

Biocom California Life Science Economic Impact Report **2022**

*The Innovation and Growth of the
Life Science Industry in California*



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Executive Summary

The 2022 Biocom California Economic Impact Report provides key data on the performance of the Life Science industry in California, an assessment of sources and growth of funding and investment, and an overview of the industry's economic impact. Innovations in biotechnology and vaccine development generate substantial growth, and California's role as the innovation hub of the Life Science industry contributes significantly to the state and regional economies. Overall, the industry directly supported approximately 435,693 jobs in 2021, indirectly supporting an additional 736,846 workers, contributed more than \$115 billion in annual labor income, and generated \$376 billion in total economic output to the California state economy. Supporting data is from the U.S. Bureau of Labor Statistics. Any inconsistencies with the data from previous year's reports is due to a difference in data sources and associated calculation methodologies.

The key findings highlighted below are further detailed in the body of the report:

- **The Life Science industry generates substantial impact across the value chain (processes/ activities by a company that add value to a product) in California's economy:** Every job in the Life Science industry generates more than two additional jobs in downstream sectors (employment multiplier of 2.69), with sub-sectors involved in pharmaceutical and drug product manufacturing and wholesale drug distribution ("Biopharmaceutical sectors") exhibiting employment multipliers of more than 4.0X.
- **The Life Science industry grew faster in California than the national average:** Life Science sectors added 23,196 jobs to the California economy in 2021 -- about one-fifth of US growth in Life Science employment -- which represents a year-over-year (YOY) growth rate of 5.8 percent compared to the U.S. average YOY rate of 3.9 percent.
- **Both manufacturing and research and development (R&D) activities were important to Life Science job growth in California in 2021:** Sub-sectors involved in bio and nano technology R&D ("Biotechnology sectors") added 7,151 jobs in 2021 and alone responsible for almost one-third of employment growth in Life Science sectors growth in 2021, while manufacturing sectors added 6,163 jobs.
- **R&D occupations in the Life Science industry in California experienced more employment growth in 2021 compared to manufacturing occupations:** YOY year employment growth was 14.5 percent for the top R&D occupations (Software Developers, Medical Scientists, and Natural Sciences Managers), and 3.5 percent for the top manufacturing occupations (Filling Machine Operators, Electrical Equipment Assemblers, Inspectors and Sorters).
- **California was a prime destination for Life Science investment in 2021:** The state benefited from record levels of Life Science investment in 2021 and attracted significant investments from venture capitalists. Venture capital investment in California was at an all-time high of \$16.6 billion. Notable U.S. investors included 4Front Ventures, iBio Inc. and Stem Holdings. Notable foreign investors in biotechnology R&D included: Oxford Nanoimaging from the UK, GemPharmtech from China, Biomex from Germany, and MolGen from the Netherlands.

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- **The California education ecosystem fosters a vibrant connection with Life Science sectors:** Approximately 18,900 two-year and 8,600 four-year degrees in Life Science fields were conferred by California-based colleges and universities in 2021, and California is host to approximately 29 community colleges with biotechnology training programs, one of the largest networks in the nation.
- **The Biocom California index experienced slight YOY decline in 2021:** The Biocom Index is a calculated weighted average, consisting of various components that measure the performance of the Life Science industry. The index was positively impacted by an increase in venture capital spending, offset by slightly lower figures for National Institute of Health (NIH) and National Science Foundation (NSF) funding, and fewer patents granted. Life Science venture capital investment increased to \$16.6 billion in 2021, an all-time high. NIH awards in the state of California totaled \$5.1 billion in 2021, with major recipients including Stanford University (\$38.6 million), the UC System (\$28.3 million) and California Institute of Technology (\$26 million). The number of patents granted in California also fell slightly to 1,495, a slight fall from the previous year. This was the first time since 2013 that the Biocom California index value fell.

Future Outlook:

After significant innovation in 2021, Life Sciences is primed for even more growth in 2022, fueled by new strategic partnerships, growing public and private investment, and advanced innovations. These include advancements in new technology such as mRNA, cell and gene therapy, and partnerships with technology companies to further advance science and digital transformation in medicine.

¹Cal Biotechnology, "Statewide Program Inventory", 2021. As reported by California Governor's Office of Business and Economic Development



Introduction

The Life Science industry in California remained resilient to the economic downturn caused by the COVID-19 pandemic, with the state's pivotal role in vaccine development and deployment during the pandemic sustaining substantial economic activity and even growth. Overall, the Life Science industry – which is comprised of the six major sub-sectors defined below – generated substantial contribution to the state and regional economies, directly supporting approximately 435,693 jobs in 2021, indirectly supporting an additional 736,846 workers, contributed more than \$115 billion in annual labor income, and generated \$376 billion in total economic output to the California state economy.

Life Science Scope

Six major sub-sectors comprise the Life Science industry scope² :

- 1. Biotechnology:** Research and development in biotechnology and nanobiotechnology; artificial and synthetic fiber manufacturing
- 2. Biopharmaceuticals:** Medicinal and botanical manufacturing; pharmaceutical preparation manufacturing; intro-vitro diagnostic substance manufacturing; biological product manufacturing; drugs merchant wholesalers
- 3. Medical Devices and Equipment:** Ophthalmic goods manufacturing; irradiation equipment manufacturing; surgical and medical instrument manufacturing; surgical appliance and supplies manufacturing; optical instrument and lens manufacturing³ ; dental laboratories; medical, dental, and hospital equipment and supplies merchant wholesalers
- 4. Research and Manufacturing:** Research and development in physical engineering and life sciences²; medical laboratories; testing laboratories²
- 5. Scientific/Research Tools:** Laboratory instruments manufacturing; laboratory chemicals (basic organic) manufacturing; electromedical and electrotherapeutic apparatus manufacturing
- 6. Food and Agriculture Biotechnology:** Ethyl alcohol manufacturing; nitrogenous fertilizer manufacturing²; phosphatic fertilizer manufacturing²; pesticide and other agriculture chemical manufacturing²

²See Appendix for the complete composition of NAICS codes considered for Life Science industries

³Life Sciences represents just a fraction of overall activity in this NAICS area where other industry sectors may be more substantial



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2021 Performance

Life Science sectors drew considerable attention during the pandemic, particularly biotechnology sub-sectors which attracted record levels of financing and investment. Job growth – which initially lagged the strong investment performance of Life Sciences in response to the pandemic – was robust in 2021. YOY growth in California (5.8 percent) trended higher than the national average (3.9 percent) in 2021, which is expected given the region’s central importance as a hub for Life Science activity.

Approximately 435,000 workers in California are employed in Life Science sectors. These sectors added about 25,000 jobs to the state economy in 2021. The biotechnology sub-sectors were especially important to job growth, adding more than 7,700 jobs in 2021 and representing almost one-third of U.S. job growth in biotechnology during this time. In-vitro manufacturing experienced substantial job growth in 2021, however manufacturers in other Life Science sectors did not experience the same level of growth. Wholesale traders and distributors of drugs and pharmaceuticals added approximately 1,200 jobs to the local economy last year.

Figure 1. Life Science Employment and YOY Growth, 2021

	California		USA	
	Emp (2021)	YOY % growth	Emp (2021)	YOY % growth
Biotechnology	66,290	13.2%	308,355	9.7%
Research & Manufacturing	160,753	4.9%	1,215,458	2.5%
Biopharmaceuticals	81,319	4.2%	578,085	3.4%
Medical Devices and Equipment	90,631	3.8%	628,356	4.4%
Scientific/Research Tools	35,615	4.7%	168,371	2.4%
Food and Agriculture Biotechnology	1,035	2.4%	19,485	1.2%
Total	435,693	5.8%	2,918,109	3.9%

SOURCE: Quarterly Census of Wages and Employment (BLS), 2021 ⁴

⁴The Bureau of Labor Statistics makes periodic updates to previously published data. At the conclusion of Q3 2022, there was an update to the underlying data in the NAICS codes in Research and Manufacturing and Medical Devices sectors in California. The update was exclusive to California, the data for the US overall remains same as previously reported. The update resulted in an increase in the reported Life Science employment in California from 394,045 to 435,693



Economic Impact – California State

In 2021, the Life Science sectors in California employed more than 435,000 workers across R&D, manufacturing, and trade and distribution activities which generated significant benefits to the statewide economy.

Economic Impact Modeling utilizes an input-output methodology to evaluate the impact of a series of economic activities. Input-output analysis is a means of examining the relationships within an economy among businesses and among businesses and consumers. It attempts to capture all monetary market transactions for consumption within a specific time period. The underlying mathematical formula facilitates the examination of the effects of a change in one or several economic activities upon an entire economy (impact analysis). The methodology assumes that industries respond to meet consumption (demand) directly or indirectly by supplying goods and services to other industries. Each industry that produces goods and services generates demand for other goods and services. These iterations can be mathematically summarized and described by “multipliers.”

Figure 2 depicts the economic impact output results for the state’s Life Science sectors in 2021. The economic impact model used to calculate these numbers was created using IMPLAN, an industry standard. The inputs for the model were sourced using the U.S. Bureau of Labor Statistics. Any inconsistencies in the results of the economic impact with previous year’s reports are due to a difference in the inputs used for the respective IMPLAN models.

Figure 2: Economic Impact of Life Science Sub-Sectors in California: Employment and Output, 2021

	Employment (# of workers)				Output (U.S. \$ M's)			
	Direct	Indirect + Induced	Total	Multiplier	Direct	Indirect + Induced	Total	Multiplier
Biotechnology	66,290	104,507	170,797	2.58	\$20,527	\$21,156	\$41,683	2.03
Research & Manufacturing	160,753	140,582	301,335	1.87	\$30,465	\$28,513	\$58,978	1.93
Biopharmaceuticals	81,369	264,168	345,537	4.25	\$106,589	\$60,536	\$167,125	1.57
Medical Devices and Equipment	90,631	141,897	232,528	2.56	\$32,986	\$29,673	\$62,659	1.90
Scientific/Research Tools	35,615	82,607	118,222	3.32	\$24,964	\$18,857	\$43,821	1.76
Food and Agriculture Biotechnology	1,035	82,607	4,120	3.98	\$960	\$774	\$1,734	1.81
Total	435,693	736,846	1,172,539	2.69	\$216,491	\$159,509	\$376,000	1.74

SOURCE: IMPLAN

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Economic Impact – California State

Direct benefits refer to economic activity resulting directly from Life Science establishments, e.g., the scientists and engineers that are hired as part of R&D activities. Indirect benefits refer to inter-industry purchases that arise as businesses respond to purchase requests from Life Science establishments, e.g., headcount of supplier industries and sub-contractors. Induced benefits refer to household spending generated by the direct and indirect beneficiaries of Life Science sectors.

The Life Science industry in California represents total output of approximately \$376 billion in 2021, with activity in Biopharmaceuticals representing about 45 percent of the total. Every dollar of output in the Life Science industry in California generates approximately \$1.74 of additional activity in the economy in terms of purchases from local suppliers and household spending on local goods and services. Output in Biotechnology sub-sectors is especially impactful in California, generating about \$2.03 of additional activity per dollar of output.

Every job in the Life Science industry in California generates additional employment of more than two workers in the state economy (employment multiplier of 2.69). Biopharmaceutical sub-sectors exhibit an employment multiplier of more than 4.0X, indicating that direct employment in these sub-sectors (81,369 workers) has a significant downstream employment impact generating an additional 264,168 jobs in the state economy. The Life Science industry directly supports more than \$56.6 billion in annual worker income and contributes indirectly to more than \$58.5 billion in annual worker income. Appendix E highlights detailed direct and indirect impacts by sub-sector.

Figure 3 illustrates the industries which experienced the largest economic impact from the Life Science industry in California, i.e., those industry sectors with the largest direct, indirect, and induced employment effect. While the major Life Science employer sub-sectors are included in the mix, general business input sub-sectors (real estate, legal, warehousing, transportation) which represent the major indirect effect of the Life Science industry, as well as consumer sectors (e.g., restaurants, retail, etc.) also play a major role in the induced effect.



Figure 3: Top Life Science Sub-Sectors by Economic Impact in California, 2021

Rank	Industry	Employment			
		Direct	Indirect	Induced	Total
1	Scientific research and development services	115,217	10,916	1,267	127,400
2	Community Colleges, colleges, universities, and professional schools	76,959	544	5,690	83,192
3	Medical and diagnostic laboratories	34,777	0	1,111	35,888
4	Wholesale - Drugs and druggist sundries	31,856	10,591	779	43,226
5	Wholesale - Professional and commercial equipment and supplies	29,530	8,068	1,251	38,849
6	Pharmaceutical preparation manufacturing	28,905	130	126	29,161
7	Surgical and medical instrument manufacturing	28,673	109	28	28,810
8	Electromedical and electrotherapeutic apparatus manufacturing	22,006	60	5	22,071
9	Surgical appliance and supplies manufacturing	11,398	145	24	11,567
10	In-vitro diagnostic substance manufacturing	10,991	87	19	11,098
11	Analytical laboratory instrument manufacturing	9,996	19	1	10,016
12	Dental laboratories	9,635	21	70	9,726
13	Medicinal and botanical manufacturing	6,542	1,298	9	7,849
14	Ophthalmic goods manufacturing	4,331	2	39	4,371
15	Dental equipment and supplies manufacturing	3,261	38	6	3,305
16	Biological product (except diagnostic) manufacturing	3,075	150	3	3,227
17	Irradiation apparatus manufacturing	2,568	2	0	2,570
18	Other basic organic chemical manufacturing	2,237	41	3	2,281
19	Industrial process variable instruments manufacturing	1,552	8	1	1,561
20	Optical instrument and lens manufacturing	648	37	0	685
21	Glass product manufacturing made of purchased glass	588	159	36	783
22	All other food manufacturing	396	102	213	711
23	Fertilizer mixing	185	18	3	206
24	Nitrogenous fertilizer manufacturing	114	22	2	139
25	Pesticide and other agricultural chemical manufacturing	95	3	5	102
26	Artificial and synthetic fibers and filaments manufacturing	89	0	0	89
27	Phosphatic fertilizer manufacturing	70	5	1	76
28	Other real estate	0	30,303	11,643	41,946
29	Management of companies and enterprises	0	29,302	3,755	33,056
30	Employment services	0	26,084	8,406	34,490

SOURCE: IMPLAN

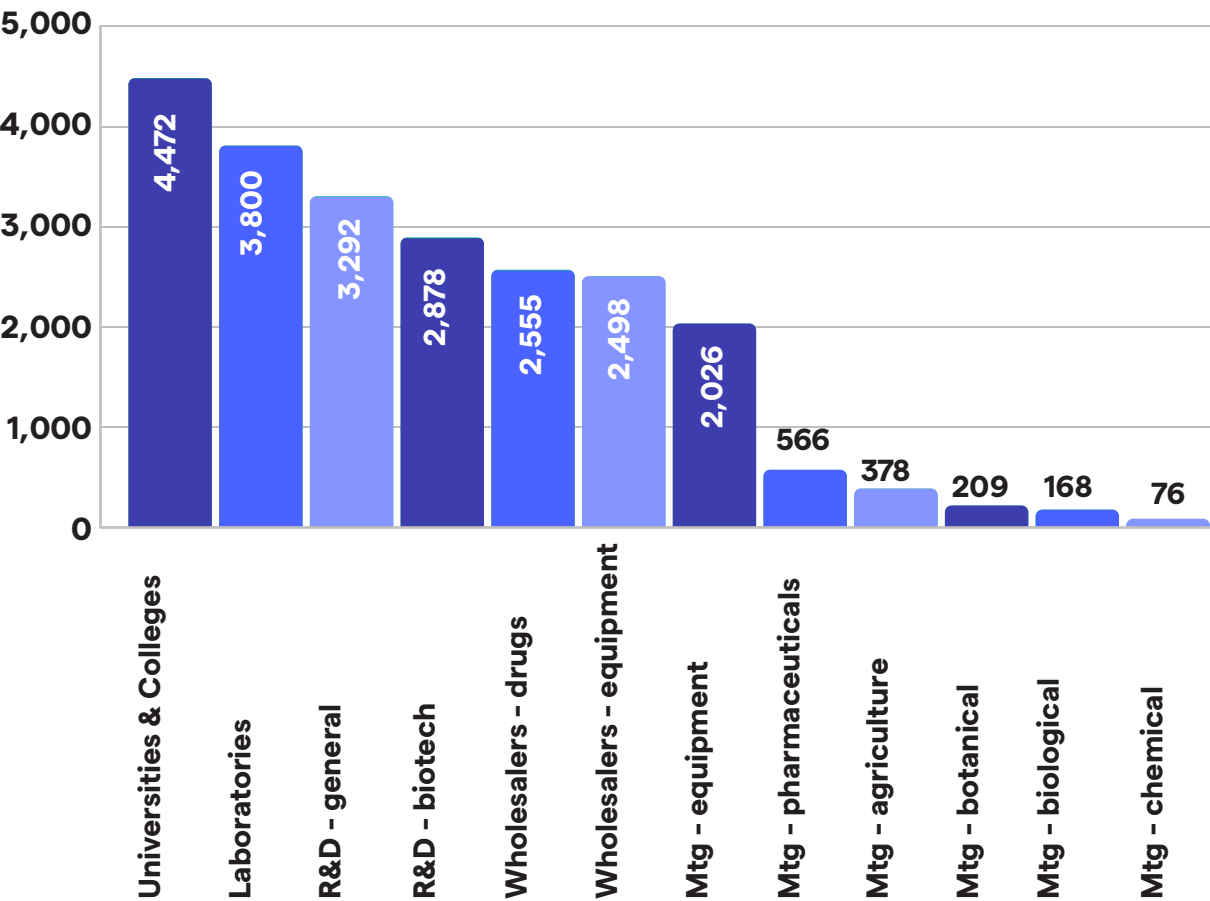


Major Characteristics Of The Life Science Sector In California

Establishments

As of 2021, there are approximately 16,000 establishments in Life Science sectors in California, with almost two-thirds representing universities, colleges, or research and development institutions. There are also significant concentrations of laboratories (3,800 establishments), drug merchant wholesalers (2,555 establishments), medical supplies wholesalers (2,498 establishments), as well as a variety of manufacturers (3,562 establishments). Within the manufacturing sub-sector, significant concentrations exist in surgical and medical instruments, electromedical and electrotherapeutic apparatus, instruments for measurement and process control, as well as pharmaceutical preparation services.

Figure 4. Life Sciences in California: Composition of Establishments



SOURCE: IMPLAN

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Education

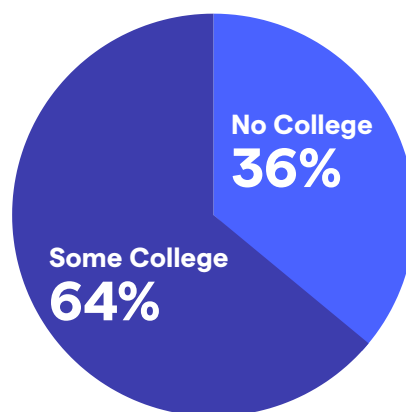
California has a strong pipeline of graduates which support a vibrant connection between California universities and the Life Science sector. Approximately 18,900 two-year degrees and 8,600 four-year degrees were conferred by California-based colleges and universities in the 2021/22 academic year. Biology and the biological sciences represent the third-largest academic concentration among California graduates, behind Liberal Arts and Business Administration disciplines. California hosts the largest number of community college biotechnology programs in the nation, and biotechnology education has a particularly significant history in the state. The UC and Cal State systems are recognized nationally for the ground-breaking programs established in biomanufacturing.

Figure 5. Educational Attainment in California

Educational Attainment in California	Share of CA Residents
No High School Diploma	15.2%
High School Graduate	20.4%
Some College, No Degree	21.0%
Associate Degree	8.0%
Bachelor's Degree	22.6%
Postgraduate Degree	12.9%

SOURCE: U.S. Census Bureau

Figure 6. Majority of California Residents have Some College Education



SOURCE: U.S. Census Bureau

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Occupations and Salaries

The Life Science sector includes a variety of occupations across all categories in the value chain in California's economy. R&D categories typically include a variety of scientists, engineers, and technicians, as well as IT roles including computer programmers, software developers and project management specialists. Manufacturing categories in Life Sciences typically include high levels of repetitive labor occupations, but also significant concentrations of specialized labor, e.g., industrial engineers, biochemists, medical scientists, compliance officers, etc. Finally, drug and equipment wholesale categories are typically composed of sales and marketing representatives, customer service representatives, shipping, receiving, and inventory clerks. **Figure 7** highlights the top 30 occupations in the Life Science industry by employment and the respective educational attainment.

Figure 7. Representative Occupations⁵ in Life Science Industry, by Employment 2021

Rank	Occupation	Educational Attainment	Emp (2021)	Avg Annual Wage (US\$)
1	Software Developers	Bachelor's Degree	15,457	\$146,800
2	Medical Scientists, except Epidemiologists	Postgraduate Degree	11,250	\$119,200
3	General and Operations Managers	Associate Degree	10,865	\$154,100
4	Team Assemblers	High School Graduate	10,272	\$41,600
5	Inspectors, Testers, Sorters, Samplers, and Weighers	Associate Degree	9,895	\$52,300
6	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Associate Degree	9,602	\$105,500
7	Business Operations Specialists, All Other	Associate Degree	8,623	\$82,900
8	Sales Representatives, Wholesale and Manufacturing, except Technical and Scientific Products	Associate Degree	8,470	\$79,300
9	Natural Sciences Managers	Bachelor's Degree	7,801	\$205,30
10	Packaging and Filling Machine Operators and Tenders	High School Graduate	7,631	\$40,400
11	Biological Scientists, All Other	Postgraduate Degree	7,262	\$101,800
12	Managers, All Other	Associate Degree	6,963	\$160,800
13	Biochemists and Biophysicists	Bachelor's Degree	6,719	\$104,500
14	Biological Technicians	Bachelor's Degree	6,652	\$56,200
15	Chemists	Bachelor's Degree	6,650	\$98,200
16	Computer and Information Systems Managers	Bachelor's Degree	6,012	\$217,000
17	Laborers and Freight, Stock, and Material Movers, Hand	High School Graduate	6,005	\$39,700
18	Architectural and Engineering Managers	Bachelor's Degree	5,991	\$181,600

⁴ Occupations are reported and aggregated as standardized occupation codes (SOCs) as part of the Quarterly Census of Wages and Employment conducted by the US Bureau of Labor Statistics



Rank	Occupation	Educational Attainment	Emp (2021)	Avg Annual Wage (US\$)
19	Customer Service Representatives	High School Graduate	5,777	\$46,200
20	Engineers, All Other	Bachelor's Degree	5,707	\$111,400
21	Mechanical Engineers	Bachelor's Degree	5,488	\$111,400
22	Electrical Electromechanical Equipment Assemblers	Associate Degree	5,440	\$46,400
23	Sales Managers	Associate Degree	5,154	\$146,600
24	Office Clerks, General	High School Graduate	5,068	\$44,700
25	First-Line Supervisors of Production and Operating Workers	High School Graduate	5,020	\$70,500
26	Project Management Specialists	Associate Degree	4,919	\$109,000
27	Phlebotomists	Associate Degree	4,778	\$46,200
28	Medical and Clinical Laboratory Technicians	Associate Degree	4,709	\$69,600
29	Industrial Engineers	Bachelor's Degree	4,643	\$107,900
30	Medical and Clinical Laboratory Technologists	Bachelor's Degree	4,549	\$70,500

SOURCE: IMPLAN



Key Factors And Metrics

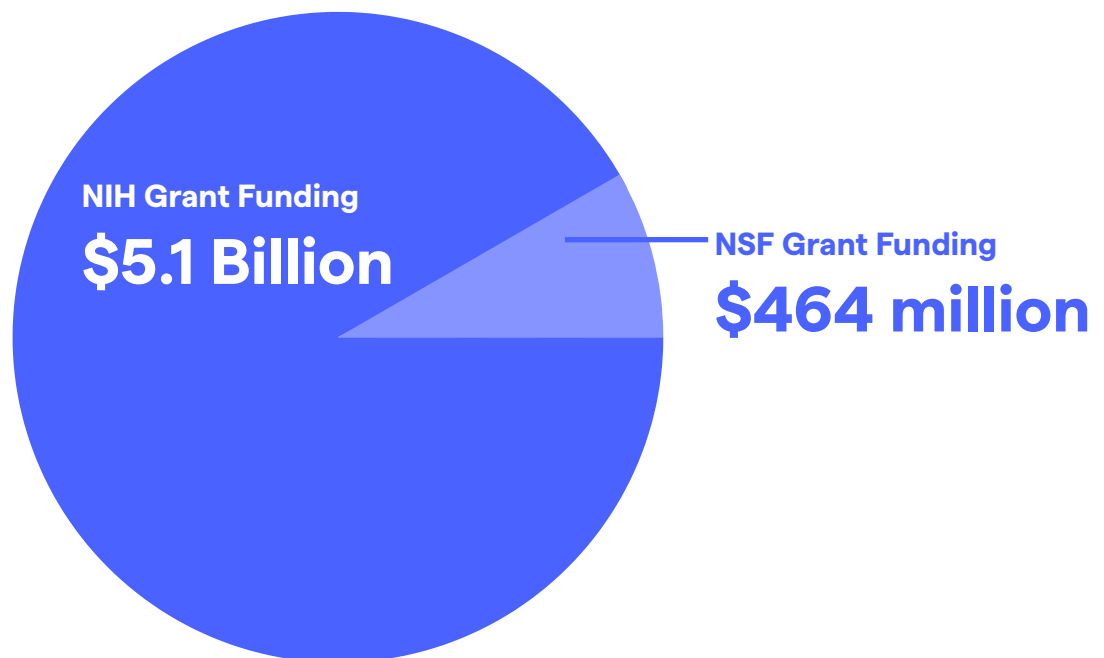
The Life Science industry represents a model of funding that includes financing from government sources and private capital.

Research Funding

The NIH and NSF are important sources of early-stage research funding for the Life Science industry in California. In 2021, the NIH alone provided research grants of over \$5.1 billion to California. These two organizations awarded more than 10,629 research grants in 2021 to the State of California, with approximately \$1.2 billion for core Life Sciences. The NIH accounted for 90% of this total funding. In terms of funding for core Life Sciences, the contributions from the two agencies are more equal, with NIH accounting for 10 percent of total funding in 2021².

Figure 8. NIH and NSF Give \$5.6 Billion to California in 2021

Total Grant amounts awarded to California, \$



SOURCE: NIH, NSF

² The NIH also funds significant amounts of other health care research in addition to that central to the biotechnology, pharmaceutical, and other businesses that represent the core of Life Sciences.³2021 data is reflective of August 2022

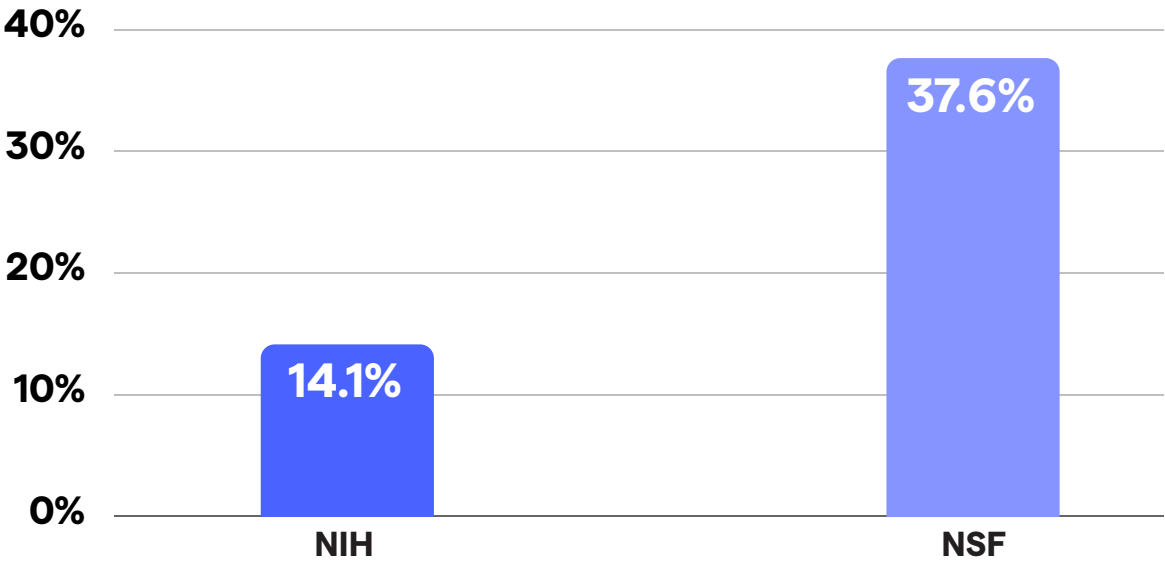


Total NIH awards to the State of California numbered 1,137 in 2021, with a total funding of \$5.1 billion of which \$720 million was directed towards funding core Life Sciences.

While amounts varied widely across core Life Science projects, the overall funding through NIH Grants fell slightly in 2021 from approximately \$5.5 billion in 2020. Furthermore, the NSF grant funding also saw a decrease from the 2020 levels of \$680 million.

Total NSF awards to the State of California numbered 775 in 2021, with total funding of \$464 million.

Figure 9. LIFE Sciences Research Targets California
Share of total 2021 Core Life Sciences Funding, Percent



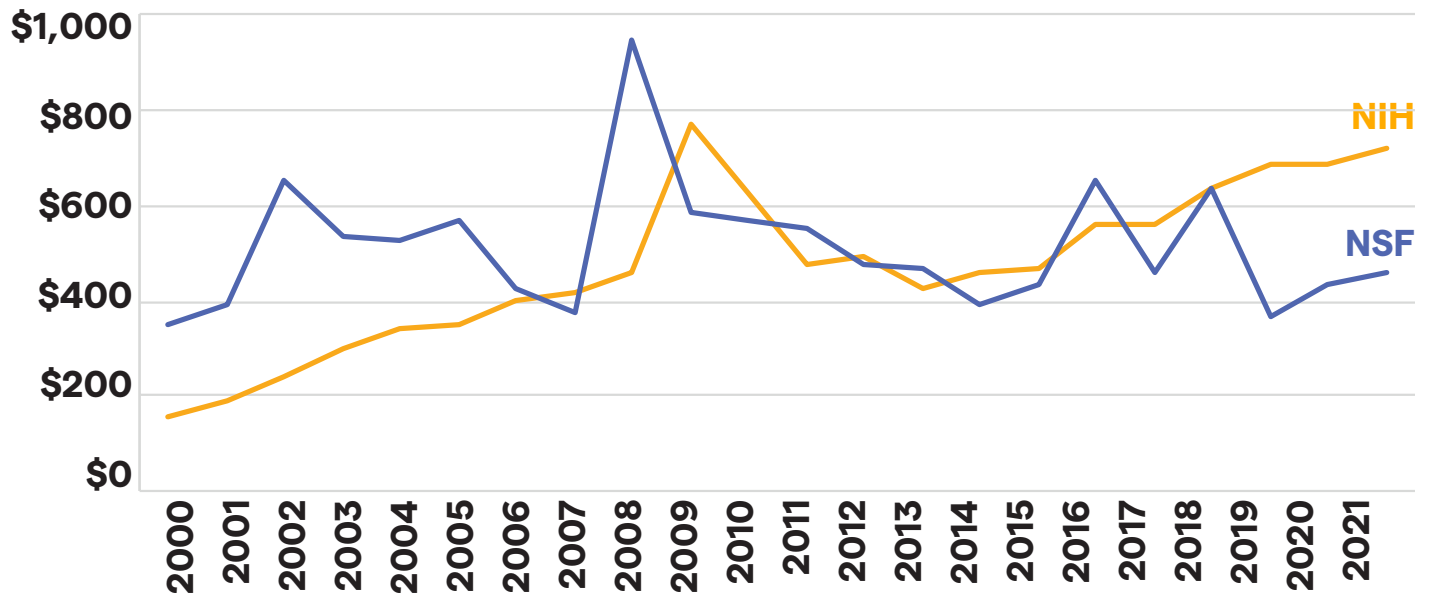
NSF grants to the core of Life Sciences also vary widely across projects, but the average grant was approximately \$600,000 in 2021. While total NSF grants declined from 2020 to 2021, the average dollar per grant increased, which was estimated at \$500,000.

Research awards specifically targeted to Life Sciences in California can vary substantially from year to year depending on administration and congressional policies and agency priorities. While NIH funding has exceeded NSF grants substantially during the past two years, that is not always the case. As recently as 2018, NSF funding to the core of Life Sciences was somewhat higher than that from the NIH.

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Figure 10. NIH Outpaces NSF Core Funding in Recent Years
Millions of Dollars



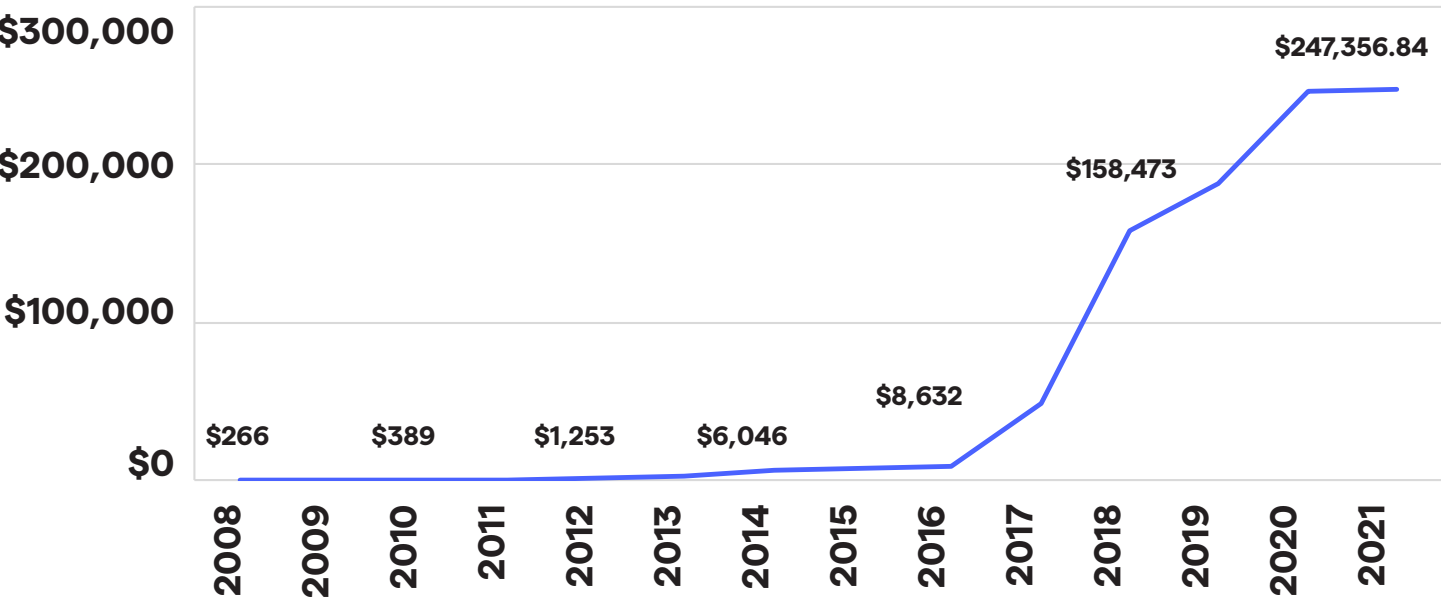
SOURCE: NIH, NSF



Government Contracts

In addition to funding from the NIH and NSF, various other branches of the U.S. government award contracts to California entities, including universities, companies, and non-profit organizations involved in Life Sciences. In 2021, these contracts totaled \$247 billion, led by Department of Defense (DoD) procurement awards. The 2021 total represented more than a 30 percent jump from 2019. The dramatic growth since 2009, when funding equaled less than \$300 million, reflects increased investment by the government. This interest has spanned a wide range of applications, ranging from treatments for long-term chronic diseases, such as Alzheimer’s, to finding treatments for COVID-19. The DoD has targeted areas such as disease prevention, trauma management, environmental remediation, and advanced materials research.

Figure 11. Government Contract Spending Jumps 30% in 2021 Since 2019
Millions of Dollars



SOURCE: USASPENDING.GOV

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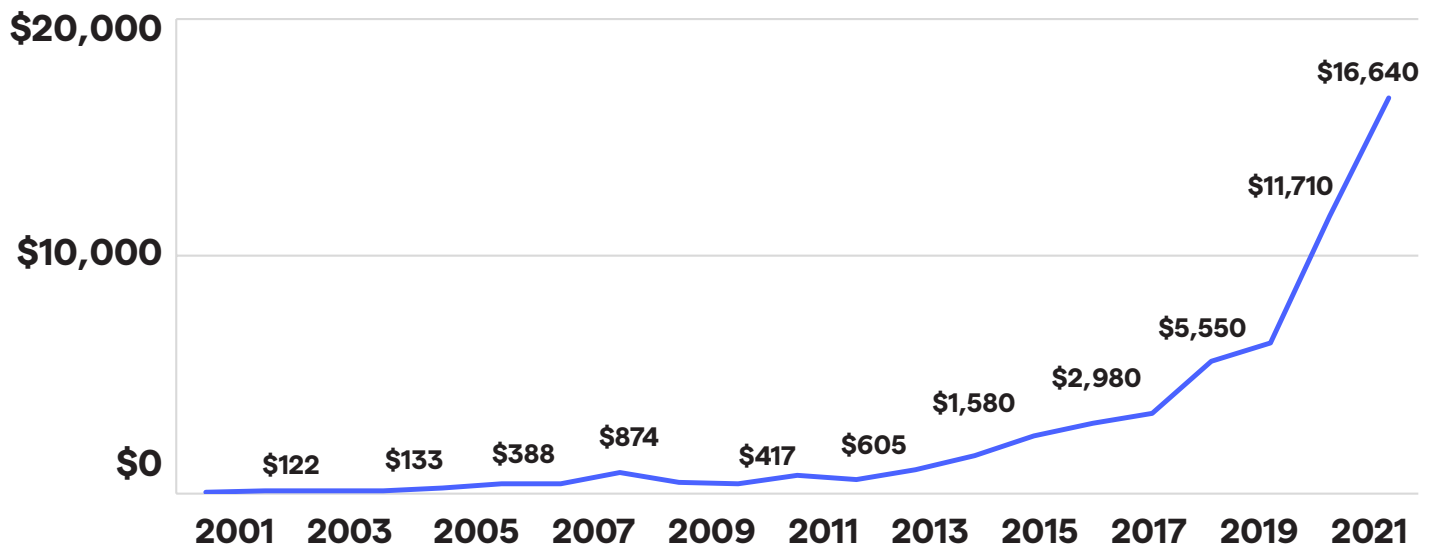


Venture Capital

Propelled by low interest rates and investor interest in promising treatments under development, venture capital soared to a record high of \$16.6 billion in 2021 in the Life Science sector in California. The surge included investments from established VC funds, cross-over investors and some new players in the market. This represents an increase of over 29 percent from 2020 and more than tripled the amount attracted just three years earlier in 2018. Of the more than \$53 billion total U.S venture capital funding in 2021, the Life Science sector in California attracted about 31 percent; this is an increase from the prior year where overall funding in California was \$11.7 billion.

Figure 12. Venture Capital Reaches All-time High in 2021

Life Sciences in California, millions of dollars



SOURCE: Pitchbook Data Inc.

Patents

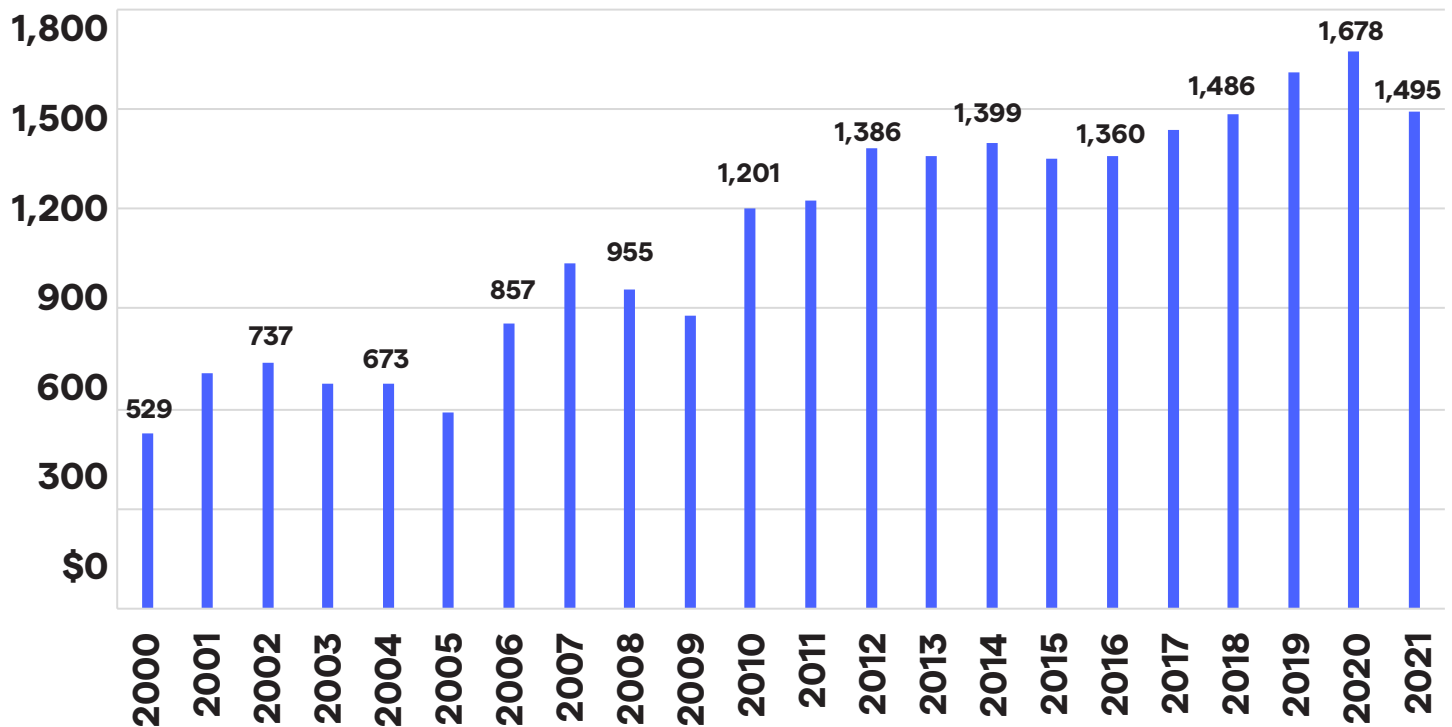
Patents granted to Life Science innovations in California reached an all-time high in 2020 but dropped slightly in 2021. The year's 1,495 total decreased from the prior year's patent total of 1,678 patents. As of July 2022, the reported total number of patents granted in 2022 is 865.

These patents have surpassed 1,000 each year since 2010. Since 2000, the Life Science sector in California has earned over 24,000 patents³.

³ Patent grants are not equivalent to those that are cleared or approved by the U.S. Food and Drug Administration (FDA)



Figure 13. Life Sciences in CA Receives 24,000 Patents Since 2000
Number of patents



SOURCE: USPTO

Exports

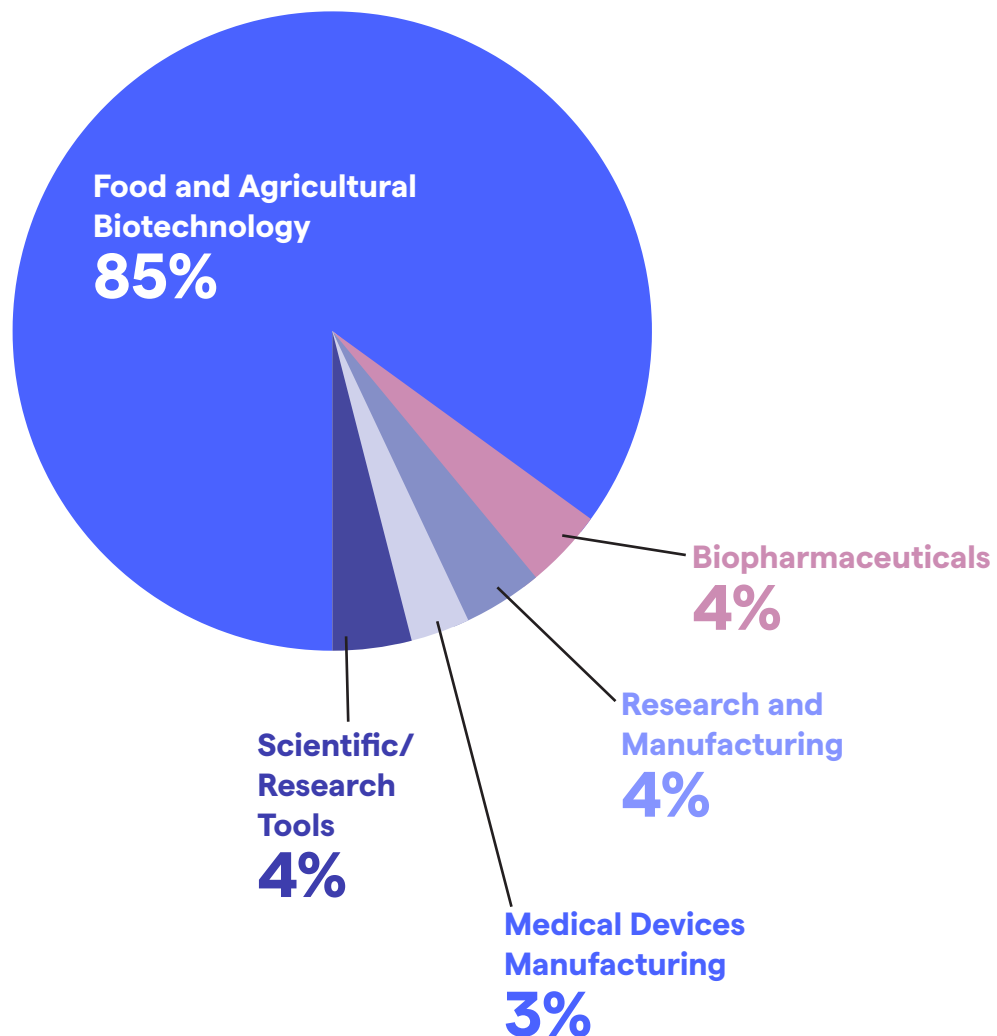
Exports of goods and services from entities in California totaled \$207 billion in 2021. From this, almost \$20 billion was attributed to exports of goods and services that originated from the Life Science sector in California. Food and Agricultural Biotechnology accounted for the largest share at almost 85 percent followed by Biopharmaceuticals which was at 4 percent.

The economic slowdown in China, as suggested by lower consumer spending relative to the pre-pandemic levels, contributed to the drop in exports from the Life Science sector in 2021. Other reasons for drop in exports include supply chain gridlocks and inefficiencies with the handling of cargo on the ports.

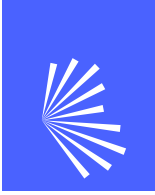


Figure 14. Food and Agricultural Biotechnology Represents Largest Share of Foreign Exports

Share of life sciences Foreign Exports, 2021



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Biocom California Index

This report presents a proprietary Biocom California Index to track California's Life Science sector performance over time with respect to a variety of metrics including:

- **Number of NIH grants**
- **Value of NIH grants**
- **Number of NSF grants**
- **Value of NSF grants**
- **Number of patents granted**
- **Number of payroll jobs**
- **Number of establishments**
- **Value of venture capital investments**

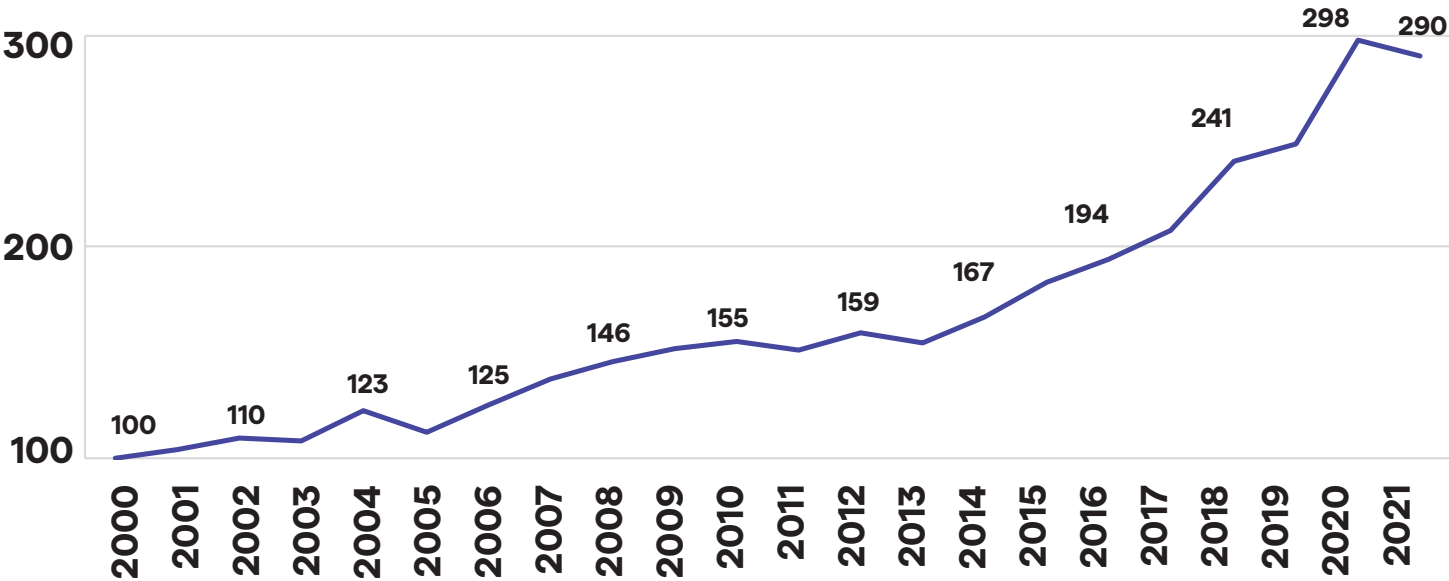
The Biocom California Index, based on a weighted average of these components, has grown significantly over the last two decades. From the year 2000 base value of 100, the Index reached 290 in 2021. This indicates that the Life Science sector in California, measured with respect to above dimensions, is now 2.9x larger than in 2000. This represents a compound annual average growth rate of 5.2 percent.

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In 2021, with the slowdown in some sectors of economy and rising inflation, the Biocom California Index fell to an indexed value of 290 from 298 in 2020, and the first time since 2013. This decline can primarily be attributed to the decline in funding by the NIH and the NSF. Despite such declines, the employment generated by the Life Science sector continued to grow in 2021.

Figure 15. Biocom California Index Shows Life Sciences’
Climb in California SINCE 2000
Index, 2000=100



SOURCE: Deloitte

The Biocom California Index has advanced nearly every year since 2000. Only five years (2003, 2005, 2011, 2013 and 2021) experienced declines, with those drops due to the performance of different components. However, declines in government funding, from either NIH or NSF, was the consistent factor causing the decline in each year.

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Economic And Financial Forces Driving Life Sciences

How sensitive is Life Sciences to changes in the overall economy, financial markets, and national policies regarding interest rates and research funding? To understand the major economic and financial forces that impact the performance of the Life Science sector in California, an econometric model was developed. Four factors appear to significantly influence sector employment.

U.S. real gross domestic product (GDP): Upswings and downswings in the national economy significantly affect Life Sciences, although other factors moderate that influence. Isolating the U.S. economy's effect, each percentage point change in real (inflation-adjusted) GDP growth causes approximately a 0.7 percent change in total Life Science employment.

NIH and NSF grant funding: The combined dollar amounts from the NIH and NSF significantly influence the number of Life Science jobs in California.

Interest rates: The base short-term interest rate targeted by the Federal Reserve impacts Life Science employment in California. Lower interest rates lead to more hiring in the sector, while higher rates result in less hiring. Interest rates affect the amount of risk Life Science firms are willing to accept with respect to expansion and their ability to borrow funds

Index performance & M&A activity: The performance of indices such as the NASDAQ Composite stock market index, S&P 500, the Dow Jones Index, NASDAQ Biotechnology Index and S&P Biotechnology Select Industry Index show changes in investors' demand for technology and other stocks targeted for growth. Rising stock prices, especially as measured by these indices, reflect investor appetite to deploy capital in areas such as Life Science. The record number of IPOs which raised over \$11 billion in 2021 is another driving force to the Life Science industry performance. 2021 also had high M&A activity with deal values trending over \$75 billion that contributed to the positive performance of the Life Sciences industry.

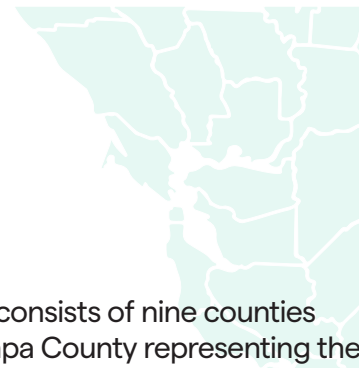
The combination of these variables provides context for the performance of Life Science employment in California. In 2021, total real GDP grew by 5.7 percent, while NIH and NSF grant funding dipped modestly. Large gains in the NASDAQ, Dow Jones, and S&P 500 coupled with an expansionary monetary policy in terms of lower interest rates offset those negatives. The net result was a 5.8 percent gain in Life Science employment in the State.

Regional Performance

Life Sciences represents a particularly important force in California's major economic clusters. In this section, key data points relevant to the Life Sciences are reported for the following four:

1. **Bay Area: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties**
2. **Los Angeles Area: Los Angeles, San Bernardino, and Ventura Counties**
3. **Orange County**
4. **San Diego County**

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Bay Area

The Bay Area represents a total workforce of approximately 4.2 million people and consists of nine counties with Santa Clara County representing the largest (workforce of 1.05 million), and Napa County representing the smallest (workforce of 74,000).

The Bay Area is a large regional Life Science cluster. The location quotient for biotechnology employment in the Bay Area – a by-location measure of concentration in an industry sector relative to the U.S. average– is 4.96 for R&D in biotechnology, and 2.85 for research in nanotechnology. R&D activities in biotechnology have been important to job growth in the Bay Area, accounting for approximately 3,900 new jobs in 2021 and more than 17,000 new jobs over the last five years.

There are three substantial manufacturing sub-sectors in the Bay Area: pharmaceutical drug and API manufacturing, medical instrument (surgical, electromedical, laboratory, etc.) manufacturing, and in-vitro diagnostic manufacturing. Among these three manufacturing sub-sectors, in-vitro diagnostic manufacturing contributed the most to job growth in 2021, adding approximately 2,000 jobs to the Bay Area economy. Among the medical instrument manufacturers, electromedical, laboratory equipment, and measuring instrument contributed the most to job growth in 2021. Employment among medical equipment wholesalers grew 15 percent YOY, adding approximately 500 new jobs.

Figure 16. Life Science Direct Employment and Growth in Bay Area, 2021

	Emp (2021)	Growth (YOY%)	Top 3 Occupations by Employment
Research & Manufacturing	53,914	4.1%	1. Software developer 2. Medical scientist 3. Natural sciences manager
Medical Devices & Equipment	17,916	3.2%	1. Team assemblers 2. Laboratory technicians 3. Inspectors, testers, samplers
Biopharma	25,784	2.3%	1. Filling machine operators 2. Chemical equipment operators 3. Inspectors, testers, samplers
Biotechnology	34,977	10.3%	1. Software developers 2. Medical scientists 3. Natural science managers
Scientific / Research Tools	13,397	6.3%	1. Electro equipment assemblers 2. Software developers 3. Electrical engineers
Food & Agriculture Biotechnology	143	-11.7%	1. Filling machine operators 2. Food batch makers 3. Packers and packagers
Total	146,131	5.2%	

SOURCE: IMPLAN

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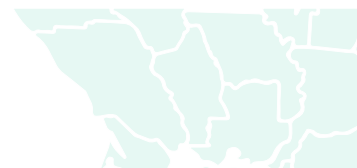


Figure 17: Life Science Direct Employment in Bay Area, by County, 2021

Region	Research & Manufacturing	Medical Devices & Equipment	Bio-pharmaceutical	Bio-technology	Scientific/ Research Tools	Food & Ag Biotechnology
Alameda County	15,558	6,953	3,216	6,830	3,920	48
Contra Costa County	1,196	946	685	1,317	631	21
Marin County	346	94	2,035	558	45	2
Napa County	85	78	24	23	118	0
San Francisco County	10,273	536	628	5,001	544	18
San Mateo County	7,801	2,294	11,902	16,792	1,552	8
Santa Clara County	17,210	5,215	5,549	4,310	6,215	7
Solano County	472	557	1,376	123	33	5
Sonoma County	975	1,242	369	22	339	33
Bay Area Total	53,914	17,916	25,784	34,977	13,397	143

SOURCE: IMPLAN

Figure 18: Life Science Economic Impact in Bay Area, by County, 2021

Region	Employment (workers)			Labor Income (U.S. \$ M's)			Output (U.S. \$ M's)		
	Direct	Total	Multiplier	Direct	Total	Multiplier	Direct	Total	Multiplier
Alameda County	36,525	116,073	3.18	\$9,314	\$15,332	1.65	\$41,740	\$57,402	1.38
Contra Costa County	4,796	9,205	1.92	\$627	\$992	1.58	\$3,292	\$4,476	1.36
Marin County	3,080	6,325	2.05	\$60	\$97	1.62	\$275	\$443	1.61
Napa County	328	693	2.11	\$24	\$50	2.07	\$186	\$249	1.34
San Francisco County	17,000	26,923	1.58	\$1,310	\$2,728	2.08	\$6,755	\$10,073	1.49
San Mateo County	40,349	70,685	1.75	\$2,686	\$3,920	1.46	\$11,103	\$14,132	1.27
Santa Clara County	38,506	104,074	2.70	\$8,285	\$13,798	1.67	\$45,416	\$59,348	1.31
Solano County	2,566	4,623	1.80	\$145	\$186	1.28	\$840	\$976	1.16
Sonoma County	2,980	9,239	3.10	\$481	\$837	1.74	\$2,731	\$3,797	1.39
Bay Area Total	146,130	347,840	2.38	\$22,932	\$37,939	1.65	\$112,338	\$150,894	1.34
* Total refers to the sum of direct, indirect, and induced impacts									

SOURCE: IMPLAN

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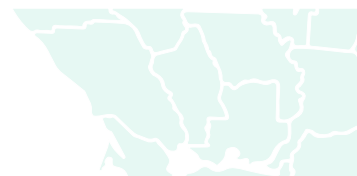


Figure 19: Educational Attainment in Bay Area, by County, 2021

Region	No High School	High School Graduate	Some College No Degree	Associate Degree	Bachelor's Degree	Postgraduate Degree
Alameda County	9.8%	16.1%	16.5%	6.4%	30.0%	21.2%
Contra Costa County	10.1%	16.9%	21.5%	8.5%	27.7%	16.0%
Marin County	7.1%	9.8%	15.9%	5.8%	36.6%	24.8%
Napa County	15.6%	17.6%	21.1%	9.2%	25.4%	11.2%
San Francisco County	8.1%	10.5%	12.6%	5.0%	38.5%	25.4%
San Mateo County	8.3%	14.1%	15.9%	6.7%	31.0%	23.9%
Santa Clara County	9.9%	13.0%	14.2%	6.6%	29.2%	27.1%
Solano County	11.1%	23.6%	28.4%	10.6%	18.5%	7.8%
Sonoma County	11.8%	18.9%	25.5%	9.4%	22.8%	11.6%

SOURCE: U.S. Census Bureau

Figure 20: Key Metrics in Bay Area, by County, 2021

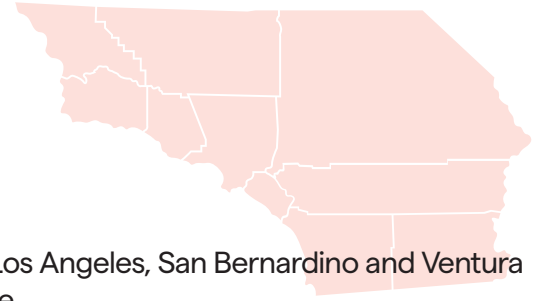
Region	Establishments	Avg. Wages per Worker	Location Quotient	Productivity	NIH Awards (\$ Millions)	NSF Awards (\$ Millions)
Alameda County	1,073	\$142,316	2.12	\$364,259	\$392.47	\$89.12
Contra Costa County	351	\$112,520	0.48	\$346,148	\$5.42	\$1.18
Marin County	122	\$200,705	0.85	\$1,114,650	\$22.41	\$0.25
Napa County	32	\$83,303	0.19	\$268,606	\$0.25	-
San Francisco County	818	\$148,957	1.51	\$328,181	\$856.58	\$16.64
San Mateo County	807	\$274,258	3.19	\$918,617	\$91.78	\$7.86
Santa Clara County	1,629	\$178,233	1.76	\$523,432	\$682.28	\$66.49
Solano County	121	\$93,233	0.73	\$491,854	\$2.15	-
Sonoma County	207	\$102,675	0.67	\$339,671	\$1.34	\$0.28
Total/Average	5,160	\$148,167	1.28	\$521,713	\$2,054.68	\$181.54

SOURCE: Bureau of Labor Statistics, NIH and NSF

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Los Angeles Cluster

For the purposes of this report, the Los Angeles Cluster is defined as Los Angeles, San Bernardino and Ventura Counties. This cluster represents a total workforce of 5.2 million people.

With the second-largest life science workforce in the state, with 91,633 total direct employees and 243,564 in total employment, the Los Angeles Cluster continues to have a strong foundation for future growth and is a significant contributor to the region's overall economy.

Job growth in the Los Angeles Life Science sector has primarily been driven by wholesale trade and distribution activities. Wholesalers of pharmaceutical and drug products employ a workforce of approximately 13,000 people, employment is averaging a stable 2.9 percent five-year growth and grew at 7.7 percent in 2021, adding about 1,700 jobs. Medical, dental, and hospital equipment wholesalers represent about 9,000 workers with 0.8 percent growth in 2021 adding almost 900 jobs over the last five years.

The employment base and job growth for the Life Science industry in the Los Angeles Cluster has varied depending on the sector and occupation. There is significant R&D activity in the Los Angeles Cluster including R&D employment of 52,908 in 2021. R&D and biotechnology added approximately 2,300 jobs in the Los Angeles Cluster over the last five years while we saw an overall decline of 1,700 general Life Science R&D jobs over the same period.

Manufacturing of surgical appliance and equipment represents about 9,300 workers, however employment in the surgical and medical instrument sub-sector has declined 3.4 percent annually over the last five years. Overall employment in pharmaceutical preparation manufacturing – representing about 7,300 workers in 2021 – has declined 8.4 percent annually over the last five years.

Job growth in the Los Angeles Life Science sector has primarily been driven by wholesale trade and distribution activities. Wholesalers of pharmaceutical and drug products employ a workforce of approximately 13,000 people, employment is averaging a stable 2.9 percent five-year growth and grew at 7.7 percent in 2021, adding about 1,700 jobs. Medical, dental, and hospital equipment wholesalers represent about 9,000 workers with 0.8 percent growth in 2021 adding almost 900 jobs over the last five years.

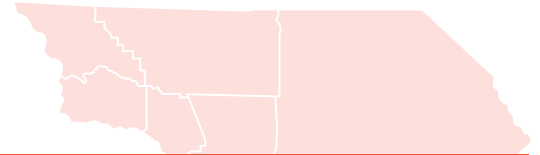


Figure 21: Life Science Direct Employment, Growth, and Occupations in Los Angeles Cluster, 2021

	Emp (2021)	Growth (YOY%)	Top 3 Occupations by Employment
Research & Manufacturing	42,404	5.7%	1. Medical laboratory technician 2. Phlebotomist 3. Software developer
Medical Devices & Equipment	18,543	4.4%	1. Team assemblers 2. Sales representative 3. Laboratory technician
Biopharma	21,245	3.1%	1. Sales representative 2. Filling machine operator 3. Freight and material movers
Biotechnology	5,846	16.2%%	1. Software developers 2. Medical scientists 3. Biological scientist
Scientific / Research Tools	3,333	-2.8%	1. Electro equipment assemblers 2. Software developers 3. Electrical engineers
Food & Agriculture Biotechnology	263	3.4%	1. Filling machine operators 2. Food batch makers 3. Chemical equipment operators
Total	91,633	5.1%	

SOURCE: IMPLAN

Figure 22: Life Science Direct Employment in Los Angeles Area, by County, 2021

Region	Research & Manufacturing	Medical Devices & Equipment	Bio-pharmaceutical	Bio-technology	Scientific/ Research Tools	Food & Ag Biotechnology
Los Angeles County	39,231	14,956	17,638	4,892	2,816	158
San Bernardino County	2,022	2,363	1,556	71	382	81
Ventura County	1,150	1,224	2,052	882	135	24
Los Angeles Total	42,404	18,543	21,245	5,846	3,333	263
City of Los Angeles	18,616	3,707	5,349	1,286	477	53

SOURCE: IMPLAN

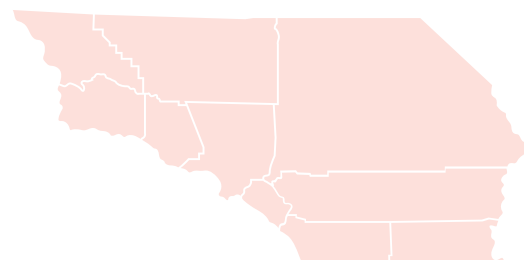


Figure 23: Life Science Economic Impact in Los Angeles Area, by County, 2021

Region	Employment (workers)			Labor Income (U.S. \$ M's)			Output (U.S. \$ M's)		
	Direct	Total	Multiplier	Direct	Total	Multiplier	Direct	Total	Multiplier
Los Angeles County	79,691	215,963	2.71	\$9,047	\$19,126	2.11	\$57,872	\$87,408	1.51
San Bernardino County	6,475	13,080	2.02	\$805	\$1,288	1.60	\$5,873	\$7,403	1.26
Ventura County	5,467	15,636	2.86	\$536	\$1,242	2.32	\$4,586	\$6,809	1.48
Los Angeles Total	91,633	244,678	2.67	\$10,387	\$21,655	2.08	\$68,331	\$101,620	1.49
City of Los Angeles	29,488	34,168	1.16	\$2,602	\$2,982	1.15	\$9,226	\$10,213	1.11

* Total refers to the sum of direct, indirect, and induced impacts

SOURCE: IMPLAN

Figure 24: Educational Attainment in Los Angeles, by County, 2021

Region	No High School	High School Graduate	Some College No Degree	Associate Degree	Bachelor's Degree	Postgraduate Degree
Los Angeles County	18.5%	20.4%	19.3%	7.1%	23.0%	11.6%
San Bernardino County	18.4%	26.7%	24.5%	8.8%	14.4%	7.2%
Ventura County	14.5%	19.2%	22.2%	10.3%	22.2%	11.6%
City of Los Angeles	20.4%	18.8%	17.6%	6.4%	24.6%	12.1%

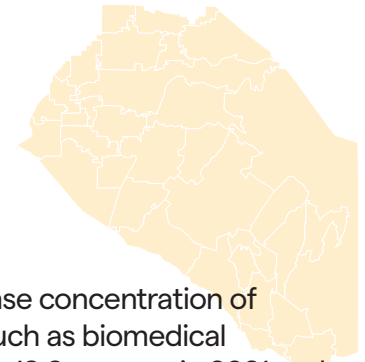
SOURCE: U.S. Census Bureau

Figure 25: Key Metrics in Los Angeles, by County, 2021

Region	Establishments	Avg. Wages per Worker	Location Quotient	Productivity	NIH Awards (\$ Millions)	NSF Awards (\$ Millions)
Los Angeles County	4,548	\$94,728	1.00	\$227,593	\$1,355.07	\$121.52
San Bernardino County	525	\$68,967	0.37	\$218,694	\$10.88	-
Ventura County	393	\$99,331	0.69	\$297,018	\$2.90	-
Total/Average	5,466	\$87,675	0.69	\$247,768	\$1,386.85	\$121.52
City of Los Angeles	NA	\$92,605	1.07	\$261,700	\$1,079.79	\$68.85

SOURCE: Bureau of Labor Statistics, NIH and NSF

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Orange County Cluster

Orange County has a workforce of 1.67 million people in 2021. The county has a dense concentration of R&D employment largely focused on general engineering and Life Science topics such as biomedical sciences, bioengineering, medical imaging etc. Biotechnology employment grew by 18.9 percent in 2021 and employment in food and agricultural biotechnology grew by 8.9 percent. Growth in Orange County research fields was also driven by medical laboratories which have added more than 2,200 jobs to the area since 2017.

There are two major manufacturing sectors in Orange County: surgical and medical instruments and electromedical apparatuses. Surgical and medical instrument manufacturing has been growing at 5.6 percent annually for the last five years, employs more than 10,000 people in the county, and is heavily concentrated relative to the U.S. average with a location quotient of 7.13. The manufacturing of electromedical apparatus equipment – which includes imaging equipment, ultrasound equipment, pacemakers, hearing aids – employs more than 7,000 people in the county with a location quotient of 8.55.

Equipment and drug merchant wholesalers are also substantial employers in Orange County, accounting for approximately 11,000 jobs in 2021.

Figure 26: Life Science Direct Employment, Growth, and Occupations in Orange County, 2021

	Emp (2021)	Growth (YOY%)	Top 3 Occupations by Employment
Research & Manufacturing	15,661	9.1%	1. Medical laboratory technician 2. Phlebotomist 3. Medical scientist
Medical Devices & Equipment	25,557	5.2%	1. Team assemblers 2. Sales representative 3. Laboratory technician
Biopharma	10,063	2.8%	1. Sales representative 2. Filling machine operator 3. Freight and material movers
Biotechnology	768	18.9%	1. Software developers 2. Medical scientists 3. Biological scientist
Scientific / Research Tools	8,301	2.0%	1. Electro equipment assemblers 2. Software developers 3. Electrical engineers
Food & Agriculture Biotechnology	42	8.9%	1. Filling machine operators 2. Food batch makers 3. Packers and packagers
Total	60,391	5.4%	

SOURCE: IMPLAN

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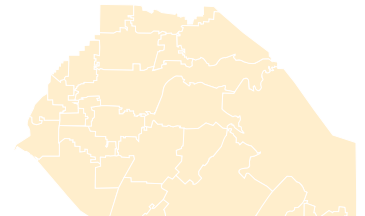


Figure 27: Life Science Economic Impact in Orange County, 2021

Region	Employment (workers)			Labor Income (U.S. \$ M's)			Output (U.S. \$ M's)		
	Direct	Total	Multiplier	Direct	Total	Multiplier	Direct	Total	Multiplier
Orange County	60,391	172,048	2.85	\$7,521	\$16,714	2.22	\$45,146	\$70,804	1.57
Orange County Total	60,391	172,048	2.85	\$7,521	\$16,714	2.22	\$45,146	\$70,804	1.57

* Total refers to the sum of direct, indirect, and induced impacts

SOURCE: IMPLAN

Figure 28: Educational Attainment in Orange County, 2021

Region	No High School	High School Graduate	Some College No Degree	Associate Degree	Bachelor's Degree	Postgraduate Degree
Orange County	13.6%	17.0%	19.7%	7.6%	27.7%	14.4%

SOURCE: U.S. Census Bureau

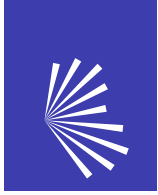
Figure 29: Key Metrics in Orange County, 2021

Region	Establishments	Avg. Wages per Worker	Location Quotient	Productivity	NIH Awards (\$ Millions)	NSF Awards (\$ Millions)
Orange County	2,356	\$105,298	1.38	\$335,985	\$209.54	\$28.08

SOURCE: Bureau of Labor Statistics, NIH and NSF



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San Diego Cluster

The San Diego Cluster represents a total workforce of 1.76 million people and is comprised of San Diego County.

Life Science industries employed approximately 71,419 workers in 2021. The largest employment sectors are in Research & Manufacturing and Biotechnology, which employ 22,259 and 20,830 workers, respectively. The highest growth sector in 2021 was Biotechnology, which experienced year-on-year growth of 18.0 percent, followed closely by Biopharmaceutical, which experienced year-on-year growth of 15.4 percent.

San Diego hosts a vibrant R&D environment supported by a deep network of educational institutions. R&D in biotechnology employs more than 21,000 workers in the region, hosts a concentration of workers with location quotient of 8.19, and has experienced year-on-year employment growth of 21 percent. R&D in general engineering and Life Sciences employs an additional 19,000 workers in the area, with a location quotient of 3.84, and experienced year-on-year employment growth of 6 percent last year. The average wage of an R&D worker in biotechnology is \$188,166, compared to the average wage of an R&D worker in general engineering and Life Sciences which is \$244,299. Educational institutions in the area – colleges, universities, and professional schools – altogether employ more than 34,000 workers, and experienced employment growth of 5 percent last year in 2021.

There are three manufacturing sectors that contribute to employment in San Diego. The largest manufacturing sector (electromedical apparatus equipment) employs 4,700 people, and experienced modest year-on-year growth of 1 percent last year. The second largest (in-vitro diagnostic manufacturing) employs 4,600 workers and grew employment by 14.4 percent in 2021. Surgical and medical instrument manufacturing is the third-largest manufacturing sector and employs approximately 3,000 workers, but reduced in size by 2 percent last year.

Drug merchant wholesalers added approximately 500 jobs to the San Diego Cluster last year totaling 2,700 workers.



Figure 30: Life Science Direct Employment, Growth, and Occupations in San Diego County, 2021

	Emp (2021)	Growth (YOY%)	Top 3 Occupations by Employment
Research & Manufacturing	22,259	4.6%	1. Software developer 2. Medical scientist 3. Natural sciences manager
Medical Devices & Equipment	10,439	2.2%	1. Team assemblers 2. Laboratory technician 3. Sales representative
Biopharma	11,454	15.4%	1. Filling machine operator 2. Inspectors, testers, samplers 3. Chemical equipment operators
Biotechnology	20,830	18.0%	1. Medical scientist 2. Software developer 3. Natural sciences manager
Scientific / Research Tools	6,399	3.9%	1. Electro equipment assemblers 2. Software developers 3. Electrical engineers
Food & Agriculture Biotechnology	38	3.0%	1. Filling machine operators 2. Food batch makers 3. Packers and packagers
Total	71,419	9.4%	

SOURCE: IMPLAN

Figure 31: Life Science Direct Employment in San Diego, 2021

Region	Research & Manufacturing	Medical Devices & Equipment	Bio-pharmaceutical	Bio-technology	Scientific/ Research Tools	Food & Ag Biotechnology
San Diego County Total	22,259	10,439	11,454	20,830	6,399	38
City of San Diego	17,416	5,665	5,604	18,712	2,461	23

SOURCE: IMPLAN

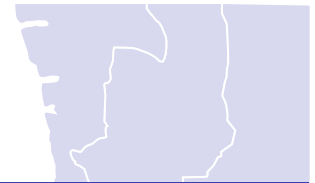


Figure 32: Life Science Economic Impact in San Diego County, 2021

Region	Employment (workers)			Labor Income (U.S. \$ M's)			Output (U.S. \$ M's)		
	Direct	Total	Multiplier	Direct	Total	Multiplier	Direct	Total	Multiplier
San Diego County	71,149	115,158	1.62	\$4,998	\$10,468	2.09	\$33,381	\$49,817	1.49
San Diego Total	71,149	115,158	1.62	\$4,998	\$10,468	2.09	\$33,381	\$49,817	1.49
City of San Diego	49,880	70,874	1.42	\$4,537	\$7,623	1.68	\$17,257	\$21,614	1.25

* Total refers to the sum of direct, indirect, and induced impacts

SOURCE: IMPLAN

Figure 33: Educational Attainment in San Diego County, 2021

Region	No High School	High School Graduate	Some College No Degree	Associate Degree	Bachelor's Degree	Postgraduate Degree
San Diego County	11.0%	18.1%	22.2%	8.4%	25.4%	14.7%
City of San Diego	9.9%	14.9%	19.3%	7.8%	29.3%	18.9%

SOURCE: U.S. Census Bureau

Figure 34: Key Metrics in San Diego County, 2021

Region	Establishments	Avg. Wages per Worker	Location Quotient	Productivity	NIH Awards (\$ Millions)	NSF Awards (\$ Millions)
San Diego County	2,703	\$149,528	2.00	\$397,040	\$1,075.11	\$67.85
City of San Diego	NA	\$152,845	2.63	\$405,847	\$113.94	\$9.05

SOURCE: Bureau of Labor Statistics, NIH and NSF



Other Counties In California

Figure 35: Life Science Direct Employment, Growth, and Occupations in Other Counties in California, 2021

Region	Employment (workers)			Labor Income (U.S. \$ M's)			Output (U.S. \$ M's)		
	Direct	Total	Multiplier	Direct	Total	Multiplier	Direct	Total	Multiplier
Alpine County	0	0	n/a	0	0	n/a	0	0	n/a
Amador County	55	90	1.63	3	4	1.36	21	26	1.25
Butte County	874	1,190	1.36	34	49	1.47	84	137	1.62
Calaveras County	8	16	2.00	1	2	1.45	3	4	1.36
Colusa County	18	24	1.33	2	2	1.16	11	12	1.10
Del Norte County	3	5	1.50	0	0	1.71	2	2	1.24
El Dorado County	364	598	1.64	30	42	1.41	89	126	1.42
Fresno County	3,037	7,158	2.36	181	401	2.21	984	1,658	1.69
Glenn County	10	15	1.60	1	1	1.46	3	4	1.33
Humboldt County	589	1,021	1.73	28	52	1.88	187	266	1.43
Imperial County	79	134	1.70	5	8	1.51	21	29	1.37
Inyo County	8	10	1.30	0	0	1.29	1	1	1.37
Kern County	1,531	2,729	1.78	114	184	1.61	588	796	1.35
Kings County	51	90	1.77	4	6	1.53	34	42	1.22
Lake County	9	20	2.14	0	1	2.51	4	6	1.50
Lassen County	34	44	1.30	3	3	1.16	7	8	1.27
Madera County	40	57	1.43	4	5	1.26	8	11	1.39
Mariposa County	14	19	1.36	1	1	1.15	3	4	1.19
Mendocino County	64	143	2.25	6	10	1.72	50	65	1.28
Merced County	614	810	1.32	27	37	1.34	83	114	1.36
Modoc County	2	3	2.00	0	0	1.24	0	0	1.32
Mono County	0	0	n/a	0	0	n/a	0	0	n/a
Monterey County	768	1,298	1.69	52	85	1.62	217	309	1.43
Nevada County	183	368	2.01	10	18	1.76	83	115	1.39

SOURCE: IMPLAN

Prepared for Biocom California, the trade association for the State of California. When referencing this document, please use "Biocom California's 2022 Life Science Economic Impact Report" for citation.



Region	Employment (workers)			Labor Income (U.S. \$ M's)			Output (U.S. \$ M's)		
	Direct	Total	Multiplier	Direct	Total	Multiplier	Direct	Total	Multiplier
Placer County	1,513	3,286	2.17	132	245	1.85	488	802	1.64
Plumas County	7	13	1.83	0	1	1.56	2	2	1.48
Riverside County	8,586	18,469	2.15	738	1,232	1.67	3,508	5,069	1.44
Sacramento County	8,695	19,472	2.24	880	1,585	1.80	3,167	5,153	1.63
San Benito County	175	289	1.65	19	25	1.31	171	192	1.13
San Joaquin County	1,555	2,549	1.64	103	157	1.53	427	588	1.38
San Luis Obispo County	1,731	2,938	1.70	94	158	1.68	538	750	1.39
Santa Barbara County	4,765	9,164	1.92	417	719	1.72	1,483	2,311	1.56
Santa Cruz County	2,750	5,567	2.02	175	383	2.19	1,209	1,813	1.50
Shasta County	402	748	1.86	28	46	1.66	129	185	1.43
Sierra County	0	0	n/a	0	0	n/a	0	0	n/a
Siskiyou County	12	17	1.38	1	1	1.18	2	3	1.30
Stanislaus County	1,246	2,175	1.75	100	148	1.48	481	632	1.31
Sutter County	42	67	1.59	3	4	1.34	9	13	1.38
Tehama County	7	17	2.60	1	1	1.89	4	6	1.35
Trinity County	7	11	1.60	1	1	1.27	2	2	1.36
Tulare County	680	1,371	2.01	51	88	1.73	349	461	1.32
Tuolumne County	27	46	1.73	2	3	1.40	8	11	1.37
Yolo County	5,172	6,657	1.29	217	302	1.39	619	888	1.43
Yuba County	59	76	1.30	5	5	1.16	12	15	1.23
Total	45,782	88,771	1.94	3,473	6,017	1.73	15,091	22,632	1.50

* Total refers to the sum of direct, indirect, and induced impacts

SOURCE: IMPLAN



Figure 36: Educational Attainment in Other Counties in California, by County, 2021

Region	No High School	High School Graduate	Some College No Degree	Associate Degree	Bachelor's Degree	Postgraduate Degree
Alpine County	5.9%	36.8%	23.0%	8.0%	11.7%	14.5%
Amador County	9.8%	30.6%	30.5%	11.7%	12.2%	5.2%
Butte County	10.3%	22.8%	29.4%	10.7%	18.5%	8.2%
Calaveras County	9.8%	31.5%	28.0%	12.4%	13.6%	4.8%
Colusa County	28.2%	28.4%	20.6%	9.4%	10.5%	2.9%
Del Norte County	22.3%	34.0%	22.6%	7.8%	9.1%	4.2%
El Dorado County	6.0%	20.3%	26.2%	11.2%	24.9%	11.5%
Fresno County	22.1%	23.1%	23.7%	9.5%	14.8%	6.8%
Glenn County	25.8%	27.4%	23.5%	10.0%	10.9%	2.3%
Humboldt County	9.3%	23.9%	26.6%	11.1%	20.6%	8.5%
Imperial County	25.1%	26.9%	24.9%	6.7%	12.3%	4.2%
Inyo County	9.6%	28.7%	25.0%	9.7%	17.6%	9.5%
Kings County	24.8%	26.5%	24.9%	8.8%	10.0%	5.0%
Kern County	24.2%	28.3%	23.1%	7.7%	11.1%	5.5%
Lake County	14.6%	31.8%	26.5%	11.6%	10.2%	5.3%
Lassen County	21.4%	34.2%	25.7%	7.4%	8.6%	2.6%
Madera County	28.3%	23.5%	26.5%	7.4%	10.6%	3.7%
Mariposa County	8.6%	23.6%	31.0%	10.7%	17.8%	8.2%
Mendocino County	14.6%	28.9%	28.0%	9.3%	13.3%	5.8%
Merced County	28.2%	26.9%	23.1%	7.9%	9.8%	4.2%
Modoc County	17.1%	30.7%	28.3%	9.9%	10.7%	3.2%
Mono County	13.9%	23.2%	26.0%	8.9%	21.8%	6.2%
Monterey County	28.2%	21.1%	18.2%	8.4%	15.5%	8.5%
Nevada County	5.7%	19.0%	27.6%	10.6%	25.4%	11.2%
Placer County	4.2%	16.4%	25.1%	11.1%	29.4%	13.7%
Plumas County	5.8%	24.7%	32.8%	13.1%	15.7%	8.0%
Riverside County	16.8%	27.5%	24.8%	8.4%	14.8%	7.6%
Sacramento County	11.3%	22.2%	24.9%	9.8%	21.5%	10.4%

Prepared for Biocom California, the trade association for the State of California. When referencing this document, please use "Biocom California's 2022 Life Science Economic Impact Report" for citation.



Region	No High School	High School Graduate	Some College No Degree	Associate Degree	Bachelor's Degree	Postgraduate Degree
San Benito County	16.7%	26.9%	26.7%	10.2%	14.7%	4.8%
San Joaquin County	19.0%	28.9%	23.3%	9.5%	13.3%	5.9%
San Luis Obispo County	9.1%	20.5%	25.4%	10.4%	22.7%	11.8%
Santa Barbara County	19.9%	17.0%	21.6%	8.5%	20.5%	12.6%
Santa Cruz County	12.3%	15.6%	22.5%	8.5%	24.7%	16.3%
Shasta County	8.7%	24.8%	32.5%	11.4%	15.4%	7.1%
Sierra County	7.8%	26.1%	35.0%	11.3%	9.7%	10.1%
Siskiyou County	10.5%	26.1%	32.2%	11.3%	13.0%	7.0%
Stanislaus County	18.7%	30.5%	25.3%	7.7%	12.7%	5.1%
Sutter County	18.5%	22.9%	26.9%	11.3%	13.7%	6.8%
Tehama County	14.4%	29.3%	31.0%	9.6%	12.0%	3.8%
Trinity County	7.5%	41.6%	28.6%	7.7%	10.0%	4.5%
Tulare County	27.4%	26.7%	22.9%	8.7%	9.9%	4.4%
Tuolumne County	9.6%	26.1%	33.2%	11.4%	14.1%	5.5%
Yolo County	11.9%	17.8%	20.7%	7.5%	22.3%	19.9%
Yuba County	16.6%	24.4%	30.0%	10.9%	12.9%	5.1%

SOURCE: IMPLAN



Figure 37: Key Metrics in Other Counties in California, by County, 2021

Region	Establishments	Avg. Wages per Worker	Location Quotient	Productivity	NIH Awards (\$ Millions)	NSF Awards (\$ Millions)
Alpine County	1	\$68,872	0.23	\$397,370	-	-
Amador County	8	\$36,177	0.15	\$324,204	-	-
Butte County	225	\$86,507	0.92	\$160,542	-	\$0.28
Calaveras County	2	\$67,154	0.02	\$321,033	-	-
Colusa County	4	\$72,370	0.05	\$460,419	-	-
Del Norte County	2	\$75,873	0.01	\$298,447	-	-
El Dorado County	51	\$75,873	0.22	\$337,527	-	-
Fresno County	320	\$58,304	0.47	\$161,979	\$1.81	\$0.96
Glenn County	2	\$80,023	0.02	\$292,602	-	-
Humboldt County	192	\$65,415	0.87	\$154,137	-	\$0.81
Imperial County	23	\$64,704	0.04	\$655,133	-	\$0.30
Inyo County	4	\$77,046	0.04	\$265,768	-	-
Kern County	231	\$68,018	0.27	\$244,236	-	\$0.19
Kings County	11	\$82,159	0.03	\$517,161	-	-
Lake County	3	\$74,327	0.02	\$252,015	-	-
Lassen County	4	\$99,270	0.11	\$291,718	-	-
Madera County	12	\$38,203	0.03	\$267,555	-	-
Mariposa County	4	\$49,094	0.14	\$202,837	-	-
Mendocino County	13	\$63,013	0.09	\$331,448	-	-
Merced County	24	\$84,677	0.70	\$162,776	\$5.36	\$11.75
Modoc County	1	\$86,889	0.04	\$278,315	-	-
Mono County	1	\$50,124	0.06	\$385,230	-	-
Monterey County	152	\$73,777	0.31	\$172,804	\$0.26	\$1.06
Nevada County	35	\$74,101	0.19	\$355,229	\$0.80	-
Placer County	110	\$67,986	0.29	\$292,255	-	-
Plumas County	2	\$88,631	0.03	\$280,022	-	-
Riverside County	466	\$78,051	0.48	\$251,211	\$39.31	\$28.04
Sacramento County	555	\$111,473	0.63	\$323,171	\$3.72	\$1.74
San Benito County	12	\$92,154	0.29	\$1,039,862	\$10.88	-
San Joaquin County	108	\$61,830	0.35	\$187,128	\$0.28	\$0.69

SOURCE: Bureau of Labor Statistics, NIH and NSF



Continued Figure 37: Key Metrics in Other Counties in California, by County, 2021

Region	Establishments	Avg. Wages per Worker	Location Quotient	Productivity	NIH Awards (\$ Millions)	NSF Awards (\$ Millions)
San Luis Obispo County	189	\$76,094	1.01	\$222,030	\$0.29	\$0.75
Santa Barbara County	193	\$80,745	1.27	\$225,541	\$27.33	\$34.62
Santa Cruz County	87	\$68,211	1.57	\$185,391	\$52.24	\$10.04
Shasta County	56	\$59,026	0.27	\$221,374	-	-
Sierra County	1	\$90,154	0.01	\$402,741	-	-
Siskiyou County	3	\$68,708	0.03	\$264,258	-	-
Stanislaus County	152	\$68,044	0.37	\$275,383	\$0.10	-
Sutter County	12	\$82,405	0.10	\$243,097	-	-
Tehama County	4	\$109,857	0.01	\$315,599	-	-
Trinity County	2	\$88,662	0.12	\$373,510	-	-
Tulare County	56	\$58,616	0.14	\$465,968	-	-
Tuolumne County	9	\$75,553	0.05	\$263,692	-	-
Yolo County	93	\$75,780	4.42	\$133,775	\$273.03	\$32.72
Yuba County	6	\$92,286	0.17	\$247,555	-	-

SOURCE: Bureau of Labor Statistics, NIH and NSF



Prepared for Biocom California, the trade association for the State of California. When referencing this document, please use "Biocom California's 2022 Life Science Economic Impact Report" for citation.



Appendix A

Comparison with Past Economic Impact Reports

The Biocom California 2022 Economic Impact Report was completed by Deloitte Consulting LLP. In past years, the Databook was completed by the Fermanian Business & Economic Institute at Point Loma Nazarene University (2021) and Clower & Associates (prior to 2021). Some numbers may not be comparable to past reports due to the following factors:

1. The industry definitions are composed of the same NAICS codes as the Biocom California Economic Impact Report 2021. Some NAICS codes have been updated by changing the “%” of the industry that is considered part of the Life Science sector. The changes were made to accurately reflect the Life Science industry as it continues to evolve.
2. The inconsistencies in the employment data between 2020 and 2021 are due to a difference in data sources and associated calculation methodologies used. The employment data for 2021 has been sourced from the U.S. Bureau of Labor Statistics which is a widely accepted source for employment statistics in the U.S.
3. Deloitte uses the econometric modeling software, IMPLAN. This is a widely accepted modeling software. While numbers should be somewhat comparable, the change in methodology of inputs used in the model may present some discrepancies with past reports.
4. The Biocom California 2022 Economic Impact Report was altered from previous reports to include additional metrics and analysis of the drivers of the Life Science industry in California, such as the top occupations by SIC codes, alterations to some NAICS codes to use a larger proportion of the industry’s output.
5. The inconsistencies in the economic output between 2020 and 2021 can be attributed to the difference in the data source and associated calculation methodologies for the inputs used for the economic impact model. The inputs for the economic impact model were sourced from the U.S. Bureau of Labor Statistics.

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Appendix B

Industries and NAICS Codes

1. Biotechnology

325220 Artificial and Synthetic Fibers and Filaments Manufacturing
541713 Research and Development in Nanotechnology
541714 Research and Development in Biotechnology

2. Biopharmaceuticals

325411 Medicinal and Botanical Manufacturing
325412 Pharmaceutical Preparation Manufacturing
325413 In-Vitro Diagnostic Substance Manufacturing
325414 Biological Product (except Diagnostic) Manufacturing
424210 Drugs and Druggists' Sundries Merchant Wholesalers

3. Medical Devices and Equipment

327215 Glass Product Manufacturing Made of Purchased Glass (15%)
333314 Optical Instrument and Lens Manufacturing (15%)
334517 Irradiation Apparatus Manufacturing
339112 Surgical and Medical Instrument Manufacturing
339113 Surgical Appliance and Supplies Manufacturing
339114 Dental Equipment and Supplies Manufacturing
339115 Ophthalmic Goods Manufacturing
339116 Dental Laboratories
334510 Electromedical and Electrotherapeutic Apparatus Manufacturing (25%)
423450 Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers

4. Research and Manufacturing

541380 Testing Laboratories (12%)
541714 Research and Development in Biotechnology (except Nanobiotechnology)
541715 Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)
611310 Colleges, Universities, and Professional Schools (Private) (25%)
621511 Medical Laboratories

5. Scientific/Research Tools

325199 All Other Basic Organic Chemical Manufacturing
334516 Analytical Laboratory Instrument Manufacturing
334510 Electromedical and Electrotherapeutic Apparatus Manufacturing (75%)

6. Food and Agriculture Biotechnology

325193 Ethyl Alcohol Manufacturing
311999 All Other Miscellaneous Food Manufacturing (10%) (includes plant-based and cellular grown meats/seafoods)
325311 Nitrogenous Fertilizer Manufacturing (15%)
325312 Phosphatic Fertilizer Manufacturing (15%)
325314 Fertilizer (Mixing Only) Manufacturing (15%)
325320 Pesticide and Other Agricultural Chemical Manufacturing (15%)

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Appendix C

Glossary of Terms

Average compensation: Average annual salary and benefits

Direct employment: Total number of people employed In Life Science enterprises

Total jobs: Total number of jobs created after multiplier effects due to spending in supply chains and consumer spending by all employees

Labor income: Wages, salaries, and earnings of business proprietors

Productivity: Product of output per worker and the wage rate

Output: Estimated total production and measure of overall economic activity

DOD: U.S. Department of Defense

FDA: U.S. Food and Drug Administration

NIH: U.S. National Institutes of Health

NSF: U.S. National Science Foundation



Appendix D

Data Collection

Data collection was performed using two distinct methods. For some sources that did not provide search by NAICS codes, keyword searches were used. The keywords used across all platforms were bio renewable, biofuel, biopharmaceutical, biotechnology, nanotechnology, bio-agriculture, and bio agriculture. The following sources used keyword searches:

- National Institutes of Health
- National Science Foundation
- Pitchbook Inc. Venture Capital Data
- US Patent and Trademark Office

NAICS Code searches were performed to collect data from the following sources:

- California EDD
- USASpending.gov

Data was collected from the U.S. Census Bureau American Community Surveys not specific to Life Science companies.

IMPLAN

IMPLAN, a widely used econometric forecasting tool, uses unique industry codes. A majority of these codes for the Life Sciences map directly to NAICS codes. For those that were not direct matches, an intensive analysis was completed to ensure accuracy of the IMPLAN codes in relation to the Life Science industry. IMPLAN models were run to generate the overall economic impacts (direct, indirect, and induced) for California and all 4 regions within California. These models were run using 2021 employment numbers by industry category.

Biocom California Index

The Index was developed based on key metrics of the performance of the Life Science sector in California over time and in consultation with Biocom California. The Index components and weights encompass the following:

Component	Weight
Number of NIH grants	0.02
Value of NIH grants	0.08
Number of NSF grants	0.02
Value of NSF grants	0.08
Number of payroll Jobs	0.20
Number of establishments	0.35
Value of venture capital investments	0.05

Annual data was collected from 2000 through 2021 and each series was indexed to its 2000 value. The Biocom California Index was calculated as a weighted average of the sub-indices.

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Appendix E

		Employment (Number of workers)		Labor Income (U.S. \$ M's)		Output (U.S. \$ M's)	
		Direct	Total	Direct	Total	Direct	Total
Biopharmaceuticals	Medicinal and botanical mfg	6,542	22,483	\$1,271	\$2,539	\$5,665	\$9,675
	Pharmaceutical preparation mfg	28,905	157,884	\$6,329	\$17,331	\$59,811	\$93,585
	In-vitro diagnostic mfg	10,991	30,664	\$1,784	\$3,314	\$6,394	\$11,163
	Biological product mfg	3,075	8,403	\$513	\$925	\$2,460	\$3,791
	Drug Wholesale	31,856	152,037	\$4,590	\$13,502	\$24,251	\$47,877
Biotechnology	R&D in nanotechnology	4,287	11,183	\$620	\$1,133	\$1,324	\$2,737
	Cellulosic fiber mfg	89	291	\$10	\$26	\$74	\$126
	R&D in biotechnology	61,914	161,501	\$8,955	\$16,364	\$19,128	\$39,529
Food and Agriculture Biotechnology	Miscellaneous food mfg	396	1,191	\$27	\$84	\$162	\$334
	Nitrogenous fertilizer mfg (15%)	114	657	\$12	\$58	\$149	\$310
	Phosphatic fertilizer mfg (15%)	70	321	\$10	\$29	\$80	\$145
	Fertilizer (mixing only) mfg	185	581	\$17	\$46	\$127	\$234
	Pesticide chemical mfg (15%)	95	487	\$12	\$43	\$163	\$259
	Ethyl alcohol manufacturing	175	900	\$21	\$76	\$307	\$513
Research and manufacturing	R&D in Engineering, Life Sciences (46%)	49,016	127,857	\$7,089	\$12,955	\$15,143	\$31,294
	Testing laboratories (12%)	2,538	4,654	\$259	\$407	\$555	\$970
	Colleges and universities (25%)	76,959	109,704	\$4,509	\$6,643	\$7,710	\$14,390
	Medical laboratories	32,239	77,720	\$3,292	\$6,767	\$7,056	\$17,066
Medical devices and equipment	Surgical & medical equipment mfg	28,673	46,233	\$3,958	\$5,316	\$11,867	\$15,746
	Surgical appliance & supplies mfg	11,398	15,420	\$1,242	\$1,543	\$4,424	\$5,285
	Dental equipment mfg	3,261	8,651	\$341	\$733	\$1,044	\$2,184
	Glass product mfg (15%)	588	2,036	\$42	\$158	\$157	\$456
	Optical instrument and lens mfg (15%)	648	27,527	\$100	\$1,978	\$313	\$5,580
	Ophthalmic goods mfg	4,331	10,297	\$421	\$856	\$1,317	\$2,538
	Dental laboratories	9,635	15,645	\$654	\$1,151	\$1,118	\$2,526
	Irradiation apparatus mfg	2,568	57,934	\$305	\$4,263	\$1,518	\$12,227
	Equipment wholesale	29,530	38,070	\$4,462	\$5,120	\$11,228	\$13,666
Scientific / Research Tool	Other basic organic chemical mfg	2,062	51,326	\$243	\$4,220	\$3,612	\$14,800
	Electromedical apparatus mfg	22,006	24,669	\$3,933	\$4,154	\$13,289	\$13,872
	Measuring instrument mfg (20%)	1,552	22,368	\$159	\$1,861	\$573	\$5,173
	Analytical laboratory instrument mfg	9,996	10,651	\$1,491	\$1,539	\$4,869	\$5,016
TOTAL		435,694	1,199,346	\$56,668	\$115,134	\$205,887	\$373,068

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