



## State Snapshot

Washington is one of the premier biotechnology centers in the world and one of the fastest growing research centers in the United States, employing over 26,000 people and representing 200 companies, nonprofits, and research institutions.<sup>1</sup> The Bio-Tech & Bio-Medical Devices cluster in the Seattle metropolitan area alone contributes \$2.5 billion in gross revenue and employs over 5,800 workers with total wages of \$488 million.<sup>2</sup> With world-class research, a highly educated workforce, access to capital, and an exceptional quality of life, Washington has the resources needed for cutting edge research at universities and institutes across the state. Firms stand on the threshold of major breakthroughs that will revolutionize a wide variety of processes with increasing economic benefit locally, as well as globally.<sup>3</sup>

Washington universities receive more than half a billion dollars of research grants each year, mostly federal research and training money focused on health science and environmental related research. Among University of Washington scientists alone, there are several Nobel Prize winners and over 50 members of the National Academy of Sciences and the Institute of Medicine.

Biotechnology companies in Washington are developing methods for diagnosing and treating conditions such as cancer, AIDS, malaria, cystic fibrosis, multiple sclerosis, and rheumatoid arthritis. Medical device firms are leaders in the research and development of ultrasound imaging and heart defibrillation products. Environmental firms are developing innovative products and processes for waste management and bioremediation. 10% of firms headquartered in Washington are publicly traded on U.S. and Canadian stock exchanges.<sup>4</sup>

The Bio-Tech & Bio-Medical Devices cluster in Washington has evolved steadily over time. In recent years, advances in public policy have helped increase both the pace of discovery and the rate of commercialization of basic research. This cluster will continue expanding as entrepreneurs and scientists grow existing companies and form new enterprises.<sup>5</sup> Bio-Tech & Bio-Medical Devices in Washington has strengths that almost any other place in the world would gladly trade to have, and the state of the cluster is strong.

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<sup>1</sup> (Economic Modeling Specialists, Inc, 2010): Not accessible without paid subscription

<sup>2</sup> (University of Washington Bothell, 2008): <http://www.uwb.edu/bbti/news/washington-state-biomedical-devi>

<sup>3</sup> (Washington Biotechnology & Biomedical Association, 2006): [http://www.wabio.com/industry/annrpt/annrpt\\_overview.htm](http://www.wabio.com/industry/annrpt/annrpt_overview.htm)

<sup>4</sup> (Snohomish County Economic Development Council, 2010): <http://snoedc.org/industryclusters/lifesciences/>

<sup>5</sup> (Washington State Department of Commerce, 2010): <http://www.choosewashington.com/INDUSTRIES/SCIENCES/Pages/default.aspx>

## Snohomish County Snapshot

### Bio-Tech & Bio-Medical Devices Defined

The North American Industrial Classification System (NAICS) is the current industry classification standard in the United States. Bio-Tech & Bio-Medical Devices includes establishments engaged in conducting biotechnology research and experimental development involving the study of the use of microorganisms and cellular and biomolecular processes to develop or alter living or non-living materials. Medical and diagnostic laboratories are also included in the cluster. The table below depicts 2007 NAICS codes for the Bio-Tech & Bio-Medical Devices cluster.<sup>6</sup>

NAICS Code	Industry Title
541711	Research and development in biotechnology
621511	Medical laboratories
621512	Diagnostic imaging centers

### Employment in Bio-Tech & Bio-Medical Devices

Snohomish County employs 10% of all Washington Bio-Tech & Bio-Medical Devices employees. The number of workers in the Bio-Tech & Bio-Medical Devices cluster totaled over 2,200 as of April 2010. Employment within the cluster grew a whopping 99% since 2002 and 11% since 2009. Most employees in Bio-Tech & Bio-Medical Devices work as scientists and technicians. The top 20 occupations in the Bio-Tech & Bio-Medical Devices cluster are listed in the table below.<sup>7</sup>

SOC Code	Occupation Title	Jobs	% of Industry
19-1042	Medical scientists, except epidemiologists	269	12%
19-4021	Biological technicians	115	5%
15-1032	Computer software engineers, systems software	79	3%
15-1031	Computer software engineers, applications	58	3%
13-1199	Business operation specialists, all other	49	2%
11-9121	Natural sciences managers	49	2%
19-2031	Chemists	44	2%
17-2141	Mechanical engineers	38	2%
17-2199	Engineers, all other	37	2%
43-6011	Executive secretaries and administrative assistants	36	2%
11-9199	Managers, all other	35	2%
17-2161	Nuclear engineers	32	1%
19-1021	Biochemists and biophysicists	31	1%
29-2011	Medical and clinical laboratory technologists	28	1%

<sup>6</sup> (North American Industry Classification System, 2007): <http://www.census.gov/epcd/www/naics.html>

<sup>7</sup> (Economic Modeling Speciliasts, Inc, 2010): Not accessible without paid subscription

15-1051	Computer systems analysts	28	1%
31-9099	Healthcare support workers, all other	27	1%
29-2012	Medical and clinical laboratory technicians	26	1%
17-2031	Biomedical engineers	26	1%
17-2072	Electronics engineers, except computer	24	1%
11-9041	Engineering managers	24	1%

One challenge facing employment in the Bio-Tech & Bio-Medical Devices cluster is that more than 90% of all scientists and engineers in the world will live in Asia by the end of 2010. Over half of all engineering degrees awarded in the United States are to foreign nationals. Washington is struggling to keep its competitive advantage in the global market place. The workforce development system must be ready to act in order to recruit and retain local talent.

#### Bio-Tech & Bio-Medical Devices Spending and Activity

Support for the Bio-Tech & Bio-Medical Devices cluster has attracted many pharmaceutical companies to Snohomish County. A typical firm in the research and development stage is less than ten years old and has fewer than 50 employees. The process in bringing a new product to market can be expensive. The initial research, clinical trials, and manufacturing facilities bring the cost of a new product to between \$800 million and \$1.7 billion. To support the high cost of research and development, many small research and development companies are bought by large pharmaceutical companies who can pay for such work. These changes can make the Bio-Tech & Bio-Medical Devices cluster somewhat volatile. However, the volatility also means opportunity for growth and advancement.<sup>8</sup>

One notable and ongoing success is the Puget Sound region's role in making ultrasound technology one of medicine's most fundamental tools. The use of sound waves to produce clear images has its roots in pioneering work completed at the University of Washington Bioengineering department in the 1960s. The Puget Sound region now has over 5,000 people working at more than a dozen companies in the ultrasound business. When the public sees ultrasound equipment in hospitals or on television, there is a good chance the equipment came from engineers in greater Seattle.<sup>9</sup>

Bothell especially is a great place for biotech. Together, Bothell firms accounted for 25% of all Washington biotech and biomedical companies and 26% of all employees.<sup>10</sup> This cluster has shown and continues to show growth, with Snohomish County companies playing a major role in this dynamic sector of the economy. Research-oriented startups seem poised to survive the current economic downturn, and long-awaited clinical results could propel larger companies to stardom, creating a landscape that is true to

<sup>8</sup> (Baldwin, 2005): Link not available

<sup>9</sup> (Timmerman, 2008): <http://www.xconomy.com/boston/2008/11/03/look-inside-this-body-the-greater-seattle-ultrasound-cluster/>

<sup>10</sup> (Snohomish County Economic Development Council, 2010): <http://snoedc.org/industryclusters/lifesciences/>

the region's real strength: research at startup companies fueled by venture capital. This region has been coined a startup haven, supported further by top research institutions and universities.<sup>11</sup>

## Snohomish County Outlook

### Bio-Tech & Bio-Medical Devices Forecast

Data forecasts high growth in the number of workers in Bio-Tech & Bio-Medical Devices in the next five years, as shown in the table below.<sup>12</sup>

NAICS Code	Industry Title	2010 Jobs	2015 Jobs	% Change	Earnings Per Worker
541711	Research and development in biotechnology	2,209	2,666	31%	\$121,773
621511	Medical laboratories	27	34	26%	\$55,363
621512	Diagnostic imaging centers	195	251	29%	\$55,445
		<b>2,251</b>	<b>2,951</b>	<b>31%</b>	<b>\$115,036</b>

### Training and Educational Needs

The occupational needs of the Bio-Tech & Bio-Medical Devices cluster fall into three generalized categories, each with its own training and educational requirements: Senior Researchers, Production and Manufacturing Employees, and Sales Agents and Representatives.

*Senior Researchers:* This group of occupations is made up primarily of scientists who are likely to have a PhD or some type of graduate degree. Of the occupations evaluated for this cluster, biological scientists were the most likely to be recruited from outside the region, with physical scientists as the third most likely to be recruited from outside the Puget Sound area. The educational requirements associated with these positions can only be met at universities with extensive graduate training programs in the life and physical sciences.<sup>13</sup>

*Production and Manufacturing Employees:* While the Bio-Tech & Bio-Medical Devices cluster always looks for individuals with PhDs, a bigger need exists for positions supporting PhD level research. This group of occupations is made up primarily of assemblers, fabricators, technicians, technologists, inspectors, testers, and graders. Of the occupations evaluated for this cluster, employers had the most difficulty recruiting medical and clinical lab technologists. The educational and training requirements associated with these positions can be largely met at community colleges with appropriate certificate

<sup>11</sup> (Gonzalez, 2009): [http://seattletimes.nwsources.com/html/business/technology/2008667376\\_biotech25.html](http://seattletimes.nwsources.com/html/business/technology/2008667376_biotech25.html)

<sup>12</sup> (Economic Modeling Specialists, Inc, 2010): Not accessible without paid subscription

<sup>13</sup> (Godbe Research, 2004): Print report available from WDC

programs. The requirements necessary to be a production and manufacturing employee can also be developed internally at some of the larger biotechnology employers.<sup>14</sup>

*Sales Agents and Representatives:* Of the occupations evaluated for this cluster, sales representatives were near the top in both the level difficulty in finding qualified candidates as well as the frequency of recruiting candidates from outside the region. The sales positions within this cluster have more fluid educational requirements but often require experience in the industry as well as strong sales and communication skills. Communication skills were most often cited as the general skill current employees in this cluster were most deficient in. Opportunities for growth in these occupations included expanding certificate programs at community colleges, developing portals between industry sites and educational facilities, and communicating the benefits of production and manufacturing positions to students.<sup>15</sup>

The Bio-Tech & Bio-Medical Devices cluster places substantial emphasis on technical competence skills, and generally new workers are adequately prepared for the environment. Nearly 60% of firms judged technical competence skills to have large importance to their industry; only 16% of firms reported deficiency in this area.

Biotechnology is not well understood by most people. For that reason, it is necessary to accelerate work to educate the general population and parents of school-age children about career opportunities and the important role of biotechnology in society. It would the Bio-Tech & Bio-Medical Devices cluster to investigate whether existing resources, technical schools, programs, and curricula are aligned with industry needs; have sustainable funding sources; and shared with other educators, students, and supporters.<sup>16</sup> The figure below shows the Biotechnology, Biomedical, and Nanotechnology Career Tree.

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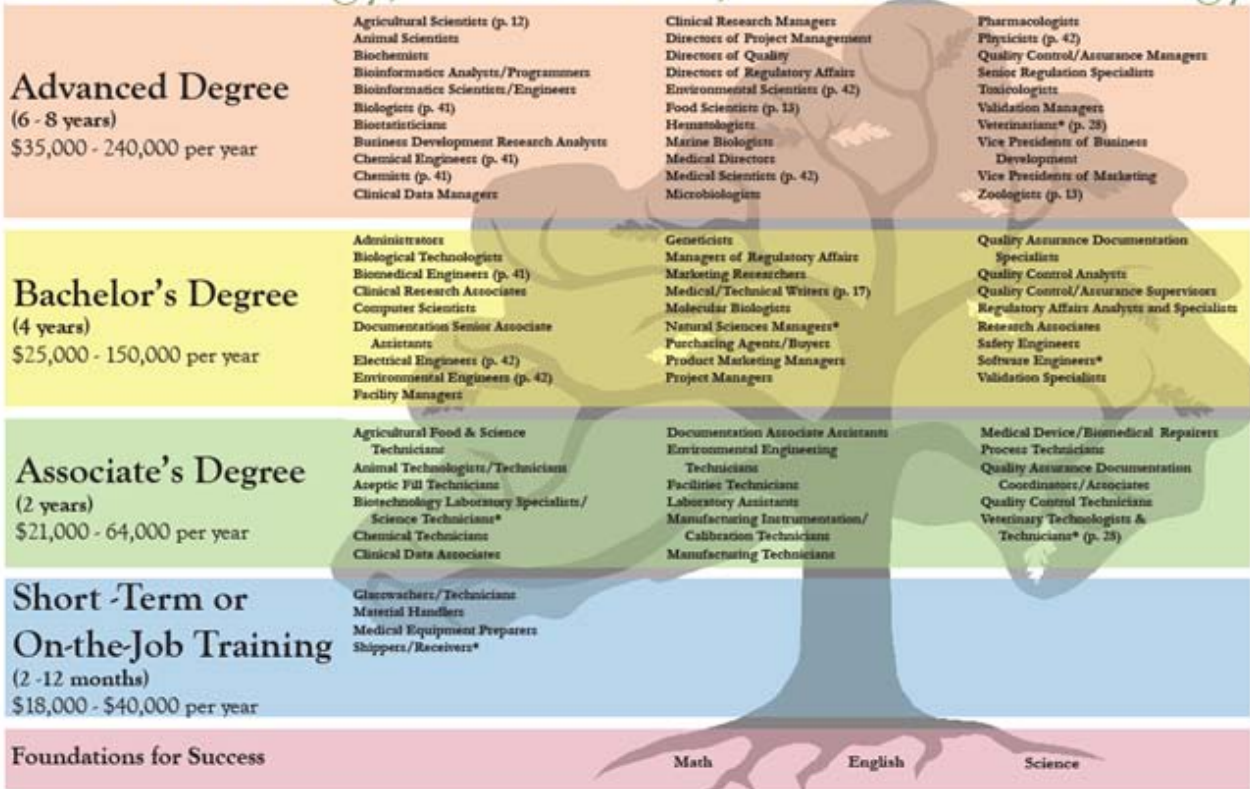
<sup>14</sup> (Godbe Research, 2004): Print report available from WDC

<sup>15</sup> (Godbe Research, 2004): Print report available from WDC

<sup>16</sup> (Puget Sound Regional Council, 2005): <http://www.prosperitypartnership.org/strategy/res.pdf>

<sup>17</sup> (Workforce Development Council Snohomish County, 2007):  
[http://careertrees.org/history/documents/originalcareertrees\\_000.pdf](http://careertrees.org/history/documents/originalcareertrees_000.pdf)

# Biotechnology, Biomedical, & Nanotechnology



Recognizing that investment in education and technology is critical to the success of Bio-Tech & Bio-Medical Devices, local community colleges have adapted their curriculum to the needs of the cluster. Each college offers a different career speciality to support the needs of employers. For example, Edmonds Community College offers a program for chemical laboratory technicians. Everett Community College offers Chemistry and Biology Associate Degrees for transfer to four year colleges. The University of Washington Bothell introduced the Biotechnology & Biomedical Technology Institute (BBTI) as a resource for individuals and organizations with an interest in the development of the biotechnology and medical device industries. BBTI seeks to engage government, business leaders, and citizens in ongoing conversations about the future of biotechnology and biomedical device technology and their implications on society and the economy.<sup>18</sup> Over 50% of jobs requiring a bachelor's degree are filled with graduates of state institutions. As competition from other states grows, it will be important to increase the number of graduates from in-state institutions.<sup>19</sup>

<sup>18</sup> (University of Washington Bothell, 2008): <http://depts.washington.edu/bbti/>

<sup>19</sup> (Baldwin, 2005): Link not available

## Innovation and Entrepreneurship in Bio-Tech & Bio-Medical Devices

Innovation in Bio-Tech & Bio-Medical Devices is defined as any new product introduced to the market that improves upon existing products either incrementally or fundamentally. Innovation is critical for meeting growing demands for more effective and affordable health care solutions. Innovation is also important for firms looking to establish a competitive advantage and fare well in the market place. Keys to accelerating innovation are: the discovery of new technologies, the trend toward convergence among core technologies, and funding and financing of research and development. Also vital is having the human capital (education, training, recruitment) necessary to support innovation. An innovation explosion, versus merely an upswing, will depend on how well Bio-Tech & Bio-Medical Devices leaders and stakeholders overcome barriers expected to influence innovation over the next decade. Barriers include the regulatory review and approval process, insurance coverage and reimbursement, and government pricing and market access policies.<sup>20</sup>

Washington is a world leader in Bio-Tech & Bio-Medical Devices and is positioned to change the future of health care. The biotechnology community has a sense of urgency that is driving the next century of innovation.<sup>21</sup> Washington ranks high in patent creation and innovation, and leads the nation in new business startup. While new business creation is high, retention is a challenge given the rapidly changing nature of the cluster.

The Puget Sound especially has a history of spawning homegrown entrepreneurs that lead technology and science in new directions.<sup>22</sup> Snohomish County wants to be known as the center of the state when it comes to the Bio-Tech & Bio-Medical Devices cluster. In 2007, Governor Chris Gregoire named an area in Bothell an Innovation Partnership Zone (IPZ), allowing the region to market itself as the only biomedical device region in Washington. The zone is considered a powerful economic engine which will support the regional economy. The IPZ designation lasts four years, during which time the state will provide technical support to increase and improve the industry. The designation itself is considered worthwhile to industries in the Bio-Tech & Bio-Medical Devices cluster. Firms in the zone can now claim to be important to innovation in Washington, and from a development standpoint, that is good news for Snohomish County. By the end of 2009, over 50 patents had been issued within IPZ boundaries.<sup>23</sup>

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<sup>20</sup> (Deloitte, 2007): [http://www.deloitte.com/assets/Dcom-Kazakhstan/Local%20Assets/Documents/dtt\\_DR\\_InnSurv020207\(2\)\(2\).pdf](http://www.deloitte.com/assets/Dcom-Kazakhstan/Local%20Assets/Documents/dtt_DR_InnSurv020207(2)(2).pdf)

<sup>21</sup> (Washington State Office of the Governor, 2007): [http://www.governor.wa.gov/priorities/economy/next\\_wa\\_final.pdf](http://www.governor.wa.gov/priorities/economy/next_wa_final.pdf)

<sup>22</sup> (Puget Sound Regional Council, 2005): <http://www.prosperitypartnership.org/strategy/res.pdf>

<sup>23</sup> (Free Patents Online, 2008): [WWW.freepatentsonline.com](http://WWW.freepatentsonline.com)

## Sustainability in Bio-Tech & Bio-Medical Devices

There have been three trends in the growth and development of biotechnology. The first trend was in human healthcare, the second trend was in agriculture, and the third trend is industrial and environmental biotechnology.<sup>24</sup> The third trend holds promise for transforming a wide variety of industrial processes by preventing pollution, reducing costs, conserving natural resources, and delivering innovative products to improve our quality of life. It also allows for the creation of new markets that develop environmentally friendly processes and products. The use of clean technologies and green chemistry are considered imperative to the future of the Bio-Tech & Bio-Medical Devices cluster.<sup>25</sup>

Case studies show environmentally friendly changes successfully taking place in the production and bleaching of pulp for paper, textile finishing, plastics production, bioethanol production, and pharmaceuticals. Everyday items such as detergent, bread, bedding, candy wrappers, vitamins, jeans, paper, fuel, antibiotics, and contact lens solution can be processed in more sustainable ways as a result of innovations in biotechnology. While environmentally friendly innovations are largely recognized as a good, there are barriers to industry-wide use of such techniques. For example, many in the field lack the knowledge, familiarity, and supplies needed to advance sustainable biotechnology. For sustainable biotechnology to deliver on its potential, it must be tested, adopted, and deployed. Many assert that the future of Bio-Tech & Bio-Medical Devices lies in creating a new industrial revolution where scientists and DNA are working hand in glove to green the landscape.<sup>26</sup>

## Conclusion

The Bio-Tech & Bio-Medical Devices cluster is thriving in Washington State and Snohomish County. The cluster has shown and continues to show growth and resiliency. Bio-Tech & Bio-Medical Devices will remain in demand with people living longer and desiring a better quality of life. With its collection of mature firms and success of start-up enterprises, Greater Seattle is already a top ten biotechnology region in the nation. Snohomish County is committed to the continued success of the Bio-Tech & Bio-Medical Devices cluster and can expect good things to come as a result of those efforts.

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<sup>24</sup> (Sustainable Biotech, 2007): <http://www.sustainablebiotech.org/index.htm>

<sup>25</sup> (Biotechnology Industry Organization, 2004): <http://www.bio.org/ind/pubs/cleaner2004/CleanerReport.pdf>

<sup>26</sup> (Biotechnology Industry Organization, 2004): <http://www.bio.org/ind/pubs/cleaner2004/CleanerReport.pdf>