation. Others work in agriculture or at medical facilities if they are involved with clinical trials of drugs. They operate and maintain laboratory instruments and ensure that the laboratory is well stocked with needed supplies. They may work with toxic substances or disease causing organisms. It is very important to follow health and safety regulations and make sure that the technicians and assistants working with them do so as well.

Wages, Hours and Benefits

- **Wages range from \$30,000 to \$70,000 per year**

The pay scale for research associates varies considerably depending on experience, type of employer and educational background. Research assistants with a master's degree earn more than those with a bachelor's degree. Private companies usually pay higher wages than universities. Salaries are generally higher in regions where the cost of living is higher. Most employees work full time, averaging 40 hours per week; overtime may be required since experiments may run for many hours and require tending.

Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

Entry level positions require at least a bachelor's degree in biology, molecular biology, biochemistry, chemistry, agriculture, computer science, engineering or a related field. In addition, one to three years laboratory experience may also be required. A master's degree is needed for some positions. In a few cases, a worker can start at an entry-level position such as laboratory technician, with an associate degree, get extensive lab experience and work up to entry level research assistant and then to research associate (usually earning a bachelor's degree during their career progression, often with the employer paying for education costs). Some positions will accept education and experience in healthcare such as registered nurse or medical technician. Experience in specific biotechnology laboratory techniques or specialized areas of research is often required for a research associate position. These requirements vary greatly depending on the area of research.

Technical Skills

- Analyze/evaluate data
- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs, GLPs, GMPs
- Plan and carry out research
- Problem solving/critical thinking
- Technical writing
- Understand technical information

Personal Skills

- Detail oriented
- Observation skills
- Organized
- Work as a team
- Work independently

Basic Skills

- Advanced math
- Written and oral communication

A general understanding of research methods and applications is very important in this job. Employers also look for hands-on lab experience. Strong problem solving skills are required including the ability to identify and troubleshoot practical problems. Research associates then apply their scientific knowledge to devise a solution to the problem. A research associate must be able to interpret a variety of instructions and have good communication skills. Computer skills including word processing, spreadsheet and database are important.

Career Advancement and Related Jobs

Almost all employers promote employees to research associate from the laboratory technician position. There are many directions in which a research associate can move. In most cases further education is required to promote above a certain level, including a master's degree or a Ph.D. Research assistants may be promoted to senior research associate positions. With a doctorate degree, this could lead to a staff scientist position. Research associates may also move into management, quality assurance or marketing at biotechnology companies. Those employed at colleges or universities may become professors.

Finding the Job

Research associate positions are available in almost every industry in which biotechnology plays a role. These companies include food and agriculture companies, pharmaceuticals, bioinformatics, biofuels, forensics, industrial products and environmental companies. Jobs are also found with universities and colleges, research institutes, hospitals and some government agencies, such as the Food and Drug Administration, Environmental Protection Agency, FBI, Department of Agriculture or the National Institutes of Health.

Other Job Titles Include

- **Associate Scientist**
- **Biotechnologist**
- **Biotechnology research associate**
- **Clinical research associate**
- **Research technician**
- **Senior research associate**

Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment. Some positions are filled through temporary agencies that specialize in biotechnology or science jobs. Other jobs are filled through referrals from employees and walk-in applicants. Positions are also filled through employment agencies specializing in scientific employment. Referrals from college professors and college employment offices are other sources of job leads. Employers often recruit on college campuses. Student internships can lead to permanent jobs.

Community College Programs

Research associate positions usually require at least a bachelor's degree. Almost every community college offers a general science program that includes biology, chemistry

and other life science courses that prepare students for transfer to a four year college. Most community colleges have transfer agreements with four year colleges and universities. People interested in research associate jobs may start in a biotechnology program at a community college and transfer to a four-year college or university to complete their bachelor's degree.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants prepare for research associate positions include:

- **Animal science**
- **Agriculture**
- **Bioinformatics**
- **Biological technician**
- **Biotechnology**
- **Chemical technology**
- **Chemistry**
- **Crop science**
- **Engineering technology**
- **Food science**
- **Life sciences**
- **Plant science**

Sales Representative

- Opportunities for someone with sales aptitude and science background
- Great job for someone who likes people and enjoys travel
- Good earning potential, usually a combination of salary and commission
- Sales representative can earn \$45,000 and up a year

Job Description and Work Conditions

Once a biotechnology company has manufactured a product, it is the job of sales representatives to sell it. A career as a sales representative may be a good fit for outgoing people who have a science or technical background. Sales representatives sell all the products of biotechnology research. They sell pharmaceuticals to doctors and hospitals; specialized equipment to researchers; enzymes to industry; laboratory testing materials to doctors; seeds and pesticides to farmers; and hazardous waste clean-up systems to help clean up toxic spills.

Sales representatives meet clients or talk with prospective customers on the phone and in person to inform them about the company's products and services. They explain the company's products to the customer and help them select the correct product to purchase. They make presentations to individuals and groups of varying sizes. Most sales representatives in the biotechnology field must have a scientific or technical background in order to be able to sell the products effectively.

In many cases a sales representative may actually be demonstrating a product, answering very technical questions about its use and following up to make sure the equipment or product is functioning properly. They may also provide training to a customer's employees in the proper use of equipment or materials. Sales representatives may work as a team with a technical sales representative with specialized knowledge or technical expertise. The sales representative would make the initial contact with customers, introduce the product and close the sale. The technical expert would be on hand to attend the sales presentation and answer specific questions and concerns.

Sales representatives must keep careful records of contacts and sales. They may develop lists of contacts from trade and professional associations. Other duties of a sales representative might include analyzing sales data, writing reports and advising other departments on customer issues. The job often requires considerable travel depending on the territory assigned.

Wages, Hours and Benefits

- **Entry level wages: \$45,000 to \$60,000 per year**
- **Experienced sales representative: \$60,000 to \$85,000 per year and up**

Compensation generally includes a salary plus a commission or bonus based on

amount of sales. Sales representatives usually earn much higher commissions as their skills, regions and clients increase. Wages are generally higher in regions where the cost of living is higher.

Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

Most employers look for a bachelors' degree in a life science field or other scientific discipline. Some accept a bachelor's degree in business or marketing. Most companies also prefer two or more years of related experience such as laboratory technician or instrumentation technician to ensure that sales representatives can understand and accurately describe the scientific background of the product. Some employer look for sales or customer service experience. This is a position that laboratory or manufacturing technicians might move into if they would like a change in job but want to stay in the biotechnology industry.

Sales representatives must have excellent communication skills in order to be able to sell the product. They should be able to speak effectively before groups of customers. The successful sales representative must have excellent interpersonal and telephone skills and be able to project a positive image on the telephone. Math skills are needed to calculate discounts and prepare and arrange sales contracts. Being detail oriented and organized is essential in keeping track of clients and orders. Computer experience is necessary, especially word processing, spreadsheet, presentation and database programs.

Technical Skills

- Computer skills
- Driver's license
- Knowledge of life sciences/chemistry
- Public speaking
- Understand technical information

Personal Skills

- Customer service skills
- Detail oriented
- Organized
- Sales ability
- Work as a team
- Work independently
- Work well under pressure

Basic Skills

- Basic math
- Written and oral communication

Career Advancement and Related Jobs

Sales representatives may begin in a position that is largely telemarketing or setting up appointments for technical sales people or they may start with their own territory.

Promotion usually means a larger or more desirable territory or a sales manager, sales analyst, product manager or district manager position. Some of these positions require a master's degree in business administration to advance. A sales representative with talent for selling, product knowledge and experience can advance without formal training and has great potential for earnings based on commission.

Other opportunities within a firm might be in the areas of buying and purchasing, advertising, public relations or marketing research. Some workers may choose to go into business for themselves as manufacturer's agents.

Finding the Job

Jobs are available with all biotechnology companies that have a product or service to sell, including biotechnology pharmaceuticals, agriculture and food, biofuels, instrumentation and supplies, private forensic laboratories, companies that specialize in environmental services and industrial product manufacturers.

Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment. Other employers fill openings through referrals from employees. Positions are also filled through employment agencies specializing in biotechnology or scientific employment. Employers often recruit on university campuses and college employment offices are a good source of job leads. Many position are filled through promotion of technicians.

Other Job Titles Include

- Account manager
- Biopharmaceutical representative
- Manufacturer's agent
- Marketing representative
- Project management assistant
- Sales coordinator
- Scientific sales
- Telemarketer

Community College Programs

Sales representative positions usually require at least a bachelor's degree including life science coursework. An associate degree from a community college is an excellent first step towards earning a bachelor's degree. Many community colleges have transfer agreements with four year colleges or universities. Community colleges offer courses in sales and management as well.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help prepare applicants for careers as a sales representative include:

- Biotechnology
- Chemistry
- Life sciences
- Management
- Sales

-
- Biotechnology scientists are at the cutting edge of new discoveries
 - Requires a Ph.D.
 - Earnings \$60,000 to \$80,000 per year and up
 - A good job for a person with an inquiring mind, an interest in science and excellent research skills

Scientist

Job Description and Work Conditions

Scientists create and test new biotechnology products. In biotechnology research and development, scientists study living things at the molecular level, including animals, plants, viruses and bacteria. Biotechnology scientists use the genetic code of organisms to find out which genes control different traits of living things. They recombine DNA from different organisms to create products that include drugs, vaccines, and medicines that treat many diseases. Scientists also develop process to produce biofuels from plants that can reduce our dependence on gasoline. In agriculture, scientists develop crops that resist disease or increase production of crops, milk, eggs, poultry and meat.

Scientists devise experiments, write protocols for conducting them and develop the techniques and equipment used in research. They often work as part of a team with engineers, other scientists, business managers and technicians. They direct the work of research assistants, laboratory technicians and laboratory assistants, who do most of the hands-on laboratory work. Biotechnology scientists must spend time studying current research being conducted in their area. Writing reports and articles for scientific journals about their research and making presentations at meetings is also part of this job.

There are many different areas of science used in biotechnology. In *biochemistry*, scientists study the chemical composition of living things and learn how they operate using the methods of chemistry. They study the complex chemical combinations and reactions involved in reproduction, growth and heredity. *Molecular biologists* study both biophysics and biochemistry, looking at the molecular building blocks of life, such as DNA, RNA, amino acids and proteins. *Microbiologists* study the growth and characteristics of microscopic organisms such as bacteria, algae, or fungi. Many microbiologists work in manufacturing to ensure that products are not contaminated with bacteria or other dangerous organisms. *Pharmacologists* work on creating and testing new drugs. They study the effectiveness of drugs and their side effects. *Agricultural, plant and crop scientists* use recombinant DNA techniques to create better food products. They make crops more resistant to drought, more nutritious, disease resistant and more productive. *Environmental scientists* use biotechnology to improve water quality, clean up hazardous spills or protect animals, plants and people from

environmental hazards. *Forensic scientists* use DNA evidence to solve crimes. Other important areas of science in biotechnology are biology and chemistry.

In applied research, biological scientists work on product development. These scientists usually work for biotechnology companies. Research is directed towards developing a product to be sold. Projects must fit the emphasis of a firm's products and goals. In private industry, scientists must understand the business aspects of their work.

Biological scientists who do research usually work in offices and laboratories. Some time is spent in laboratory work. Most of a scientist's time may be spent in the office analyzing data, keeping up with scientific literature or writing reports and scientific papers. Agricultural scientists may spend time at farms or in greenhouses. Environmental scientists may work outdoors as well. Biological scientists generally work regular hours, but overtime is common for some jobs. Some work with dangerous organisms or toxic substances and those scientists must follow strict safety procedures to avoid contamination.

Wages, Hours and Benefits

- **Entry-level wages range from \$60,000 to \$75,000 per year**

- **Experienced scientists: \$75,000 to \$100,000 or more per year**

Senior scientists may earn over \$100,000 with many years experience. Wages are generally higher in regions where the cost of living is higher. Scientists who work for biotechnology companies often receive large bonuses when they discover or develop a product which can be patented. This may double their salary. They often receive stock options and participate in employee stock ownership programs. In universities, most scientists receive salaries. They may also need to write grant proposals to fund their projects. Grants come from foundations, government agencies and industry.

Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and

Technical Skills

- Analyze/evaluate data
- Biotechnology laboratory procedures
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs, GMPs, GLPs
- Plan and carry out research
- Problem solving/critical thinking
- Technical writing skills
- Understand technical information

Personal Skills

- Detail oriented
- Observation skills
- Organized
- Work as a team
- Work independently
- Work well under pressure

Basic Skills

- Advanced math
- Written and oral communication

stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills and Training

The scientist positions in biotechnology companies usually require a Ph.D. in a science. Employers look for degrees in molecular biology, biochemistry, immunology, toxicology, plant breeding, agriculture, genetics, pharmacology, microbiology, chemistry, biology and related disciplines. Some jobs accept an M.D. (medical doctor) or D.V.M. (veterinary doctor) degree. There are a limited number of scientist jobs that require a bachelor's or master's degree with ten to fifteen years of experience in a laboratory.

People with a bachelor's or master's degree interested in pursuing a science career in a biotechnology company usually are employed as laboratory technicians or research associates. In jobs at colleges and universities, most people with a Ph.D. are expected to spend several years as a post doctoral fellow before being offered a job as a professor.

Scientists must have a thorough knowledge of their area of expertise. Precision and accuracy are extremely important in science. They must be creative and persistent in their research. Clear and concise writing and oral communication are both important. For those who want to move into management, strong business and communication skills and familiarity with regulatory issues, marketing and management are essential.

Career Advancement and Related Jobs

Some scientists move into project management or administrative positions after spending time doing research. Other positions are available as consultants to government or businesses.

Some scientists inspect foods, drugs and other products or plan and administer programs for research activities. In biotechnology, some scientists are able to develop products and start their own companies to market them. Many scientists are employed as researchers or professors at colleges, universities, private research institutes or government research facilities.

Finding the Job

Jobs are found with pharmaceutical companies, agriculture and food companies,

Other Job Titles Include

- Associate scientist
- Bacteriologist
- Biochemist
- Biologist
- Biophysicist
- Biotechnologist
- Chemist
- Food scientist
- Forensic examiner
- Microbiologist
- Molecular biologist
- Pharmacologist
- Plant pathologist
- Post doctoral fellow
- Research scientist
- Toxicologist

private forensic laboratories, instrumentation manufacturing companies, companies that specialize in environmental services or biofuel manufacturing and industrial product manufacturers. Many scientists work at colleges, universities, research institutes and hospitals. There are also positions available with government agencies such as the Food and Drug Administration, Environmental Protection Agency, FBI, local and state law enforcement agencies, Department of Agriculture and National Institutes of Health.

Scientists often find jobs by networking through professional organizations and at professional meetings. In many cases referrals by other employees are an important source. Employment at colleges and universities might also be through word of mouth and referral by professors or other employees. Positions are often listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment. Positions are also filled through employment agencies specializing in scientific employment.

Community College Programs

Scientist positions usually require a Ph.D. degree. Community colleges offer a science associate degree program that includes biology, chemistry and other life science courses that can prepare students for transfer to a four year college. Many community colleges have transfer agreements with four year colleges and universities. A strong science background is essential for transfer to a four year program and continuation for a bachelor's degree and a Ph.D.

Students interested in these programs and courses should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Community or technical college programs that can help applicants prepare for positions as a scientist include:

- Agriculture
- Animal science
- Bioinformatics
- Biological technology
- Biotechnology
- Chemical technology
- Chemistry
- Crop science
- Food science
- Life sciences (including biology, bio-chemistry, microbiology)
- Plant science
- Zoology

-
- A good job for a person with technical or scientific knowledge and good customer service skills
 - Can promote into this job from technician positions
 - Salary is \$30,000 to \$60,000 per year
 - Usually requires a bachelor's degree.

Technical Service Representative

Job Description and Work Conditions

Helping customers solve technical problems is the job of a technical service representative. These representatives help customers use the products they have purchased such as equipment, pharmaceuticals, or biological products such as enzymes, viruses or bacteria. Much of the assistance is provided over the telephone or via email. A technical service representative is usually the first point of contact for customers who are having technical problems or need service. When questions, complaints or requests for service are received, a technical service representative must be able to understand what the problem is and find a solution for it.

Some technical service representatives work closely with the sales and marketing staff and visit customers to demonstrate uses and advantages of company products. Technical service representatives provide detailed information or demonstrations of products to assist sales staff.

Once a product is purchased, a technical service representative may visit a company to train the staff how to use the product and assist with any technical problems the customer is having. If they work for a company selling scientific instruments or software, they may help install the product. In large companies, some technical service representative may offer troubleshooting and technical assistance to departments within the company.

Technical service representatives are expected to attend meetings on product updates and training for new products. Representatives need to keep accurate documentation of all service provided and be able to bring repetitive problems to a supervisor's attention. They provide important feedback to ensure that products meet customers' needs and are properly manufactured. Sometimes they do laboratory work and research to help find solutions to technical problems.

Technical service representatives usually work in an office environment. For those representatives who assist with sales calls or make site visits, travel is involved. Some jobs involve travel up to 50% or more of the time, which can include international travel.

Wages, Hours and Benefits

- Wages range from \$30,000 to \$60,000 per year

Working hours are usually a normal 40-hour workweek, Monday through Friday,

however, some companies may have technical support available 24 hours a day. In that case, shift work would be available. There are some part-time opportunities. Wages are generally higher in regions where the cost of living is higher.

Biotechnology employers offer excellent benefit packages for full-time workers, and many offer benefits to part-time employees as well. Benefit packages usually include vacation, holidays and sick leave; medical, dental, vision and prescription drug coverage; life and disability insurance; retirement plans; and profit sharing and stock ownership plans. Most companies offer education assistance plans that may include reimbursement for tuition and books, flexible work schedules or paid time off for education and training.

Qualifications, Skills, and Training

When hiring entry-level technical service representatives, employers usually look for someone with a strong science or technical background, good customer service skills, and excellent problem solving skills. Most employers require a bachelor's degree in a life science field such as biology, plant or animal science, forensics, molecular biology, biochemistry or biotechnology. Some also require up to three years experience in customer service, manufacturing or laboratory work. However, some employers will consider applicants with an associate degree in a life science and at least two years of experience. A background in instrumentation or electronics is needed for technical service representatives working for instrumentation companies.

Some technical service representatives start as laboratory technicians and are promoted into the technical service area. Starting as a lab technician will allow someone to acquire the knowledge of equipment used in various processes and expertise in both product use and maintenance. This is a good career path for someone who has a science background but is not interested in pursuing laboratory work. Excellent communication and analytical skills are needed for this job. As a technical service representative, knowledge of computers and database programs is also needed.

Technical Skills

- Analyze/evaluate data
- Computer skills
- Knowledge of life sciences/chemistry
- Knowledge of SOPs, GMPs, GLPs
- Problem solving/critical thinking
- Record keeping
- Understand technical information

Personal Skills

- Customer service skills
- Detail oriented
- Organized
- Work as a team
- Work independently
- Work well under pressure

Basic Skills

- Advanced math
- Written and oral communication

Career Advancement and Related Jobs

Promotion of technical service representatives leads to management and supervisory

roles. In a senior level position, responsibilities would be more diverse including development of service strategies and training new technical service representatives. Senior level job titles might include senior technical representative, technical service manager or supervisor, field service manager or senior customer support engineer.

Some technical service representatives, especially those who work closely with sales and marketing, move into a position on the sales and marketing team.

Finding the Job

Jobs are available with all biotechnology companies that have a product to sell and maintain or a service to provide, including pharmaceuticals, agriculture and food, instrumentation and supplies, biotechnology research services, environmental services, private forensic laboratories, instrumentation manufacturing companies and industrial product manufacturers.

Positions are frequently listed on the Internet, especially on biotechnology company sites and web sites dedicated to biotechnology, pharmaceutical, agriculture or science employment. Some positions are filled through employment agencies that specialize in biotechnology or science companies. Other jobs are filled through referrals from employees and walk-in applicants. Referrals from college professors and college employment offices are other sources of job leads. Manufacturing assistants or technicians may be promoted into technical service representative positions.

Community College Programs

Technical service representatives usually require an associate or bachelor's degree in a field related to the products being supported. Community colleges offer a science associate degree program that includes biology, chemistry and other life science courses that can prepare students for transfer to a four-year college. Many community colleges have transfer agreements with four year colleges and universities.

Students interested in these programs should check with representatives of the local community or technical college to find out about specific course offerings. Detailed information about community and technical college programs is in **Chapter 2**.

Other Job Titles Include

- Client services representative
- Customer service representative
- Customer support engineer
- Field service representative

Community or technical college programs that can help applicants get positions as a technical service representative include:

- Biological technician
- Biomedical technology/engineering
- Biopharmaceutical manufacturing
- Bioprocessing
- Biotechnology
- Chemical technology
- Chemistry
- Electronic technology
- Industrial biotechnology
- Instrumentation
- Laboratory science technology
- Life sciences

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Finding a Job

Biotechnology Employment

Job prospects are excellent for qualified job seekers with a science background and good laboratory skills. The key is to widen the job search from biotechnology companies to include many other industries that use the techniques of biotechnology in research, manufacturing and services.

More than 1,450 biotechnology companies are located in the United States. Many jobs that use biotechnology skills and knowledge are found in other industries, especially pharmaceuticals, agriculture and food companies. The largest of the biotech companies engage in manufacturing as well as research and development activities. Since this is such a new science and technology, established companies work to develop new products to add to their product lines. Smaller companies work to develop products that they hope will be marketable.

Most jobs in the biotechnology industry are in the states that have the most biotechnology companies:

- California,
- Florida,
- Georgia,
- Maryland,
- Massachusetts,
- New Jersey,
- New York,
- North Carolina,
- Pennsylvania,
- Texas, and
- Washington.

Jobs in other states are in smaller startup companies, universities, colleges, county forensic labs and research hospitals and in other industries that use biotech skills. Most biotechnology companies tend to cluster near the larger metropolitan areas where a supply of talented scientific staff is available.

Big Biotech Companies	
	<u># of employees</u>
• Amgen	17,500
• Applera	5,100
• Biogen Idec	4,300
• Chiron (Div. of Novartis)	5,500
• Genentech	11,200
• Genzyme	10,000
• Gilead Sciences	3,000
• Invitrogen	4,300
• MedImmune	2,500
Big Pharmaceutical Companies	
• Bristol-Myers Squibb	43,000
• Eli Lilly	44,500
• Johnson & Johnson	109,900
• Merck	62,600
• Pfizer	15,000
Source: Hoovers.com, 2007	

This chapter lists

- Web sites with biotechnology job openings,
- Information on biotechnology companies,
- Information about the major areas of employment, and
- Up-to-date information about career opportunities to job seekers, counselors and instructors.

Two web sites that provide lists of biotech companies in the United States are

- **Biotechnology Industry Organization, www.bio.org**
- **Bio-Link, www.bio-link.org**

Biotechnology Employers

Pharmaceuticals

The vast majority of biotechnology companies in the United States are working on pharmaceuticals or drugs. Most biotechnology job growth is expected in the areas of drugs (diagnostics and therapeutics), since research and development and manufacturing have been highest in these areas of the biotechnology industry. Many pharmaceutical companies also use biotechnology to produce drugs. Job seekers need to look for jobs in pharmaceutical companies as well as biotechnology companies and medical laboratories use biotechnology diagnostic tests.

Agriculture and Food

A small number of biotechnology companies concentrate on agriculture and food products. The biofuels industry is a growing area in agriculture that includes production of fuel from crops or improving crops for biofuels. Most of the biotech research and manufacturing in agriculture and food is carried out by large agriculture companies such as Archer Daniels Midland, Bayer Crop Science, Cargill, Dow Agro Sciences, Genencor and Monsanto. Many of these companies have locations in several states.

Universities, Colleges, Research Institutes and Hospitals

Universities employ scientists, research associates, lab technicians and lab assistants. Many of the entry level positions in these labs are likely to be held by students. Significant research occurs in this field at many colleges and universities throughout the United States. Public and private universities and colleges hire many research and development staff. Excellent opportunities exist in medical schools and hospitals that conduct research on diagnostic and therapeutic drugs. Private research institutes, are involved in biotech research, such as the Salk Institute and the Scripps Institute in San Diego, the City of Hope in Duarte, California, the Fred Hutchinson Cancer Research Center in Seattle, the Mayo Clinic in Rochester, Minnesota, the Dana-Farber Cancer Institute in Boston and the Sloane-Kettering Institute for Cancer in New York City.

Government Agencies

Government-funded research facilities research the human genome, biofuels,

pharmaceuticals and other areas of biotechnology. The National Institutes of Health and the Centers for Disease Control are major federal government agencies involved in health care. Other government agencies that work on biotechnology issues include the Oak Ridge National Laboratory in Oak Ridge, Tennessee; Sandia National Laboratory in New Mexico; and the Department of Energy's National Renewable Energy Laboratory in Golden, Colorado. Other agencies involved in research or regulation of the biotechnology industry include the Food and Drug Administration, the Department of Agriculture and the Environmental Protection Agency. State governments may also invest in or work with biotechnology researchers.

Bioinformatics

Bioinformatics uses biology, computer science and information technology for research. The bioinformatics field grows rapidly as scientists create great quantities of information and need systems to use this data for research and development activities. Bioinformatics groups store and process gene sequences, gene expression information and other data. Most of bioinformatics research is carried out either by larger biotechnology or by universities. Most bioinformatics companies are relatively small, with at most a few hundred employees. For instance, Celera, a division of Applera Corporation, is a bioinformatics company with 540 employees in California and Maryland.

Instrumentation and Supplies

Although companies that manufacture specialized equipment and supplies for bioscience research and manufacturing are a small part of the industry, they are necessary to keep the research and manufacturing processes going strong. Major instrumentation companies include Applied Biosystems, Affimetrix, and Bio-Rad Labs, all in California.

Forensics and Law Enforcement

While forensics is not strictly a biotechnology field, a significant number of forensic technicians use biotechnology laboratory skills in their work, particularly DNA fingerprinting techniques. Bioinformatics specialists also work in the field of forensics to work with DNA databases. Most of these jobs are with state and local police, sheriffs, or other law enforcement agencies; some are employed by the FBI and other federal agencies; and some are with private forensic services companies.

Bioremediation and Environment

Some companies focus on products that are used to clean up oil spills and other hazardous wastes. Biotechnology researchers have also created instruments that use biosensors to detect dangerous materials, explosives and disease causing organisms. Most companies working in bioremediation and environment are small.

How to Find a Job in Biotechnology

The first step for a job seeker would be to learn about the industry. This book is a start. The web sites listed in this chapter can help, and many articles and other books are available. One next step would be to learn about the specific company that has current job openings, especially at the company's web site. It will tell about their products, corporate culture, benefits packages and current job openings. Read the information about the company. Job seekers who know about a company always make a better impression in an interview and have a better chance of getting the job. Some very good web sites devoted to biotechnology have excellent current job listings. Biotechnology web sites are listed in the Web Sites section of this chapter.

In biotechnology, companies generally prefer to hire people with appropriate levels of education, from high school diplomas and more. Seeking as much education in the biological sciences and chemistry as possible is a good idea. Different educational paths may be followed for related fields such as agriculture, forensics or sales.

Community college programs in biotechnology offer excellent training in basic science and laboratory skills. Many colleges find that students enrolling in the biotechnology courses, degree or certificate programs already have a bachelor's, master's or even Ph.D. degree. They often are returning to college to improve their laboratory skills in order to be employed. This may affect the availability of "entry level" positions for those who do not have a previous degree.

The two most important job search tips are

- **Apply for lots of jobs.**
- **Tell everyone you know that you are looking for a job.**

The largest and most well-known biotechnology companies tend to require a higher level of education for certain jobs than small or mid-sized companies. Some require at least a bachelor's degree for almost all jobs in research and development. Often, more entry-level jobs are available for people with an associate degree in mid-sized biotechnology companies. More openings for people with high school diplomas and some college courses or associate degrees may be in the manufacturing divisions of large companies.

Be assertive in tracking down employers and jobs.

- Remember: employers need good employees as much as job seekers need the job.
- Recruiters *want* applicants.
- Although job announcements sometimes state "no phone calls", human resource professionals may be willing to speak with counselors and others who can help send them good job candidates.
- Most employers accept applications through their web site. However, an

applicant would be wise to consider speaking directly with someone who works at a company to learn more about it.

Larger companies and universities often have formal processes for applying for jobs. Knowing someone in the company, even if they are not responsible for the hiring, often helps an applicant get an interview and a job. An informational interview can be a helpful way to gain access to information and referrals. This involves speaking with a person at a company who holds the job of interest, or with someone who hires people for that job., giving you information about the company and the job. This is not the same as a job interview. An informational interview is for your information and is *not* directly related to a current job opening. Most people like to talk about their jobs and are willing to give their time to tell someone about it. And, once they have met a person interested in their company, they can sometimes help get them hired.

You can speak with employers who are not currently hiring and ask when they will be hiring. Most companies have a good idea of when they will be adding employees well into the future.

A job seeker should use as many job search resources as possible. More job leads mean more applications. More applications lead to more interviews and finding a job sooner.

Some of the best ways to find biotechnology employers are:

Networking

Many people believe that the most effective way of getting hired is to find job leads through friends, acquaintances and relatives.

- Even if they do not know of current job leads, personal contacts can often lead to meeting people who work in the industry.
- Friends, acquaintances, members of community organizations and relatives can often refer job seekers to someone who knows about the job they want.
- College and high school instructors often have great contacts in the industry.
- Ask everyone for leads.
- Speak with people working in an occupation to help learn about the job and about job openings.
- The best advice job seekers can get is, "Tell everyone you know that you are looking for a job."
- Job seekers in a specific technical field like biotechnology may unexpectedly find a friend of a friend who works in a biotechnology company and knows about current job openings.

Referrals from Current Employees

Employers like to hire new workers that are referred by current employees. Current employees are often the first to know when positions are open at their company. Many

community and technical college biotechnology programs use part-time instructors who are full-time employees of biotechnology companies. Talk with them.

Internships

Most biotechnology companies offer internships, which is an excellent way to get experience as a student, sometimes with pay. Internships help in three ways.

First, they give a student experience.

Second, the company gets to “look over” a prospective employee. Employers prefer to hire people they know over strangers.

Third, internships count as job experience. Listing an internship and the skills used in it on a resume will help get a job.

Internet

The internet is a great source of information about biotechnology. All large and many mid- and small size biotechnology companies have web sites. The “Web Sites” section of this chapter lists many other types of sites.

Various types of useful sites include

- Some with background information about the science of biotechnology.
- Others devoted to job listings in biotechnology or broader areas of science.
- Some sites are run by industry groups or scientific organizations, which often provide links to member companies’ web sites where jobs are listed.
- Some sites offer general information about occupations, useful in researching different careers.
- Remember: not every job opening in every company is listed on the Internet.

Employment Agencies

- Most biotechnology companies hire temporary employees through agencies. Some companies may have hundreds of contract and temporary employees in manufacturing, research or other positions.
- A temporary job can give you a chance to earn money while you “look over” a company, and you may have access to internal job postings not otherwise available.
- Job seekers can call a company and ask what temporary employment agency they use.
- Employment agencies also specialize in recruiting temporary employees for scientific and laboratory jobs.
- Biotechnology companies also use employment agencies to fill permanent positions.
- Ask your network, too.

Newspapers and Magazines

- The business section of the newspaper contains valuable information about companies that are making scientific breakthroughs, opening new facilities, getting big contracts, growing or moving. Even if they do not list jobs in the paper, these companies are worth contacting.
- Professional and technical job openings are often listed in the business section of the newspapers. Check out the classified advertisements in the paper version and on most newspaper web sites. You may find special sections on jobs or job fairs.
- Scientific journals and magazines with articles about recent research projects are excellent sources of information for job seekers. Job seekers can learn of successful research projects at companies or research institutes who might need more staff.
- When a new biotechnology drug of a company is approved by the Federal Drug Administration (FDA), this information will be publicized. Very likely the company will be hiring more manufacturing technicians and other staff.

Local Career Centers

Many community organizations offer job listings and other resources for job seekers. These may not be specifically oriented toward biotechnology, but the knowledgeable staff will often know of good local job search resources.

Professional and Industry Organizations

Many professional and industry organizations have job listings on the Internet and many list job openings in professional journals. The Biotechnology Industry Organization (BIO) is the largest international organization representing this industry. Their web site, www.bio.org, is an excellent source of information about companies around the country and the world and about other organizations. Professional meetings are excellent places to meet people who know about job openings, especially at the professional level. Most professional organizations have organized times for job recruiting during their meetings. **Check out these organizations in your state listed later in this chapter.**

College Placement Offices

Students should start at their college placement office. Many colleges and universities allow alumni to use these services after they graduate, sometimes for a fee.

Public Libraries

Several good directories of the biotechnology industry are available, but they are quite expensive. They may be available at public libraries at no charge to the user. Libraries also offer free high speed Internet access, which will help job seekers who do not otherwise have such access to the Internet. Larger public libraries have a business department with information about companies, trade organizations or professional associations. There are excellent databases of companies available at libraries.

Web Sites

Below is a selection of job and career web sites useful for learning about and finding jobs in biotechnology. These sites had useful information at the time this book was published. However, internet sites come and go, and change over time. If the address listed is not longer valid, try looking the organization up with a search engine to find a new address. The web sites are divided into five sections:

1. **Top Biotechnology Sites** are a few sites that are the best places to start learning about biotechnology careers and jobs.
2. **Sites About Biotechnology With Job Listings** are web sites that have biotechnology job listings as well as general and scientific information about biotechnology.
3. **Biotechnology Career and Information Sites** do not presently include job listings but do have lots of other very interesting information about biotechnology careers.
4. **State and Local Biotechnology Organizations** includes local organizations by state, which are useful to find biotech companies or programs in a specific area.
5. **General Occupation and Job Sites** includes sites that are not specific to biotechnology, but are useful to anyone looking for a job or learning about careers.

1. Top Biotechnology Career Sites

www.accessexcellence.org

The National Health Museum site includes information about biotechnology and a Resource Center with information on careers in biotechnology with job descriptions, resources and interviews with people employed in biotechnology jobs.

www.bio.org

The Biotechnology Industry Organization is the international industry association for biotechnology. The site includes information about the biotechnology industry. Click on the member directory link for a list of companies with links directly to the company web sites.

www.bio-link.org

Bio-Link is an excellent source of information about the biotech industry, lists of companies, training and education by region of the US.

www.biotechwork.org

This web site includes lists of education and training programs nationwide with labor market information links to reports about biotech labor market around the country. The site also includes an excellent list of links to other biotech web sites.

www.careervoyages.gov/biotechnology-main.cfm

The US Department of Labor site about biotechnology is designed for students with information on occupations, industry, colleges and more. This is an excellent resource for college programs.

2. Sites About Biotechnology With Job Listings

www.aalas.org

The American Association for Laboratory Animal Science offers certification for laboratory animal technicians. This site includes a list of job openings available for members only, but may be worth the cost of joining.

www.biohealthmatics.com

Biohealthmatics.com is a web site for the biomedical informatics community and has excellent information about bioinformatics careers with job listings, company profiles and more.

www.biospace.com

Biospace offers information about biotechnology companies, careers and jobs by state.

www.medzilla.com

Medzilla has large number of job listings in biotechnology pharmaceuticals, science, medical and healthcare fields. The site also includes a salary survey.

www.nature.com/naturejobs

Nature.com is associated with Nature Magazine and offers job listings in scientific fields worldwide, mostly at a higher level requiring a bachelor's or higher degree.

www.scijobs.org

The career information from Science magazine and the American Association for the Advancement of Science includes career information, job listings, science articles and much more. Some parts of the site are free, some require a subscription, but many colleges subscribe. Check with your local college library.

www.nih.gov

The National Institutes of Health, part of the US Department of Health and Human Services offers news, information about medical research and job listings.

www.newscientistjobs.com

This site, sponsored by New Scientist Magazine, lists jobs in the US and other countries for scientists, but most are higher level jobs requiring a bachelor's or higher degree.

3. Biotechnology Career and Information Sites

www.aibs.org/careers

The American Institute of Biological Sciences site includes information about a variety of life science careers, education and job resources.

www.asbmb.org

The American Society for Biochemistry and Molecular Biology site includes listings of four year colleges with programs in biochemistry and molecular biology.

www.asm.org

The American Society for Microbiology site includes information about careers and education for microbiology careers.

www.biotechinstitute.org

The Biotechnology Institute web site has information about careers, organizations, career profiles and an online newsletter for grades 7 through 12 - *Biotechnology and You*.

www.biotechworkforce.org

The National Center for the Biotechnology Workforce focuses on education and training for biotechnology jobs.

www.csuchico.edu/csuperb

The California State University Program for Education and Research in Biotechnology (CSUPERB) has a site with job links, education programs, information on the industry and links to many biotechnology sites.

www.genomics.energy.gov

The Oak Ridge National Laboratory site offers information about biofuels, the Human Genome Project, Microbial Genome Research and more biotechnology research. It includes resources on careers and many excellent links.

www.ift.org/cms

The Institute of Food Technologists site includes publications and information on occupations in jobs involving food, such as microbiology.

www.labormarketinfo.edd.ca.gov/?pageid=136

Under the Microscope, Biotechnology Jobs in California from the California Employment Development Department provides excellent job descriptions about biotechnology careers that are useful for job seekers anywhere, not just in California.

4. State and Local Biotechnology Organizations

(Listed Alphabetically by State)

www.bio.org/members/biostateaffiliates.asp

The Biotechnology Industry Organization has an up-to-date list of state biotechnology organizations at the Council of State Biotechnology Organizations. This is a good source for local information about biotechnology.

www.bioalabama.com

Biotechnology Association of Alabama

www.azbio.org

Arizona BioIndustry Association

www.arizonabiobasics.com/bioBasicsHome.cms

Arizona BioBasics

www.cccbitech.org

The site for the California Community Colleges Centers for Applied Biotechnology Initiative.

www.biocom.org

Biocom is the life science industry association in the San Diego region of California. The site offers information about education and training programs, careers, meetings, professional development courses, and links to the web site of the member organizations.

www.biocomworkforce.org

This site includes information about life science jobs, job listings and resources, focusing on the San Diego area. It has information about education and training.

www.ccewd.net/index.cfm

The California Community College Economic and Workforce Development site; click on Applied Biological Technologies for information on biotechnology programs in California Community Colleges.

www.baybio.org

BayBio is a biotechnology industry group in the San Francisco Bay area, one of the largest concentrations of biotechnology companies in the US.

www.cobioscience.com

Colorado Bioscience Association

www.curennet.org

Connecticut United for Research Excellence

www.delawarebio.org

Delaware BioScience Association

www.bioflorida.com

BioFlorida

www.flahec.org/hlthcareers

Florida Health Careers, from the Florida Area Health Education Network.

www.gabio.org

Georgia Bio

www.hawaiiiscitechcouncil.org

Hawaii Science and Technology Council

www.ibio.org

Illinois Biotechnology Industry Organization

www.ihif.org

Indiana Health Industry Forum

www.iowabiotech.com/about/about.htm

Iowa Biotechnology Association

www.kansasbio.org

Kansas Bioscience Organization

www.kentuckybioalliance.org

Kentucky BioAlliance

www.labiotech.org

Louisiana Alliance for Biotechnology

www.mainebiotech.org

Biotechnology Association of Maine

www.mdbio.org

Maryland Bio

www.massbio.org

Massachusetts Biotechnology Council

www.massbioed.org

Massachusetts Biotechnology Education Foundation

www.michbio.org

Michigan Biosciences Industry Association

www.lifesciencealley.org

Life Science Alley (Minnesota)

www.mobio.org

Missouri Biotechnology Association

www.montanabio.org

Montana BioScience Alliance

www.bionebraska.com

Bio Nebraska Life Sciences Association

www.nevbio.org

Nevada Biotechnology and Bioscience Consortium

www.nhbiotech.com

New Hampshire Biotechnology Council (NHBC)

www.biotechnj.org/index.jsp

Biotechnology Council of New Jersey

www.nmbio.org/

New Mexico Biotechnology & Biomedical Association

www.nyba.org

New York Biotechnology Association

www.ncbioscience.org

North Carolina Biosciences Organization

www.ncbiotech.org

North Carolina Biotechnology Center

www.biomanufacturing.org

Northeast Biomanufacturing Center and Collaborative

www.bioohio.com

BioOhio

www.oregonbio.org

Oregon BioScience Association

www.oregonlifescience.com:

Oregon Lifescience Online

www.pennsylvaniabio.org

Pennsylvania Bio

www.biosciencepr.org

Puerto Rico Bioscience Alliance

www.biogroupri.org

Rhode Island Tech Collective Bio Group

www.sdbio.org

South Dakota Biotech Association

www.tnbio.org

Tennessee Biotechnology Association

www.texaslifescience.com

Texas Life Science

www.vabio.org

Virginia Biotechnology Association

www.wabio.com

Washington Biotechnology & Biomedical Association

www.wisbiomed.org

Wisconsin Biotechnology and Medical Device Association

5. General Occupation and Job Sites

www.careerbuilder.com

General job listing site, with lots of science jobs.

www.collegerecruiter.com

College Recruiter is a job search site for college students and recent graduates. It includes career information, job listings and more.

www.hoovers.com

This excellent general business site, a good place to learn about the business aspects of biotechnology. It has great links to biotechnology companies. Click on the Companies or Industries links for an industry snapshot of biotechnology and for a very extensive list of biotechnology companies throughout the United States and abroad.

www.indeed.com; www.jobcentral.com

General job search site, recommended by the Wall Street Journal.

www.jobstar.org

Jobstar is a great general job and career site from public libraries in California. It includes links to salary surveys, career planning and job search resources, and California and national job listings. Although this is a California site, the information is useful anywhere.

www.job-search-engine.com

Juju, a general job search site

www.monster.com

Huge job search and career site.

www.bls.gov

U.S. Bureau of Labor Statistics provides a wealth of information about careers, wages, outlook for the future and links to state sites. The Occupational Outlook Handbook (www.bls.gov/oco) gives a detailed description of just about every occupation in the country, including skills, training, wages, employment trends. This is an excellent source of general career information.

www.doleta.gov

US Department of Labor, Employment and Training Administration has more information about training and jobs.

<http://online.onetcenter.org>

O*Net Online is an occupational information site developed by the U.S. Department of Labor. It gives detailed information about all types of industries and occupations and including skills, knowledge, training and interests.

www.usajobs.opm.gov

USAJobs is the online site of the U.S. Department of Personnel Management. This is the site for job listings if you are interested in working for federal government agencies.

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Glossary

This glossary defines biotechnology terms used in this book.

Amino Acid: Any of 20 different molecules that combine to form proteins.

Antibiotics: Drugs used to treat infection.

Antibody: A protein produced by humans and animals in response to a foreign substance or antigen. Antibodies protect the body and fight disease.

Aseptic: Free of disease-causing organisms, sterile.

Assay: To measure the effect of a substance on animals, tissues or organisms and compare results to a standard material.

Autoclave: An instrument used to sterilize glass and other items used in a laboratory.

Bacteria: Microscopic organisms with a very simple cell structure.

Bacteriology: The scientific study of bacteria, a branch of microbiology.

Biochemistry: The scientific study of the chemistry of living things.

Biofuels: Fuel made from renewable sources such as corn or crop waste. Common biofuel forms include biodiesel, ethanol and biogas.

Bioinformatics: The use of advanced computer technology for biological research. Bioinformatics is particularly important in managing and analyzing the large, complex data in genome research.

Biology: The scientific study of life.

Biopesticide: A substance created from living things that is used to kill insects and other pests.

Bioremediation: The use of microorganisms to clean up environmental problems, especially hazardous waste.

Biotechnology: The application of living things or their products to industry or technology. Usually involves the use or alteration of genetic material of living organisms.

Calibration: To make fine corrections or adjust the measuring system of instruments.

Cancer: Diseases in which abnormal cells divide without control. Cancer cells can invade nearby tissue and spread through the body.

Cell culture: Growth of living organisms in a laboratory in a specially prepared

medium outside of their normal growing environment. In biotechnology, host cells containing recombinant DNA are grown in cell cultures.

Cell: The smallest unit of any living thing. All living things are made up of cells.

Chemistry: The science of the composition and reactions of atomic and molecular systems.

Clinical trials: Studies of new drugs on patients to measure the effectiveness of the drug.

Clone: A group of identical copies of a gene, cell or organism all grown from the same parent. Cloning a gene involves creating a collection of genetically identical host cells - usually bacteria, yeast or certain mammalian cells - which all contain the same piece of recombinant DNA, including the target gene.

Culture: To grow cells in a laboratory in a specially prepared medium.

Diagnostic: A product used for the diagnosis of disease or medical condition. Monoclonal antibodies and DNA probes are diagnostic products developed through biotechnology.

DNA fingerprinting: A method of comparing the genetic similarities or differences between individuals. This technology is often used as a forensic tool to identify the source of blood and tissue samples found at crime scenes.

DNA: Deoxyribonucleic acid: The molecule that carries the genetic information for most living systems. DNA is essentially a blueprint for an organism.

Drug: Any material used to diagnose, treat, or prevent disease or other abnormal conditions.

Enzyme: A protein that assists chemical reactions needed for cell growth and reproduction.

FDA: The United States Food and Drug Administration. Regulates and approves all drugs.

Fermentation: The process of growing microorganisms to produce chemicals or pharmaceutical compounds. Microorganisms are usually grown under controlled conditions in large tanks called fermentors.

Fermentor: The large tank in which cells containing recombinant DNA are grown. Fermentors can vary in size from less than a liter to thousands of liters.

Forensic testing: Testing for the purpose of use in legal proceedings or law enforcement.

Fungus: A group of organisms that includes yeast, molds and mushrooms.

Gene: A segment of DNA in a specific location on a chromosome.

Gene mapping: Finding the locations of genes on a chromosome.

Gene sequencing: Decoding the sequence of bases on a strand of DNA.

Gene therapy: The replacement of a defective gene with a properly functioning one to treat a hereditary disease. Recombinant DNA techniques are used to insert the functioning gene into cells.

Genetic code: The molecular mechanism by which genetic information is stored in living organisms.

Genetic engineering: A technique used to change genetic material of living cells in order to make them produce new substances or products or to perform different functions.

Genetic testing: The use of a specific biological test of a person's genes to screen for inherited diseases or medical conditions.

Genetics: The scientific study of heredity or how particular characteristics or traits are passed from one generation to the next.

Genome: All the genetic information in the chromosomes of a particular organism.

Genomics: The study of genes and their functions.

GLPs: See Good Laboratory Practices.

GMPs: See Good Manufacturing Practices.

Good Laboratory Practices (GLPs): FDA rules that must be followed in design, practice and record keeping in laboratory studies of drugs and other materials regulated by Food and Drug Administration.

Good Manufacturing Practices: Strict FDA rules regarding methods and facilities used for manufacturing, packaging and storage of pharmaceuticals and other products regulated by Food and Drug Administration

Growth hormone: A protein produced by the pituitary gland that is involved in cell growth. Human growth hormone, used to treat dwarfism, was one of the first biotechnology drugs.

Heredity: Transfer of genetic information from parents to offspring.

Hormones: Chemicals produced by cells in the body that regulate the function of other cells or organs.

Human Genome Project: An international research effort to map and sequence all the genes found in human DNA.

ICH: See International Conference on Harmonisation

Instrumentation: The study, development and manufacture of scientific instruments and equipment.

International Conference on Harmonisation: An organization that creates international standards for testing pharmaceuticals in Japan, Europe and the United States. To avoid testing drugs several times in different countries, clinical trials and drug development often uses ICH standards.

Life science: Any of the science disciplines that studies living things.

Media (or medium): A substance containing nutrients needed for cell growth.

Metabolism: The physical and chemical reactions and processes involved in maintaining life.

Microbiology: Study of living organisms that can only be seen under a microscope.

Microorganism: Any organism that can be seen only with the aid of a microscope. Also called microbe.

Molecular biology: The study of the molecules that direct processes in cells; a specialty within biochemistry.

Monoclonal antibody: Highly specific, purified antibody that is derived from only one clone of cells and recognizes only one antigen.

Mutation: A change in the genetic makeup of a cell.

Nanotechnology: Use of technology to create materials on an atomic scale.

Nucleus: Part of the cell containing the chromosomes.

Organism: A living thing, which may be an animal, plant, bacterium, virus, fungus or other form.

Pathology: The scientific study of diseases.

PCR: see Polymerase chain reaction.

pH: A measure of acidity or alkalinity.

Pharmaceuticals: Drugs, including therapeutics that treat disease and diagnostics that are used to diagnose disease.

Pipette: A scientific instrument used to transfer small quantities of liquids.

Plasmid: A small circle of bacterial DNA, capable of copying itself independently in a host cell. Used in biotechnology to transfer DNA from one organism to another.

Polymerase chain reaction (PCR): A method of copying DNA sequences that uses cycles of heating and cooling.

Polymerases: Enzymes that assemble DNA (or RNA) chains from free nucleotides, using pre-existing DNA or RNA as models.

Protein purification: The process of extracting a desired protein material from cell cultures. Used to create drugs from recombinant cells.

Protein: A large, complex molecule. Many different proteins carry out essential functions in cells. Examples are hormones, enzymes and antibodies.

Proteomics: The study of proteins within cells, including identifying the different proteins in each type of cell in an organism, how the proteins function and interact with other proteins.

Protocol: The steps used in a scientific experiment.

Quality control: Quality control ensures that a biotechnology product is pure and that it meets specifications.

Recombinant DNA: DNA formed by combining segments of DNA from different organisms.

Recombination: The process of breaking apart and reconnecting DNA strands to create a new organism.

Replication: Duplication, such as making an exact copy of a strand of DNA.

RNA: Ribonucleic acid: A long chain-like molecule, similar to DNA. RNA helps translate the instructions encoded in DNA to build proteins.

Sequencing: Decoding the order of information on a strand of DNA.

SOPs: See Standard Operating Procedures.

Standard Operating Procedures: Exact procedures established by a company covering laboratory and manufacturing practices, including design, practice and record keeping in laboratory studies and methods and facilities used for manufacture, packaging and storage of materials. These must be followed to ensure accuracy of laboratory studies and purity of manufactured materials.

Therapeutics: Substances that are used to treat specific diseases or medical conditions.

Tissue culture: Growing cells in a laboratory in a specially prepared medium.

Toxic: Pertaining to a poisonous (or toxic) substance.

Transformation: Incorporation of foreign DNA into a cell.

Vaccine: A substance containing dead or weakened disease-causing organisms or parts of organisms used to give immunity against a disease caused by the organism.

Validation: To verify that a manufacturing process is being carried out according to approved methods.

Virus: A submicroscopic organism that contains genetic information but cannot reproduce itself. To reproduce, it must invade another cell and use parts of that cell's reproductive processes.

Yeast: A general term for single-celled fungi that reproduce by budding. Yeasts can ferment carbohydrates (starches and sugars) and thus are important in biotechnology, brewing and baking.