Biotechnology Careers

Research and Development Occupations

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Greenhouse Assistants

What They Do

Greenhouse Assistants carry out a variety of research tasks and experiments in the controlled environment of a greenhouse. They help researchers with experiments by maintaining equipment, recording results, keeping records, and making sure pests or plant diseases do not ruin the experiment. Greenhouse Assistants may run experiments on their own under the close supervision of researchers. They may also help study plants, analyze tissue samples, and prepare plants for DNA and cellular studies.

The main task of a Greenhouse Assistant is to care for plants being studied as part of biotechnology research projects. The projects they work on may be to create more robust crops, with better yields, or that can withstand harsh conditions. Some plant experiments involve placing genes that produce drugs into plants, to provide an inexpensive way of making pharmaceuticals.

Their wide-ranging responsibilities may include planting seeds, watering and weeding the plant beds, planting rooted plants, and nurturing root cuttings for new plantings. Greenhouse Assistants may operate machinery and equipment such as tractors, mowers, sprayers and assorted power tools.

Greenhouse Assistants in the biotechnology industry must take great care in their work because the plants they deal with may be the products of recombinant DNA research or other specialized experiments. These plants may also be rare or unique and may need extra care.

*Greenhouse Assistants in the biotech industry share characteristics of Agricultural & Food Science Technicians and Life, Physical, and Social Science Technicians, All Other. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Science – Using scientific rules and methods to solve problems.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.
- Quality Control Analysis – Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
- Near Vision – The ability to see details at close range (within a few feet of the observer).
- Number Facility – The ability to add, subtract, multiply, or divide quickly and correctly.

Training/Requirements

- High school diploma or associate degree or equivalent.
- Possess up to two years of greenhouse or plant experience.

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Greenhouse Assistants

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Greenhouse Assistants, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Greenhouse Assistants.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Agricultural & Food Science Technicians				
19-4011	3,000	3,300	90	$10.90 to $18.96
Life, Physical, and Social Science Technicians, All Other				
19-4099	11,600	14,300	540	$15.63 to $26.73

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Laboratory Assistants

What They Do

Laboratory Assistants help chemists, physicists, and other scientists in conducting tests, experiments, and analyses. They work in a variety of areas of biotechnology such as research, production, or process monitoring. Specific duties vary according to the purpose of the laboratory, and the type of tests completed. Laboratory Assistants always work under the direction of a scientist or team leader. They clean and maintain lab equipment and ensure the lab is stocked with necessary supplies.

Their responsibilities might include set-up; equipment maintenance, calibration and monitoring; troubleshooting; and sample labeling. They may also be responsible for maintaining samples, growth media and specimens, and ensuring quality control. Test results must be recorded and compiled daily, entered into computerized databases or entry books, and charts or graphs prepared to illustrate results.

*Laboratory Assistants in the biotech industry share characteristics of Biological Technicians and Life, Physical, and Social Science Technicians, All Other. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Science – Using scientific rules and methods to solve problems.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.
- Mathematics – Using mathematics to solve problems.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Operation and Control – Controlling operations of equipment or systems.

Training/Requirements

- Certification or associate degree in the laboratory sciences.
- Have up to two years of laboratory experience. (See **Additional Sources of Information**.)

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Laboratory Assistants

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Laboratory Assistants, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Laboratory Assistants.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Biological Technicians				
19-4021	5,800	7,400	260	$14.15 to $23.72
Life, Physical, and Social Science Technicians, All Other				
19-4099	11,600	14,300	540	$15.63 to $26.73

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Institute of Biological Sciences
(202) 628-1500
www.aibs.org

Society of Industrial Microbiology
(703) 691-3357
www.simhq.org

Biotechnology Industry Organization
(202) 962-9200
www.bio.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Laboratory Support Workers

What They Do

Laboratory Support Workers, also known as Lab Glass Washers or Lab Glass Cleaners, wash and dry glass and plastic ware such as pipettes, petri dishes, and test tubes. They collect the dirty items from laboratory stations, and stock clean inventory where needed. They must keep the glass-washing facility clean and swept, according to standard guidelines. To make sure no unwanted organisms are introduced to elements within an experiment, these workers use an autoclave to sterilize glassware and other items. They also test cleaned glassware for sterility. They keep records of the equipment that is used and cleaned, generally on a computer database.

These workers may also receive samples to be assayed, prepare samples for study, maintain and repair equipment, perform instrument set up and calibration, maintain quality control, keep records, guide other lab workers, and ensure lab cleanliness.

Duties may include keeping inventory and ensuring that needed supplies are ordered. Since glassware is by nature fragile, breakage does occur. A Laboratory Support Worker performs routine upkeep of glass-washing equipment and is assigned other related duties as required.

*Laboratory Support Workers in the biotech industry share characteristics of Medical Equipment Preparers and Dishwashers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Equipment Maintenance – Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.
- Information Ordering – The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).
- Trunk Strength – The ability to use your abdominal and lower back muscles to support part of the body repeatedly or continuously over time without 'giving out' or fatiguing.
- Manual Dexterity – The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.
- Mechanical – Knowledge of machines and tools, including their designs, uses, repair, and maintenance.
- Problem Sensitivity – The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

Training/Requirements

- High school diploma or associate degree or equivalent.
- Up to two years of work experience preferred.

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Laboratory Support Workers

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Laboratory Support Workers, the occupations listed below are found in the biotechnology industry and have similar duties to Laboratory Support Workers. The California outlook and wage figures below are drawn from all industries and represent occupations comparable to Laboratory Support Workers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Medical Equipment Preparers				
31-9093	2,900	3,600	120	$11.34 to $16.65
Dishwashers				
35-9021	59,700	67,600	2,800	$7.29 to $8.55

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

California Community Colleges Biotechnologies Initiative
(800) 344-3812
http://www.cccbiotech.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Plant Breeders

What They Do

Plant Breeders work with researchers to improve agricultural crops. These improvements will permit plants to be grown in hostile conditions, such as land that is salty, too moist, or in areas that are too hot or too cold. Desirable characteristics such as improved nutritional composition, better resistance to pesticides, or enhanced ability to ward off disease or pests may also be bred into crops. Some plants are even genetically altered to produce drugs and other products that can be used to treat diseases.

Plant breeding is, of course, hundreds of years old; what is new is the ability to make genetic changes more rapidly and in ways that are not possible with traditional breeding techniques.

Plant Breeders help design, develop, carry out, and implement plant breeding research projects working with a research team. Plant breeders may use exotic germ plasm and work with a variety of breeding systems, integrating them with biotechnology as needed to enhance selection methods and speed up product development. They may be responsible for project planning and personnel management.

Plant Breeders plant seeds, water and weed plant beds, plant rooted plants, and nurture root cuttings for future planting. Plant Breeders watch for trends in a plant's growth and signs of disease and record any changes. They monitor the plant's growth, the plant's productivity, and its pest infestations. Once this information is gathered, they enter it into a computer database and help interpret experimental results. This data is then given to Research and Development Scientists for analysis. Plant Breeders sometimes apply pesticides, and may need State certification.

*Plant Breeders in the biotech industry share characteristics of Plant Scientists and Agricultural Technicians. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Science – Using scientific rules and methods to solve problems.
- Mathematics – Using mathematics to solve problems.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.

Training/Requirements

- Bachelor's degree or equivalent.
- Up to two years of experience in plant breeding and/or agronomics. (See **Additional Sources of Information**.)
- Training in plant breeding or plant science.

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Plant Breeders

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Plant Breeders, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Plant Breeders.

Standard Occupational Classification	Estimated Number of Workers 2000	Estimated Number of Workers 2010	Average Annual Openings	2004 Wage Range (per hour)
Food Scientists and Technologists				
19-1012	1,800*	2,100*	60*	$19.20 to $35.88
Soil and Plant Scientists				
19-1013	1,800*	2,100*	60*	$20.81 to $36.14
Agricultural Technicians				
19-4011	3,000	3,300	90	$10.90 to $18.96

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
**Projections data is at the broader occupation group level: Agricultural and Food Scientists.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Seed Trade Association
(703) 837-8140
www.amseed.com

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Research Associates (R&D)

What They Do

Research Associates work individually and as part of a team in doing research and laboratory tasks. Directed by a scientist, they use electron microscopes, computers, thermal cyclers, and a wide variety of other equipment to study the properties of cells and parts of cells. They regularly record and analyze their findings, and interpret results in the forms of technical reports, summaries, protocols, and quantitative analyses. They keep current on methods and breakthroughs through reading scientific journals and publications. Research Associates participate in scientific conferences and publish articles for scientific journals.

They are involved in many scientific fields of study, including 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. Research Associates are sometimes expected to identify patentable inventions for their employer.

*Research Associates in the biotech industry share characteristics of Biochemists & Biophysicists, Microbiologists, Zoologists & Wildlife Biologists, Life Scientists, All Other, and Chemists. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Physics – Knowledge and prediction of physical principles, laws, their interrelationships, and applications to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and subatomic structures and processes.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Science – Using scientific rules and methods to solve problems.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
- Complex Problem Solving – Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
- Inductive Reasoning – The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).
- Deductive Reasoning – The ability to apply general rules to specific problems to produce answers that make sense.
- Writing – Communicating effectively in writing as appropriate for the needs of the audience.

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Research Associates (R&D)

Training/Requirements

- Bachelor or master's degree in a discipline such as biology, biochemistry, chemistry, molecular biology, or biotechnology.
- Possess up to two years of laboratory experience with master's and two to five years with bachelor's. (See **Additional Sources of Information**.)

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Research & Development Research Associates, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wages figures are drawn from all industries and represent occupations comparable to Research Associates.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Biochemists & Biophysicists				
19-1021	2,700	3,700	190	$23.14 to $42.55
Microbiologists				
19-1022	1,600	2,200	110	$22.58 to $37.74
Life Scientists, All Other				
19-1099	5,800	7,400	260	$27.02 to $40.97
Chemists				
19-2031	10,300	12,700	580	$20.51 to $37.71
Zoologists				
19-1023	1,500	1,700	70	$19.54 to $33.54

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Society of Clinical Research Associates
(800) 762-7292
www.socra.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Research Scientists

What They Do

Research Scientists apply scientific knowledge and theory to develop new biotechnology products. To accomplish this, they operate on the edge of scientific knowledge, and pioneer improved ways of solving existing problems. In some ways, these workers are the creative engine that drives the industry.

Research Scientists study living things and their component parts, including all forms of life—animals, plants, fungi, bacteria and viruses. These scientists must be extremely well-versed concerning their subject matter so that they can efficiently utilize company material and intellectual resources. Some work with potentially dangerous bacteria, viruses and hazardous chemicals. They must follow strict safety procedures to avoid harming themselves or others.

Research Scientists use the genetic code of organisms to determine which genes control different traits of organisms. This knowledge is used to help create drugs, vaccines, medicines and treatments for cancer, AIDS and many other diseases. They develop products to clean up hazardous waste, and develop new crops that resist disease or increase production of crops, milk, and animals. Scientists also dig deep into the inner workings of the cell so they can identify key areas where drug intervention can help cure diseases.

Research Scientists devise experiments, conduct research and even invent techniques and equipment they need to do their research. They often work as part of a team of other researchers and support staff that may include Research Assistants, Laboratory Technicians and Assistants who do most of the hands-on laboratory work. Scientists spend much time reading other research papers that have a bearing on their work. Research Scientists may supervise other Scientists and Research Associates and assume management responsibilities. They may publish the results of their research in peer-reviewed scientific journals, as well as attend meetings where they may present their findings to groups of other scientists.

*Research Scientists in the biotech industry share characteristics of Biochemists & Biophysicists, Microbiologists, Zoologists & Wildlife Biologists, Life Scientists, All Other, and Chemists. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Physics – Knowledge and prediction of physical principles, laws, their interrelationships, and applications to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and subatomic structures and processes.
- Mathematics – Knowledge of arithmetic, algebra, calculus, statistics, and their applications.
- Science – Using scientific rules and methods to solve problems.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
- Complex Problem Solving – Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

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Research Scientists

- Inductive Reasoning – The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).
- Deductive Reasoning – The ability to apply general rules to specific problems to produce answers that make sense.
- Writing – Communicating effectively in writing as appropriate for the needs of the audience.

Training/Requirements

- Doctorate degree in a scientific discipline with up to two years of experience. (See **Additional Sources of Information**).

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Research Scientists, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wages figures on the following page are drawn from all industries and represent occupations comparable to Research Scientists.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Biochemists & Biophysicists				
19-1021	2,700	3,700	190	$23.14 to $42.55
Microbiologists				
19-1022	1,600	2,200	110	$22.58 to $37.74
Zoologists & Wildlife Biologists				
19-1023	1,500	1,700	70	$19.54 to $33.54
Life Scientists, All Other				
19-1099	5,800	7,400	260	$27.02 to $40.97
Chemists				
19-2031	10,300	12,700	580	$20.51 to $37.71

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Federation of American Societies for Experimental Biology
(301) 634-7000
www.faseb.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biotechnology Careers

Clinical Research Occupations

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Animal Handlers

What They Do

Animal Handlers provide the daily care of laboratory and farm animals used in biotechnology research and testing. They may work with exotic animals such as primates and snakes; farm animals such as sheep, cattle, and pigs; domestic animals such as cats, birds, and dogs; or laboratory perennials, such as rats, mice, and frogs. They ensure animal care complies with government regulations for humane treatment of laboratory animals.

Animal Handlers are responsible for the hygiene of animals and their environment. They clean and sanitize cages, pens, and equipment. They change bedding material and wash food containers. They order, load, unload, and store feed and supplies. They mix food, liquid formulas, medications, or food supplements according to directions, prescriptions, and knowledge of animal species. They exercise, water, and feed animals according to a schedule and instructions.

They examine the animals for signs of illness and administer laboratory tests to experimental animals. They record food intake, diet, weight, size, and physical condition. They may administer medicinal doses, inoculations, or topical treatments. They groom and bathe animals and maintain the proper temperature and humidity of their quarters. Animal Handlers working in agricultural biotechnology may assist with artificial insemination, births, or milking.

Animal Handlers must observe health and safety procedures when working with research animals to avoid injury or disease. Animal Handlers may advance to Animal Technician with further training and experience.

*Animal Handlers in the biotech industry share characteristics of Nonfarm Animal Caretakers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Speaking – Talking to others to convey information effectively.
- Oral Expression – The ability to communicate information and ideas in speaking so others will understand.
- Problem Sensitivity – The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

Training/Requirements

- High school diploma or equivalent with a scientific background.
- Some employers prefer to hire employees that possess the Assistant Laboratory Animal Technician (ALAT) or similar certificate. (See **Additional Sources of Information.**)
- Possess up to two years of laboratory experience.

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Animal Handlers

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Animal Handlers, the occupation listed below is found in the biotechnology industry and has similar duties to Animal Handlers. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Animal Handlers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Nonfarm Animal Caretakers				
39-2021	8,400	10,100	380	$7.92 to $12.28

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Association for Laboratory Animal Science
(901) 754-8620
www.aalas.org

Northern California Branch of the American Association for Laboratory Animal Science
www.ncbaalas.org

Association for the Assessment and Accreditation of Laboratory Animal Care
(301) 231-5353
www.aaalac.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Animal Technicians

What They Do

Animal Technicians assist scientists who use laboratory and farm animals in biotechnology research or product testing. Animal Technicians feed, water, and examine laboratory animals for signs of illness, disease, or injury. Technicians help develop procedures for the care of laboratory animals. They are generally responsible for receiving new animals, transporting them, handling them, monitoring them, and keeping detailed records of the animals' health. They write reports, maintain research information, and perform clerical duties.

Animal Technicians help provide routine veterinary care for research animals before and after surgery. Animal Technicians prepare surgical areas, assist in veterinary care, administer anesthetics and medicine, take temperatures, help restrain animals and carry out preventative care. Technicians collect laboratory specimens such as blood, urine, and feces for testing. They may euthanize animals and dispose of the remains.

Animal Technicians maintain inventories of animal care supplies. Technicians also take care of laboratory equipment. They clean and disinfect cages and sterilize laboratory and surgical equipment by using cagewashers and autoclaves.

They may also obtain or breed the animals needed in laboratories.

*Animal Technicians in the biotech industry share characteristics of Veterinary Assistants and Laboratory Animal Caretakers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Science – Using scientific rules and methods to solve problems..
- Active Listening – Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- Equipment Selection – Determining the kind of tools and equipment needed to do a job.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.
- Wrist-Finger Speed – The ability to make fast, simple, repeated movements of the fingers, hands, and wrists.

Training/Requirements

- Most employers prefer certification in laboratory animal technology. (See **Additional Sources of Information**.)
- Three years experience working with laboratory animals. Less experience required with two-year or four-year college degree.

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Animal Technicians

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Animal Technicians, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Animal Technicians.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Veterinary Assistants and Laboratory Animal Caretakers				
31-9096	6,600	7,500	210	$8.80 to $12.65

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Association for Laboratory Animal Science
(901) 754-8620
www.aalas.org

Northern California Branch of the American Association for Laboratory Animal Science
www.ncbaalas.org

Association for the Assessment and Accreditation of Laboratory Animal Care
(301) 231-5353
www.aaalac.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Bioinformatics Specialists

What They Do

Bioinformatics has transformed the discipline of biology from a purely lab-based science to an information science as well. —National Center for Biotechnology Information

Biological processes are so complex that researchers are only now beginning to tease out the details of the human and animal genetic codes. The collection and management of data is instrumental to deciphering these complexities. It is at this interface of research and data management that the Bioinformatics Specialists work. Job titles used include bioinformaticist, bioinformatics analyst, bioinformatics scientist, and bioinformation programmer.

These computational biology specialists are well versed in both the life sciences and data processing. Modern biotech research and manufacturing could not exist without powerful computing capabilities and equipment. Bioinformatics Specialists may work on such data as DNA and protein sequence, microarray, and biological pathways analysis.

Some of the techniques they use include data mining, analysis, presentation, and storage of biological data. Not only did the information have to be stored, it had to be organized and disseminated to other scientists around the world. Formerly, life scientists worked within small discrete communities studying isolated biological problems. As the knowledge base of science grows at an ever-accelerating rate, the challenge of managing the research data creates both promise and problem. The exchange of seemingly unrelated pieces of information has given scientists in disparate areas of research insight into problems that would otherwise go unsolved. A well-known example is the polymerase chain reaction (PCR) technique for amplifying small amounts of DNA in a sample. The PCR analysis uses an enzyme from a bacteria that lives in the near-boiling waters of Yellowstone's geoactive regions. This technique gives forensic scientists a remarkable tool to help identify criminals from minuscule bits of DNA left at a crime scene.

Information in the public domain must be disseminated. For example, the National Institute of Health responds to about three million requests per day for life science information. Bioinformatics Specialists design and apply computer systems and databases to organize, analyze, and mine biological data. They work with a team of software engineers and biologists to develop and maintain a biologic database. They may create code and documentation and provide support to users. They troubleshoot operational errors and decide what action is needed. They collect, assemble, and curate emerging data. They collaborate with laboratory scientists to define and design informatics projects of value to the pharmaceutical and health care industry.

Bioinformatics Specialists must be able to work independently and as part of a team to apply their knowledge of clinical trials, sequence analysis, microarrays, and laboratory information management systems.

*Bioinformatic Specialists in the biotech industry share characteristics of Database Administrators and Applications Computer Software Engineers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Computers and Electronics – Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

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Bioinformatics Specialists

- Operations Analysis – Analyzing needs and product requirements to create a design.
- Science – Using scientific rules and methods to solve problems.
- Programming – Writing computer programs for various purposes.
- Written Comprehension – The ability to read and understand information and ideas presented in writing.
- Oral Expression – The ability to communicate information and ideas in speaking so others will understand.

Training/Requirements

- Master of Science or Ph.D. in bioinformatics, computer engineering, computational biology, or related field. Ph.D. in genetics or genomics required for some positions.
- Must have strong background in both computational and life science.
- Biological laboratory experience.
- Up to two years of related experience and knowledge of a company's products is desirable.

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Bioinformatics Specialists, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Bioinformatics Specialists.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Computer Software Engineers, Applications				
15-1031	79,100	108,900	3,760	$32.25 to $50.98
Database Administrators				
15-1061	13,600	19,300	710	$23.53 to $43.80

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

National Center for Biotechnology Information
(301) 496-2475
www.ncbi.nlm.nih.gov

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biostatisticians

What They Do

Biostatisticians apply statistical and mathematical tools to the study of biological issues. Biostatisticians help design studies that target diverse health, agricultural, and environmental issues, such as predicting disease patterns, evaluating treatment procedures, testing the effectiveness and safety of medications, and measuring other relevant data.

Biostatisticians develop and test complex experimental designs, sampling techniques, and analytical methods. They may design sample studies that use dummy data to troubleshoot the proposed design. They evaluate the statistical methods and procedures used to obtain data in order to ensure validity, applicability, efficiency, and accuracy. They examine theories, such as those of probability and inference in order to discover a mathematical basis for new or improved methods of obtaining and evaluating numerical data. Biostatisticians help interpret analyses and write the statistical summary sections for regulatory documents and research papers.

They help write and edit research results for publication in scientific journals or presentations at scientific meetings. They may help formulate studies and design databases to store data.

They may conduct ongoing studies and long-term trials of manufactured products and drugs to ensure safety and efficacy. They work closely with other staff including scientists, data collection teams, and medical staff. They may supervise staff including other statisticians. Biostatisticians work in pharmaceutical and biotech firms, government, managed care organizations, research organizations, and universities. Biostatisticians must possess excellent written and verbal communication skills to communicate with project team members. They must be knowledgeable of terminology and regulations relating to standard clinical practices.

*Biostatisticians in the biotech industry share characteristics of Statisticians. Detailed descriptions of this occupation may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Active Learning – Understanding the implications of new information for both current and future problem-solving and decision-making.
- Complex Problem Solving – Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Training/Requirements

- Master's or doctorate degree in mathematics or statistics.
- Possess one to four years related experience.

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Biostatisticians

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Biostatisticians, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wage figures are drawn from all industries and represent an occupation comparable to Biostatisticians.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Statisticians				
15-2041	3,300	3,700	130	$25.46 to $45.10

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Statistical Association
(888) 231-3473
www.amstat.org

International Biometric Society
(202) 712-9049
www.tibs.org

The Western North American Region of The International Biometric Society
www.wnar.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Clinical Research Associates

What They Do

Clinical Research Associates help design and monitor clinical research projects including clinical trials that test new pharmaceuticals on humans. They write detailed documents called 'protocols' showing how a clinical trial is to be conducted. In some cases, these workers help design experiments using drugs on animals, a process called pre-clinical testing.

Clinical Research Associates help recruit and screen human subjects for clinical trials. They help develop and obtain informed consent from subjects and manage patient participation in the trials. They may issue payments to study participants.

Their general duties include training and coordinating the activities of staff, visiting clinical testing sites to ensure facilities are adequate, and mentoring junior staff. They maintain regular contact with clinical trial staff to ensure regulations are followed and they participate in government audits.

They may also evaluate, maintain and analyze research databases. They may write grant proposals and prepare budgets. They help ensure clinical trials are conducted in compliance with government regulations and ethical standards. They may be asked to make presentations at scientific conferences and may write articles for technical journals.

Clinical Research Associates work for pharmaceutical companies, biotechnology firms, medical device manufacturers, medical research universities, government agencies, and contract research organizations. Large organizations have several levels of Clinical Research Associate positions leading to senior and management positions.

*Career Research Associates in the biotech industry share characteristics of Medical Scientists and All Other Life Scientists. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Active Learning – Understanding the implications of new information for both current and future problem-solving and decision-making.
- Science – Using scientific rules and methods to solve problems.
- Instructing – Teaching others how to do something.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Speaking – Talking to others to convey information effectively.

Training/Requirements

- Bachelor or master's degree in life sciences, health field, or RN degree.
- Possess up to two years experience in medical research, pharmaceutical research, or nursing.
- Voluntary certification enhances employability. (See **Additional Sources of Information**.)

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Clinical Research Associates

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Clinical Research Associates, the occupations listed below are found in the biotechnology industry and have similar duties to Clinical Research Associates. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Clinical Research Associates.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Medical Scientists, Except Epidemiologists				
19-1042	9,800	13,200	510	$26.56 to $44.07
Life Scientists, All Other				
19-1099	5,800	7,400	260	$27.02 to $40.97

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Society of Clinical Research Associates
(800) 762-7292
www.socra.org

Association of Clinical Research Professionals
(703) 254-8100
www.acrpnet.org

Society for Clinical Trials
(410) 433-4722
www.sctweb.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Medical Writers (Technical Writers)

What They Do

Medical Writers involved in clinical research write the clinical documents needed to obtain approval from regulatory agencies for new drugs or medical devices. These documents include new drug application documents, investigator's brochures, marketing authorization application documents, reports of clinical trials, and special regulatory requested documents. The writing style is objective and non-promotional. They may also edit similar material written by other writers. They must be well versed in biomedical terminology and the requirements of regulatory agencies. They work closely with research staff and may assist them in the preparation of protocols. Medical Writers may also write product reviews, training manuals for sales force, slide presentations, video scripts, posters, abstracts and manuscripts for science journals, and textbooks. They should have the ability to organize and prioritize work to meet deadlines and will need proficiency in word processing or desktop publishing software, statistics, epidemiology, demography, public health, and geographic information systems.

*Medical Writers in the biotech industry share characteristics of Technical Writers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- English Language – Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
- Communications and Media – Knowledge of media production, communication, and dissemination techniques and methods. This includes alternative ways to inform and entertain via written, oral, and visual media.
- Active Listening – Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- Active Learning – Understanding the implications of new information for both current and future problem-solving and decision-making.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
- Writing – Communicating effectively in writing as appropriate for the needs of the audience.
- Monitoring – Monitoring/assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.

Training/Requirements

- Bachelor or master's degree in life sciences.
- Extension programs at several California colleges and universities offer certificates in technical writing.

Pharmaceutical firms usually hire Medical Writers with several years' experience in regulatory processes. Contract research organizations (CROs) offer more opportunity for the fledgling Medical Writer to gain experience writing for clinical trials in various stages of development. Professional associations offer classes or certification specific to medical writing. The Drug Information Association has a certificate program in Medical Communication.

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Medical Writers (Technical Writers)

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Medical Writers, the occupation listed below is found in the biotechnology industry and has similar duties. Medical Writers are found within the broad occupational group, Technical Writers. The California outlook and wages in the figures below are drawn from all industries and represent a comparable occupation.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Technical Writers				
27-3042	7,300	9,000	380	$25.29 to $41.03

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Northern California Science Writers Association
www.ncswa.org

National Association of Science Writers, Inc.
(304) 754-5077
www.nasw.org

Northern California American Medical Writers Association
www.amwancal.org

Council of Science Editors
(703) 437-4377
www.councilscienceeditors.org

Society for Technical Communication
(703) 522-4114
www.stc.org

Drug Information Association
(215) 442-6100
www.diahome.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biotechnology Careers

Manufacturing Occupations

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Assay Analysts

What They Do

Assay analysts conduct routine qualitative and quantitative analysis of tissue and cell cultures to ensure compliance with specifications. They follow written protocols to run the tests. They also prepare, maintain, and check reagents, cell and tissue cultures, and equipment prior to running tests. They document experimental results and write technical reports using word processing and spreadsheet software. They may help modify assay procedures to run faster and more accurately. They may also help make changes to the manufacturing processes as part of their work.

Assay Analysts must understand quality control systems and scale up, bioreactors, filtration, centrifugation, and other basic cell culture unit operations.

*Assay Analysts in the biotech industry share characteristics of Chemical Technicians and Biological Technicians. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Science – Using scientific rules and methods to solve problems.
- Information Ordering – The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).
- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Training/Requirements

- Associate degree or bachelor of science degree.
- Up to two years of experience in sterile manufacturing environment.

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Assay Analysts

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Assay Analysts, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wages figures are drawn from all industries and represent occupations comparable to Assay Analysts.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Chemical Technicians				
19-4031	5,200	6,100	220	$13.58 to $22.95
Biological Technicians				
19-4021	5,800	7,400	260	$14.15 to $23.72

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Association of Analytical Communities
(800) 379-2622
www.aoac.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biochemical Development Engineers

What They Do

Biochemical Development Engineers develop and execute the scalable processes, instruments, and tools needed to generate a manufactured product, from the design stage to end-stage manufacturing. They design new manufacturing facilities and equipment and troubleshoot problems related to production equipment and systems. Biochemical Development Engineers use their knowledge of pilot plant, Current Good Manufacturing Practices (cGMP) standards, and bioprocess development environments to conduct research to develop new and improved chemical manufacturing processes.

Biochemical Development Engineers are responsible for recommending ways to cut production costs, while producing a quality product. They perform laboratory studies of steps in the manufacture of new products and troubleshoot proposed processes in small-scale pilot operations. They direct scale-up transfer of processes developed by scientists to manufacturing production processes resulting in a commercial product. These engineers may write research findings for scientific journals.

*Biochemical Development Engineers in the biotech industry share characteristics of Chemical Engineers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Physics – Knowledge and production of physical principles, laws, their interrelationships, and application to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and subatomic structures and processes.
- Science – Using scientific rules and methods to solve problems.
- Operations Analysis – Analyzing needs and product requirements to create a design.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Training/Requirements

- Bachelor or master's degree in chemical or biochemical engineering or related discipline.
- Up to two years of experience in pharmaceutical processes or research product development.

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Biochemical Development Engineers

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Biochemical Development Engineers, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Biochemical Engineers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Chemical Engineers				
17-2041	2,300	2,600	100	$33.92 to $56.57

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Institute of Chemical Engineers (AIChE)
(212) 591-7338
www.aiche.org

Northern California Section of AIChE
www.aiche-norcal.org

National Center for Manufacturing Sciences (NCMS)
(734) 995-0300
www.ncms.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Instrumentation/ Calibration Technicians

What They Do

Instrumentation/Calibration Technicians work on the specialized equipment necessary to the research and manufacturing processes in biotechnology. They test, calibrate, operate, and repair measuring and recording instruments, apparatus, and equipment. Some of the tools they use include flow meters, gas analyzers, mass balances, microscopes, digital multimeters, and oscilloscopes.

These workers test systems and assist in the validation of new or existing manufacturing plants. They may collect and organize data from manufacturers and users of equipment. They help identify, then purchase and organize the storage of repair parts. They document findings and prepare technical reports with recommendations for solving technical problems. They work with scientists, engineers and other staff.

*Instrumentation and Calibration Technicians in the biotech industry share characteristics of Electrical and Electronic Engineering Technicians and Inspectors, Testers, Sorters, and Weighers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Design – Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Equipment Selection – Determining the kind of tools and equipment needed to do a job.
- Equipment Maintenance – Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.
- Problem Sensitivity – The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.
- Deductive Reasoning – The ability to apply general rules to specific problems to produce answers that make sense.

Training/Requirements

- Associate's degree in biotechnology, electronics, instrumentation or health-related fields.
- Scientific background and from one to two years of experience in quality control systems.

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Instrumentation/ Calibration Technicians

California Job Outlook and Wages

While the Bureau of Labor Statistics does not collect wage and employment figures on Instrumentation and Calibration Technicians, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Instrumentation and Calibration Technicians.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Electrical and Electronic Engineering Technicians				
17-3023	27,700	32,000	1,010	$19.11 to $29.38
Inspectors, Testers, Sorters, and Weighers				
51-9061	57,400	62,700	1,840	$9.14 to $18.28

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

The American Society for Engineering Education
(202) 331-3500
http://www.asee.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Manufacturing Engineers

What They Do

Manufacturing Engineers work to make the most efficient manufacturing design possible. They may work to help develop, test, and evaluate integrated systems for managing small, medium or large industrial production facilities. They must concern themselves with a number of elements of the engineering equation, including the work environment, quality and inventory control, logistics and material flow, cost analysis, production coordination, and sometimes the development of equipment and tooling.

Manufacturing Engineers work with other engineering staff members to make sure everything is in place when a new product is made. They find out how much time is used by manufacturing personnel in doing each step of production. They may also help develop cost estimates for new and existing products. Their job requires keeping detailed records of their activities, as well as entering them into a computer database in order to devise reports.

*Manufacturing Engineers in the biotech industry share characteristics of Industrial Engineers. Detailed descriptions of this occupation may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Production Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Design – Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.
- Mathematics – Using mathematics to solve problems.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Oral Expression – The ability to communicate information and ideas in speaking so others will understand.
- Management of Material Resources – Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.

Training/Requirements

- Bachelor's degree in a science-related field, or an engineering bachelor's with knowledge of science.
- Up to two years experience in research product development or in manufacturing.

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Manufacturing Engineers

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Manufacturing Engineers, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wages figures are drawn from all industries and represent an occupation comparable to Manufacturing Engineers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineers				
17-2112	18,600	20,800	670	$30.00 to $44.98

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

California Department of Consumer Affairs
State Board of Registration for Professional Engineers
(800) 952-5210
www.dca.ca.gov

Institute of Industrial Engineers
(800) 494-0460
www.iienet.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Manufacturing Research Associates

What They Do

Manufacturing Research Associates work in the production, packaging, and distribution sections of a biotechnology firm. They observe the production line, making sure it runs according to the designed plan, and make adjustments in steps or equipment in order to improve the process. These workers work as part of a team. They use cleanroom process equipment such as chromatographs, centrifuges, fermentors and bioreactors. They also maintain production line equipment such as packaging machines.

These workers are responsible for keeping records of their activities and findings. They must keep regulatory guidelines in mind during the course of their work.

*Manufacturing Research Associates in the biotech industry combine characteristics of Industrial Engineers, Chemists, Microbiologists, and Biochemists. Detailed descriptions of these occupations are found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Active Learning – Understanding the implications of new information for both current and future problem solving and decision-making.
- Problem Sensitivity – The ability to tell when something is wrong or is likely to go wrong.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.

Training/Requirements

- Bachelor or master's degree in engineering, life sciences, or another scientific discipline.
- Up to two years of experience in a manufacturing environment.

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Manufacturing Research Associates

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Manufacturing Research Associates, the occupations below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Manufacturing Research Associates.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineers				
17-2112	18,600	20,800	670	$30.00 to $44.98
Chemists				
19-2031	10,300	12,700	580	$20.51 to $37.71
Microbiologists				
19-1022	1,600	2,200	110	$22.58 to $37.74
Biochemists and Biophysicists				
19-1021	2,700	3,700	190	$23.14 to $42.55

These figures do not include self-employment.
Source: www.labormarketinfo.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Institute of Industrial Engineers
(800) 494-0460
www.iienet.org

Occupational Information Network (O*NET)
http://online.onetcenter.org/

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Manufacturing Technicians

What They Do

Manufacturing Technicians help produce and package products. They operate and maintain a variety of manufacturing machines and equipment, making sure they work well and operate correctly. Technicians read dials and meters to verify equipment functions according to specifications. They clean, lubricate, connect, install, replace, or make minor adjustments or repairs to hoses, pumps, filters, or screens to maintain processing equipment, using hand tools. They order enough raw materials to ensure an adequate supply.

Manufacturing Technicians follow standard operating procedures to prepare a product. They may be responsible for inventory, weighing and measuring raw materials, and distributing them to the right machine at the right time. Technicians mix ingredients according to specifications. They use a computer to keep detailed records of the production process to ensure compliance with federal regulations. They may write standard operating procedures and assist with product sampling. Technicians maintain logs of instrument readings, test results, and shift production. They may have to work in special clothing in a "clean room" environment.

*Manufacturing Technicians in the biotech industry share characteristics of Team Assembler; Separating, Filtering, Clarifying, Precipitating and Still Machine Setters, Operators and Tenders; Crushing, Grinding and Polishing Machine Setters, Operators and Tenders; Extruding, Forming, Pressing, and Compacting Machine Setters, Operators and Tenders; and Other Production Workers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Mechanical – Knowledge of machines and tools, including their designs, uses, repairs, and maintenance.
- Operation Monitoring – Watching gauges, dials, or other indicators to make sure a machine is working properly.
- Operation and Control – Controlling operations of equipment or systems.
- Control Precision – The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.
- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Problem Sensitivity – The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.
- Operation Monitoring – Watching gauges, dials, or other indicators to make sure a machine is working properly.

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Manufacturing Technicians

Training/Requirements

- Certification or associate degree in biotechnology or related health sciences field.
- Several years of experience in sterile manufacturing environment preferred.

What's the Job Outlook?

While the Bureau of Labor Statistics does not collect data on Manufacturing Technicians, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Manufacturing Technicians.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Team Assemblers				
51-2092	113,900	113,700	2,920*	$8.39 to $13.30
Separating, Filtering, Clarifying, Precipitating and Still Machine Setters, Operators and Tenders				
51-9012	5,800	6,900	300	$12.73 to $20.05
Crushing, Grinding and Polishing Machine Setters, Operators and Tenders				
51-9021	2,900	2,900	80*	$9.46 to $16.41
Extruding, Forming, Pressing, and Compacting Machine Setters, Operators and Tenders				
51-9041	6,200	6,200	160*	$9.57 to $15.82
Production Workers, All Other				
51-9199	49,800	62,700	2,480	$7.70 to $10.19

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
**This figure represents annual openings due to separations only.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

National Association of Manufacturers
(202) 637-3000
www.nam.org

National Center for Manufacturing Sciences
(734) 995-0300
www.ncms.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Process Development Associates

What They Do

Process Development Associates put into place the best procedures to make the most product at the lowest cost. Manufacturing involves stable, efficient processes, and the Process Development Associate help makes this possible. Associates help conduct experiments that can point the way to efficient, cost-effective production techniques. They may help test for purity, develop assays for purified samples, and help resolve the inevitable problems that are associated with full-scale production.

The manufacturing processes may be in fermentation, purification, and aseptic fill areas. Packaging and distribution procedures might also fall within the associate's area of responsibility. They may be also responsible for researching, developing, and implementing new methods and technologies to improve production.

*Process Development Associates in the biotech industry combine characteristics of Industrial Engineers and Chemists. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Speaking – Talking to others to convey information effectively.
- Writing – Communicating effectively in writing as appropriate for the needs of the audience.
- Computers and Electronics – Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Systems Evaluation – Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.
- Active Learning – Understanding the implications of new information for both current and future problem solving and decision-making.
- Problem Sensitivity – The ability to tell when something is wrong or is likely to go wrong.

Training/Requirements

- Bachelor or master's degree in biosciences, other scientific disciplines, or in engineering.
- Up to two years experience in manufacturing.

In addition to the above requirements, associates working in biotechnology would benefit from taking coursework in biology, chemistry, and chemical production.

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Process Development Associates

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Process Development Associates, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wages figures are drawn from all industries and represent occupations comparable to Process Development Associates.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineers				
17-2112	18,600	20,800	670	$30.00 to $44.98
Chemists				
19-2031	10,300	12,700	580	$20.51 to $37.71

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Institute of Industrial Engineers
(800) 494-0460
www.iienet.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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State of California
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Process Development Engineers

What They Do

Before a new product can be produced and sold, an efficient and cost-effective way to manufacture it must be developed. An important member of the team that can make this possible is the Process Development Engineer. These engineers help innovate, develop, and design manufacture production processes that can produce an acceptable product at a cost that can allow the company to make a profit on it.

Process Development Engineers can design entire new production processes, or can modify existing ones to perform more efficiently and produce a product at a lower cost. They must keep detailed records of their work, and may need to persuade the company of a design's benefits. These engineers may oversee the implementation of a new or improved design. They may train technicians in the proper operation of a manufacturing process. They may operate as part of a team and may supervise other staff. These engineers develop manufacturing prototypes. Process Development Engineers may use existing tests or develop new ones to ensure the proper operation of a facility. These engineers often must troubleshoot problems.

Process Development Engineers also take into account the need to meet government regulations for manufacturing.

*Process Development Associates in the biotech industry combine characteristics of Industrial Engineers and Chemical Engineers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Systems Evaluation – Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Quality Control Analysis – Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
- Operations Analysis – Analyzing needs and product requirements to create a design.

Training/Requirements

- Bachelor or master's degree in the biosciences or in electrical, mechanical, or chemical engineering.
- Up to two years of related experience.

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Process Development Engineers

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Process Development Engineers, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wages figures are drawn from all industries and represent occupations comparable to Process Development Engineers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineers				
17-2112	18,600	20,800	670	$30.00 to $44.98
Chemical Engineers				
17-2041	2,300	2,600	100	$33.92 to $56.57

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Institute of Industrial Engineers
(800) 494-0460
www.iienet.org

American Institute of Chemical Engineers
(212) 591-7338
www.aiche.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Production Planners/ Schedulers

What They Do

Manufacturing exists to create a product and then deliver it to a customer. Modern manufacturing facilities operate most efficiently and cost-effectively if production can be tailored to the needs of the customers. This is where the Production Planner Scheduler comes into the picture. This worker plans, schedules, and coordinates the manufacturing process to meet the demand for the products.

Production Planner Schedulers make up timetables for each step of the manufacturing process, making sure the proper raw materials are available, and also making sure the production facility is ready to meet demand in the proper amount and on time. They track all workflow through the facility. Schedulers work closely with production, quality control, customer service, and marketing and sales to make sure that production schedules can be met and that the finished products are meeting company standards and customer needs. They keep careful records of customer's orders, raw materials, and material production, and understand all phases in the supply chain. They work closely with other manufacturing staff, including customer service and product engineering. They work with mathematical concepts such as probability, statistics, geometry, and trigonometry, and apply concepts such as fractions, percentages, ratios, and proportions to practical situations. Schedulers regularly use software programs such as word processing, spreadsheets, and relational databases.

*Production Planners/Schedulers in the biotech industry combine characteristics of Industrial Engineers and Production, Planning, and Expediting Clerks. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Clerical – Knowledge of administrative and clerical procedures and systems such as word processing, managing files and records, stenography and transcription, designing forms, and other office procedures and terminology.
- Active Listening – giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Complex Problem Solving – Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

Training/Requirements

- Bachelor's degree in biological or physical sciences almost always required.
- Two years manufacturing experience.

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Production Planners/ Schedulers

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Production Planners/Schedulers, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wages figures are drawn from all industries and represent occupations comparable to Production Planners/Schedulers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineers				
17-2112	18,600	20,800	670	$30.00 to $44.98
Production, Planning, and Expediting Clerks				
43-5061	37,700	43,300	1,470	$14.40 to $23.97

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Institute of Industrial Engineers
(800) 494-0460
www.iienet.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biotechnology Careers

Regulatory Affairs Occupations

Documentation Coordinators 85
Documentation Specialists 87

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Documentation Coordinators

What They Do

Documentation Coordinators maintain a biotechnology firm's master filing system, most of which is stored electronically. Documents required during a product's development and manufacturing phases are varied and many, and include standard operation procedures, federal approval applications, grants, compliance forms, and other materials important to the company's functioning. These workers create, distribute, and audit all documentation materials to make sure they are current and accurate. Coordinators also make certain these documents are available to appropriate personnel or outside entities when requested.

Documentation Coordinators scan and store important documents in electronic files, convert documents to editable format, reformat documents to comply with guidelines, and archive company records. They also may make labels and key enter data into databases or documents.

Important skills, knowledge, and abilities include:

- Reading Comprehension – Ability to understand written sentences and paragraphs in work related documents.
- Oral Expression – Ability to communicate information and ideas in speaking so others will understand.
- Clerical – Knowledge of administrative and clerical procedures and systems such as word processing, managing files and records, stenography and transcription, designing forms, and other office procedures and terminology.
- Customer and Personal Service – Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
- Active Listening – Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

Training/Requirements

- High school diploma or associate degree.
- Up to two years of experience in documentation, quality control or quality assurance.

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Documentation Coordinators

What's the California Job Outlook?

The figures below are drawn from surveys across all industries and represent the broad occupational group, General Office Clerks, which includes Documentation Coordinators.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Office Clerks, General				
43-9061	400,300	446,500	13,490	$9.41 to $15.86

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

International Association of Administrative Professionals
816-891-6600
www.iaap-hq.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Documentation Specialists

What They Do

Documentation Specialists handle the regulatory affairs, compliance, and electronic submission aspects of a biotechnology company. In smaller firms there may be one Specialist handling all related tasks, while larger biotechnology firms may hire several professionals to divide the responsibilities. These workers are sometimes known as regulatory affairs specialists, electronic submission specialists, or compliance specialists.

Documentation Specialists coordinate and prepare document packages for submission to regulatory agencies. They compile all materials required for regulatory submissions, license renewal, and registrations. They must stay current with regulatory procedures and changes. They monitor and improve tracking and control systems and recommend strategies for earliest possible approvals of clinical trial applications.

Some Documentation Specialists focus on electronic submission of documentation. They train others on e-submission procedures and software and coordinate submission issues between departments. They authorize applications, notices, and electronic submission forms required by government agencies such as the Food and Drug Administration and Information Security Office.

Documentation Specialists who concentrate on compliance coordinate, prepare, and perform internal and external audits, ensuring compliance with regulatory standards. They collaborate with clients to develop positive and productive approaches to regulatory compliance. They participate in Good Laboratory Practices (GLP) training of functional areas and assist in development of training sessions. They coordinate activities for regulatory agency inspections.

*Documentation Specialists in the biotech industry share characteristics of Management Analysts. Detailed descriptions of this occupation may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Administration and Management – Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.
- Writing – Communicating effectively in writing as appropriate for the needs of the audience.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Speaking – Talking to others to convey information effectively.
- Systems Evaluation – Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.
- Active Listening – Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

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Documentation Specialists

Training/Requirements

- Bachelor's degree in a scientific field.
- Three to five years experience in documentation, quality control, or quality assurance.

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Documentation Specialists, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wage figures are drawn from all industries and represent an occupation comparable to Documentation Specialist.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Management Analysts 13-1111	53,300	71,600	2,560	$25.83 to $46.41

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Source of Information

American Management Association International
(800) 262-9699
www.amanet.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biotechnology Careers

Quality Systems Occupations

Microbiologists 91
Quality Assurance Auditors 93
Quality Control Analysts 95
Quality Control Engineers 97
Quality Control Inspectors 99
Safety Specialists 101
Validation Technicians 103

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Microbiologists

What They Do

Microbiologists study the growth, characteristics, and effects of bacteria and other microorganisms to better understand their relation to human, plant, and animal health. They look for unwanted microorganisms in raw materials and in finished products. Using various pieces of equipment, they examine microorganisms to ensure that company and regulatory quality standards are being met. They are also responsible for maintaining good records of their studies.

Microbiologists in biotechnology use microscopes to examine the physiological, morphological, and cultural characteristics of microorganisms in humans, water, food, and plants. They research, identify and classify these microorganisms to develop products such as vitamins, antibiotics, amino acids, grain alcohol, sugars, and polymers. They conduct experiments, often with minimal guidance, operating and maintaining laboratory equipment and working according to good laboratory procedures (GLP) safety guidelines.

They perform activities related to cell harvesting, downstream processing, and product recovery or isolation. During both research studies and the manufacturing process, Microbiologists must screen for any novel organisms and activities. In addition to documenting the progress of their experiments and findings, they write and execute technical studies.

Microbiologists analyze products by developing offline assays. They ensure the production of recombinant microorganisms (e.g., a combination of DNA molecules taken from different sources).

These workers must be able to communicate with research team members and production staff at all levels. They must also be emotionally flexible, ready to change direction quickly during an experiment as situations change.

Important skills, knowledge, and abilities include:

- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, an disposal methods.
- Written Comprehension – The ability to read and understand information and ideas presented in writing.
- Active Learning – Understanding the implications of new information for both current and future problem-solving and decision-making.
- Science – Using scientific rules and methods to solve problems.
- Deductive Reasoning – The ability to apply general rules to specific problems to produce answers that make sense.

Training/Requirements

- Bachelor or master's degree in microbiology.

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Microbiologists

What's the California Job Outlook?

The California outlook and wage figures below are drawn from all industries and represent the occupational group Microbiologists.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Microbiologists				
19-1022	1,600	2,200	110	$22.58 to $37.74

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Society for Microbiology
1752 N Street, N.W.
Washington, D.C. 20036-2904
(202) 737-3600
www.asm.org

Institute of Food Technologists
525 W. Van Buren, Suite 1000
Chicago, IL 60607 USA
Fax: 312-782-8348
www.ift.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Quality Assurance Auditors

What They Do

Quality Assurance Auditors make sure a manufacturing facility is performing efficiently and producing quality products. These workers complete tests during manufacturing to make certain that the process is in compliance with company and industry methods and standards. The biotechnology industry must be diligent complying with regulations that are designed to protect the public. The Food and Drug Administration (FDA) approves both the ingredients in a drug as well as the specific manufacturing process used to make the drug. Quality Assurance Auditors must be familiar with FDA and government regulations in order to observe and document that the manufacturing company is following approved production procedures.

Some Quality Assurance Auditors work in process validation verifying that each phase in the production process follows the specific procedures in the Good Manufacturing Practices (GMPs). If there are any deviations from approved procedures, they must record what took place. They must also sign-off on each phase of the production process to document that proper procedures were followed. Quality Assurance Auditors use the cGMPs (current Good Manufacturing Processes) documentation to correct inadequacies in production records to furnish the most accurate instructions.

Quality Assurance Auditors may also oversee the proper storage of raw materials. They may also inspect equipment to ensure that it is operating properly within established guidelines.

Quality Assurance Auditors must maintain excellent records, since they write detailed reports that document each step of the production process.

*Quality Assurance Auditors in the biotech industry share characteristics of Industrial Engineering Technicians. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Quality Control Analysis – Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
- Information Ordering – The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

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Quality Assurance Auditors

Training/Requirements

- Bachelor's degree in the biosciences or another scientific discipline.
- Up to two years of experience in biological or pharmaceutical manufacturing.

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Quality Assurance Auditors, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wages figures are drawn from all industries and represent an occupation comparable to Quality Assurance Auditors.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineering Technicians				
17-3026	6,000	6,900	220	$18.48 to $29.77

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Institute of Quality Assurance
www.iqa.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Quality Control Analysts

What They Do

Quality Control Analysts are responsible for inspecting raw materials and finished products to make sure they meet required levels of quality. They are responsible for gathering data for documentation of testing methods and for interpreting results. They must keep excellent records of the results of their inspections. Quality Control Analysts write reports and communicate their findings to relevant personnel.

Quality Control Analysts participate in a wide variety of quality tests at each phase of the manufacturing process. Some analysts inspect raw materials and equipment parts received from suppliers. Others test goods during the manufacturing process and retest the completed products. Analysts often contribute the expertise to confirm that manufacturing materials and components meet established guidelines. As part of their job duties, Quality Control Analysts also calibrate and maintain lab test equipment, develop testing methods, and revise and update operating procedures, as necessary.

One subspecialty is the Quality Control Biochemistry Technician. These workers analyze raw materials and manufactured goods held in storage to determine shelf-life and to make sure that the products have not deteriorated over time.

*Quality Control Analysts in the biotech industry shares characteristics of Industrial Engineering Technicians. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Mathematics – Using mathematics to solve problems.
- Quality Control Analysis – Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
- Science – Using scientific rules and methods to solve problems.
- Information Ordering – The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

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Quality Control Analysts

Training/Requirements

- Bachelor or master's degree in biological sciences or another scientific discipline.
- Possess up to two to five years of experience preferably in a research environment in chemistry or biochemistry.

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Quality Control Analysts, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wages figures are drawn from all industries and represent an occupation comparable to Quality Control Analysts.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineering Technicians				
17-3026	6,000	6,900	220	$18.48 to $29.77

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

National Center for Manufacturing Sciences (NCMS)
(734) 995-0300
www.ncms.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Quality Control Engineers

What They Do

Quality Control Engineers design, review, and establish quality assurance programs for all phases of manufacturing and development to ensure conformity with both company and regulatory requirements, such as cGMPs (current Good Manufacturing Processes), ISO (International Organization for Standardization), and Food and Drug Administration regulations. Engineers devise and put into practice the procedures needed to determine the accuracy of equipment used in testing, production, and inspection processes. They also plan tests to ensure that quality control analysis is conducted properly. Quality Control Engineers must regularly document their procedures and findings, complete statistical evaluations to analyze trends, and write reports. They troubleshoot manufacturing difficulties, and recommend changes to processes or equipment calibration. Engineers may also conduct company training or supervise quality control efforts.

*Quality Control Engineers in the biotechnology industry combine characteristics of Industrial Engineers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Management of Material Resources – Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems.
- Written Comprehension – The ability to read and understand information and ideas presented in writing.
- Oral Expression – The ability to communicate information and ideas in speaking so others will understand.
- Deductive Reasoning – The ability to apply general rules to specific problems to produce answers that make sense.
- Originality – The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.

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Quality Control Engineers

Training/Requirements

- Bachelor or master's degree in engineering or the biological sciences.
- Possess two to five years of quality control experience.

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Quality Control Engineers, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wages figures are drawn from all industries and represent an occupation comparable to Quality Control Engineers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Industrial Engineers				
17-2112	18,600	20,800	670	$30.00 to $44.98

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Society of Civil Engineers
(800) 548-2723
www.asce.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Quality Control Inspectors

What They Do

Quality Control Inspectors examine raw materials and finished manufactured products to ensure compliance with good manufacturing and laboratory practices. They use different types of inspection equipment such as force gauges, pin gauges, ring gauges, calipers, pressure gauges, rules and optical comparators to inspect materials in a manufacturing facility. Quality Control Inspectors keep close watch over critical equipment and instruments throughout their work shift. Inspectors use established procedures to select a representative sample of products in order to make sure adequate testing is done. They often send the products they inspect to other personnel, such as a microbiologist, to conduct additional tests. They may review blue prints and drawing specifications during the product inspection process.

Quality Control Inspectors must clearly explain and document inspection results and product deviations from accepted manufacturing standards. More experienced inspectors may analyze manufacturing failures and suggest potential solutions. They may write and update inspection procedures and checklists when needed. They are responsible for using and maintaining their test equipment and instruments in the proper fashion.

*Quality Control Inspectors in the biotech industry share characteristics of Inspectors, Testers, Sorters, Samplers, and Weighers. Detailed descriptions of this occupation may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Knowledge and ability to follow regulations pertaining to good manufacturing practices.
- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Engineering and Technology – Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Quality Control Analysis – Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
- Science – Using scientific rules and methods to solve problems.
- Information Ordering – The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations.)
- Originality – The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.

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Quality Control Inspectors

Training/Requirements

- High school diploma or Associate degree in biotechnology or health related field.
- Scientific background and from one to two years of experience in quality control systems.

A formal survey is not available; however, a review of job openings indicates California biotechnology employers usually require a significantly higher level of education for this occupation, a bachelor degree or higher, than required in other industries.

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Quality Control Inspectors, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wage figures are drawn from all industries and represent an occupation comparable to Quality Control Inspectors.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Inspectors, Testers, Sorters, Samplers, and Weighers				
51-9061	57,400	62,700	1,840	$9.14 to $18.28

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Society of Quality
www.asq.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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State of California
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Safety Specialists

What They Do

Safety Specialists are important to the safe operation of manufacturing facilities. They work with other staff to analyze the workplace to help eliminate and prevent disease and injury that could be caused by chemicals, physical hazards, biological agents, and even ergonomic problems. They may conduct safety inspections and make sure government health and safety laws are followed. They may test employees to make sure they have not been exposed to unsafe levels of hazardous materials.

Safety Specialists are responsible for the proper use, storage, treatment, recycling and disposal of chemicals, biological or other waste materials. They inspect laboratories to ensure compliance with government safety regulations as outlined by the Occupational Safety and Health Act or Environmental Protection Agency (EPA). Safety Specialists may also work directly with waste disposal contractors while maintaining detailed records of all waste removal and disposal transactions.

Safety Specialists review projects and designs in an effort to foresee health hazards. They inspect work environments, processes, and materials to evaluate potential health risks to prevent disease and injuries potentially caused by chemicals, physical hazards, biological agents or ergonomic factors. Safety Specialists also assess regulatory compliance issues, and potential legal liabilities for the biotechnology company. They make recommendations for corrective actions to alleviate health hazards.

The role of the Safety Specialist can vary widely depending upon the setting. One of the most challenging aspects of the job is participating as part of emergency response teams, providing emergency services after earthquakes, hazardous chemical spills or other emergency situations.

Many Specialists are responsible for overseeing safety-training courses for employees on safe work practices and emergency procedures. Safety Specialists may conduct the training, assign other employees, or hire outside vendors to provide the training. They also document employee's safety training and organize refresher courses as needed.

*Safety Specialists in the biotech industry share characteristics of Occupational Health and Safety Specialists. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Public Safety and Security – Knowledge of relevant equipment, policies, procedures, and strategies to promote effective local, state, or national security operations for the protection of people, data, property, and institutions.
- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Speaking – Talking to others to convey information effectively.
- Problem Sensitivity – The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

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Safety Specialists

Training/Requirements

- Bachelor's degree in a life science, chemistry, or industrial hygiene.
- Possess up to two years of related experience.

What's the California Job Outlook?

The California outlook and wage figures are drawn from all industries and represent an occupation comparable to Safety Specialists.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Safety Specialists				
29-9011	3,500*	4,200*	150*	$21.53 to $35.33

These figures do not include self-employment.
***Average annual openings** include new jobs plus openings due to separations.*
**Projections data is at the broader occupation group level: Occupational Health and Safety Specialists and Technicians.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Society for Quality
(800) 248-1946
www.asq.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Validation Technicians

What They Do

Validation Technicians create test procedures and standards to make sure biotechnology products are manufactured in accordance with regulatory standards and company specifications. They collect and analyze data, prepare reports, and recommend improvements in the manufacturing process. Validation Technicians use a computer to maintain validation lab records and data files.

Technicians working in pharmaceutical settings require knowledge of sterilization principles, good manufacturing processes (GMPs), and Food and Drug Administration regulations. Some Validation Technicians help resolve manufacturing difficulties and design technical solutions.

*Validation Technicians in the biotech industry share characteristics of Inspectors, Testers, Sorters, Samplers, and Weighers. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Production and Processing – Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Quality Control Analysis – Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
- Operation Monitoring – Watching gauges, dials, or other indicators to make sure a machine is working properly.
- Near Vision – The ability to see details at close range (within a few feet of the observer).
- Category Flexibility – The ability to generate or use different sets of rules for combining or grouping things in different ways.
- Visual Color Discrimination – The ability to match or detect differences between colors, including shades of color and brightness.
- Perceptual Speed – The ability to quickly and accurately compare similarities and differences among sets of letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.

Training/Requirements

- Associate or bachelor's degree in biotechnical or related health sciences field.
- Bachelor degree required in Chemistry, Biology, or Engineering for supervisory or management positions.

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Validation Technicians

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Validation Technicians, the occupations listed below are found in the biotechnology industry and have similar duties. The California outlook and wages figures are drawn from all industries and represent an occupation comparable to Validation Technicians.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range Per Hour
Inspectors, Testers, Sorters, Samplers, and Weighers				
51-9061	57,400	62,700	1,840	$9.14 to $18.28

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Institute of Validation Technology
(800) 276-4242
www.ivthome.com

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biotechnology Careers

Information Systems Occupations

Library Assistants 107
Scientific Programmer Analysts 109

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Library Assistants

What They Do

Information management is a vital part of the Biotech industry. Large volumes of data relating to biotechnology are produced throughout the world each year, and researchers and other staff need fast access to pertinent information.

Library Assistants help company personnel find material that is important to their work, and is otherwise not readily available. They are especially involved in doing on-line searches.

They may help people use indexes and databases to locate books and other material. They gather information from a variety of sources and put it in a format that meets the requestor's needs.

Library Assistants may help run or maintain the company database. Library Assistants help manage library inventory, as well as manage print and electronic resource material.

Library Assistants may help run a company library, although on-line sources are sometimes supplanting written material held on-site. The Assistants file and keep track of publications, periodicals, CDs and other informational storage media in a company library.

*Library Assistants in the biotech industry share characteristics of Library Assistants, Clerical. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Clerical – Knowledge of administrative and clerical procedures and systems such as word processing, managing files and records, stenography and transcription, designing forms, and other office procedures and terminology.
- Customer and Personal Service – Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Service Orientation – Actively looking for ways to help people.
- Information Ordering – The ability to arrange things or actions in a certain order or pattern according to a specific rule of set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

Training/Requirements

- High school diploma or equivalent.
- Possess up to two years of relevant library experience or completion of on-the-job training.

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Library Assistants

What's the California Job Outlook?

The figures below are drawn from surveys across all industries and represent occupations comparable to Library Assistants.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Library Assistants, Clerical				
43-4121	11,900	15,100	800	$10.56 to $16.92

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

California Library Association
(916) 447-8541
www.cla-net.org

Medical Library Association
(312) 419-9094
www.mlanet.org

American Library Association
(800) 545-2433
www.ala.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Scientific Programmer Analysts

What They Do

Scientific Programmer Analysts are essential in helping scientists to see relationships and patterns in a vast amount of seemingly dissimilar data, as well as better understanding the structure and function of cells. They write, edit, and maintain computer programs to help these scientific endeavors. Their work entails gathering requirements from scientists, preparing flow charts, developing and writing code, testing and debugging programs, and providing regular maintenance functions. They may also develop software for use in automated test activities. In biotechnology, example program analyses include protein sequence, expression, small molecule, and assays.

Scientific Programmer Analysts employed in biotechnology develop sound clinical study designs, prepare statistical analysis, and review case report forms to ensure proper data collection techniques are followed. They may prepare templates and programming for periodic progress reports, as well as compile clinical data for management review.

They determine system specifications, input and output processes, and hardware and software compatibility. Scientific Programmer Analysts must identify program discrepancies and resolve data problems. They must be able to work with abstract concepts and be accurate while under pressure. Their work requires good communications skills and the ability to work on a team.

*Scientific Programmer Analysts in the biotech industry share characteristics of Computer Systems Analysts. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Computers and Electronics – Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Customer and Personal Service – Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
- Troubleshooting – Determining causes of operating errors and deciding what to do about it.
- Programming – Writing computer programs for various purposes.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Operations Analysis – Analyzing needs and product requirements to create a design.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
- Written Expression – The ability to communicate information and ideas in writing so others will understand.
- Deductive Reasoning – The ability to apply general rules to specific problems to produce answers that make sense.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.

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Scientific Programmer Analysts

Training/Requirements

- Bachelor's degree in Computer Science, Engineering, or a scientific discipline.
- Possess up to two years of related experience.

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Scientific Programmers, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wages figures are drawn from all industries and represent an occupation comparable to Scientific Programmer.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Computer Systems Analysts				
15-1051	52,800	70,600	2,380	$27.60 to $42.70

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

Association for Information Systems
(404) 651-0348
www.aisnet.org

Computing Research Association (CRA)
(202) 234-2111
www.cra.org

National Association of Computer Consultant Businesses
(703) 838-2050
www.naccb.org

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Biotechnology Careers

Marketing and Sales Occupations

Customer Service Representatives 113
Graphic Designers 115
Sales Representatives 117
Technical Services Representatives 119

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Customer Service Representatives

What They Do

Customer Service Representatives provide a direct link from the company to the customer. Primarily offering service via the telephone or the internet, they handle both new and existing customers, answer questions, provide help with problems. They help keep the customer informed as to delivery time and order status. They take orders for products or services, answer delivery questions, find replacement part numbers, and perform other sales support functions. They may enter customer data into a computer database.

Customer Service Representatives are an integral part of the company's sales team. As part of the sales team, they may also support company employees in the field. They may have sales goals to meet. They often work as part of a team with other sales staff.

*Customer Service Representatives in the biotech industry share characteristics of Agricultural & Food Science Technicians and Life, Physical, and Social Science Technicians, All Other. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Customer and Personal Service – Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
- Speaking – Talking to others to convey information effectively.
- Active Listening – Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- Reading Comprehension – Understanding written sentences and paragraphs in work related documents.
- Number Facility – The ability to add, subtract, multiply, or divide quickly and correctly.

Training/Requirements

- Bachelor of Arts or Science degree.
- Up to two years of related experience.
- Must possess some knowledge of the company's products. (See **Additional Sources of Information**.)

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Customer Service Representatives

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Customer Service Representatives, the occupations listed below are found in the biotechnology industry and have similar duties to Service Representative. The California outlook and wage figures are drawn from all industries and represent occupations comparable to Clinical Research Associates.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Customer Service Representatives				
43-4051	197,600	244,900	7,670	$11.90 to $19.06

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Marketing Association
(800) AMA-1150
www.marketingpower.com

International Customer Service Association
(800) 360-4272
www.icsa.com

Society for Marketing Professional Services
(800) 292-7677
www.smps.org

National Association of Sales Agents-A Manufacturer's Representative Association
(815) 838-3055
www.nasareps.com

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Graphic Designers

What They Do

Graphic Designers in the biotechnology industry work with researchers and biocommunications specialists to visually depict scientific ideas and statistical data. Graphic Designers create the graphics used to inform customers, train employees, and promote products or services. Design needs range from exhibits, product displays, logos, packaging, and models to marketing and training materials.

Graphic Designers use the most up-to-date computers and design software to illustrate complicated biotechnology processes. They may sculpt three dimensional models of microbiologic processes. They design graphics and layouts for product illustrations, company logos, and Internet Web sites.

Graphic Designers work as a team with researchers, sales managers, customer service and technical service staff to create communications and visual aides. In small organizations, they may perform all graphic design specialties. In larger firms, they may coordinate the work of other specialists, such as biomedical photographers and medical illustrators. They build relationships with external suppliers including freelance graphic designers and printers. They may develop and maintain an image library. They must ensure design projects are completed by deadlines and that all involved stay on schedule.

Detailed descriptions of this occupation may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.

Important skills, knowledge, and abilities include:

- Time Management – Managing one's own time and the time of others.
- Communications and Media – Knowledge of media production, communication, and dissemination techniques and methods. This includes alternative ways to inform and entertain via written, oral, and visual media.
- Design – Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.
- Coordination – Adjusting actions in relation to others' actions.
- Originality – The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.
- Computers – Knowledge of computer hardware and software, including applications and programming.

Training/Requirements

- A bachelors's degree is most often required for Graphic Designers. The Commission on Accreditation of Allied Health Education Programs accredits two-year interdisciplinary graduate programs in biomedical visualization.
- Possess one to four years related experience.

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Graphic Designers

What's the California Job Outlook?

The California outlook and wage figures below are drawn from all industries and represent the occupational group Graphic Designers.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Graphic Designers				
27-1024	21,200	25,300	690	$15.85 to $27.87

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

BioCommunications Association
(919) 245-0906
www.bca.org

The Association of Medical Illustrators
(719) 598-8622
www.medical-illustrators.org

California Occupational Guide No. 4, Commerical Artists
www.labormarketinfo.edd.ca.gov

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Sales Representatives

What They Do

Sales Representatives are one of the most important workers in the biotechnology industry, because their success is the company's success.

Sales Representatives sell goods for wholesalers or manufacturers where technical or scientific knowledge is required in such areas as biology, engineering, chemistry, and biotechnology. They are responsible for selling a company's products or services.

Sales Representatives generally sell directly to the customer, and may visit them at their office, manufacturing facility, or other location. Representatives familiarize the customer with the various aspects of the product or service, pointing out features that each individual customer is interested in. They may demonstrate products or services. Representatives take orders, quote prices, inform the customer of any special pricing offers, and answer questions. They generally are also required to find and sell to new customers by telephoning or visiting them.

They may have sales goals or quotas, and part of their income may come as a percentage of sales. Some Sales Representatives handle important accounts and may spend a great deal of time with just a few customers. Experienced Sales Representatives may also train new sales staff.

*Greenhouse Assistants in the biotech industry share characteristics of Agricultural & Food Science Technicians and Life, Physical, and Social Science Technicians, All Other. Detailed descriptions of these occupations may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Sales and Marketing – Knowledge of principles and methods for showing, promoting, and selling products or services. This includes marketing strategy and tactics, product demonstration, sales techniques, and sales control systems.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Speaking – Talking to others to convey information effectively.
- Writing – Communicating effectively in writing as appropriate for the needs of the audience.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.

Training/Requirements

- Bachelor of Arts or Science degree.
- Up to two years of related experience.
- Must possess some knowledge of the company's products. (See **Additional Sources of Information**.)

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Sales Representatives

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Marketing and Sales Representatives, the occupation listed below is found in the biotechnology industry and has similar duties to Sales Representative. The California outlook and wage figures are drawn from all industries and represent an occupation comparable to Sales Representatives.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products				
41-4011	47,000	57,400	2,270	$22.83 to $45.39

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Marketing Association
(800) AMA-1150
www.marketingpower.com

Society for Marketing Professional Services
(800) 292-7677
www.smps.org

National Association of Sales Agents
(815) 838-3055
www.nasareps.com

Occupational Information Network (O*NET)
http://online.onetcenter.org

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Technical Services Representatives

What They Do

Technical Services Representatives work with customers over the telephone, on-line, or in person to resolve difficulties with products or services their company provides. These representatives help customers use the products they have purchased such as equipment, pharmaceuticals, or biological products such as DNA, viruses, or bacteria. They also answer questions from prospective customers concerning the more technical aspects of products or services. Technical Service Representatives may be asked to travel to a customer's location to help resolve problems. Representatives may work as part of a team to resolve difficulties. Often, they are required to keep records of their customer contacts. Problems that they encounter can sometimes be an indication that the company needs to improve their product, or provide better documentation so the customer can resolve problems themselves.

This interactive position provides technical information for incoming customer and distributor inquiries, answers technical inquiries on products and services, maintains and answers customer e-mails in Gold Mine software, and resolves customer technical difficulties.

*Technical Services Representatives in the biotech industry share characteristics of Life, Physical, and Social Science Technicians, All Other. Detailed descriptions of this occupation may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Important skills, knowledge, and abilities include:

- Active Listening – Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- Service Orientation – Actively looking for ways to help people.
- Customer and Personal Service – Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
- Oral Comprehension – The ability to listen to and understand information and ideas presented through spoken words and sentences.
- Oral Expression – The ability to communicate information and ideas in speaking so others will understand.

Training/Requirements

- Bachelor of Arts or Science degree.
- Up to two years of related experience.
- Must possess some knowledge of the company's products. (See **Additional Sources of Information**.)

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Technical Services Representatives

What's the California Job Outlook?

While the Bureau of Labor Statistics does not collect data on Technical Services Representatives, the occupation listed below is found in the biotechnology industry and has similar duties. The California outlook and wage figures are drawn from all industries and represent an occupation comparable to Technical Service Representatives.

Standard Occupational Classification	Estimated Number of Workers 2002	Estimated Number of Workers 2012	Average Annual Openings	2005 Wage Range (per hour)
Life, Physical, & Social Science Technicians, all other				
19-4099	11,600	14,300	540	$15.63 to $26.73

These figures do not include self-employment.
Average annual openings *include new jobs plus openings due to separations.*
Source: www.labormarketinfo.edd.ca.gov , Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Additional Sources of Information

American Marketing Association
(800) AMA-1150
www.marketingpower.com

National Association of Pharmaceutical Sales Representatives
(800) 913-0701
www.napsronline.org

Society for Marketing Professional Services
(800) 292-7677
www.smps.org

National Association of Sales Agents-A Manufacturer's Representative Association
(815) 838-3055
www.nasareps.com

National Technical Services Association
(703) 684-4722
www.ntsa.com

Occupational Information Network (O*NET)
http://online.onetcenter.org

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