



The sector is supported by a strong research infrastructure composed of world-class university and government laboratories and various research institutes. Winnipeg's health research sector employs some 3,400 people in more than 330 businesses. The **Canadian Science Centre for Human and Animal Health**, which houses the **National Microbiology Laboratory**, was the first facility in the world to accommodate both human and animal health facilities at the highest level of biocontainment under one roof.

Guelph: Thriving Agricultural Programs

The **University of Guelph** – world renowned for its agricultural, veterinarian and life-sciences programs – is the heart of a 20-year-old agri-biotech cluster. The cluster comprises over 200 organisations employing more than 6,000 people. The University of Guelph developed the first diagnostic blood test for omega-3 fatty acids and a revolutionary wood composite building material.

Maxxam Analytics' Guelph facility specialises in genetic identification for forensic investigations, paternity tests, verifying animal parentage and DNA traceability



FINANCIAL SUCCESS

In 2003, US\$1.3 billion was invested in Canadian biotechnology companies, a remarkable 155 per cent increase over 2002 (source: Ernst & Young, Global Biotechnology Report 2004). With about one third of publicly listed biotechnology companies recording profits, the outlook for the sector is strong. Canada's success in biotechnology has not gone unnoticed by the global investment community: the global venture capital firm MPM Capital led a US\$32-million financing round of Vancouver-based NeuroMed Technologies Inc., while Swiss, Swedish and Finnish investors staked US\$9 million in Montreal-based Galileo Genomics.

programs. **Semex Alliance**, a global leader in the US\$1-billion bull-semen market, uses genetic screening to ensure bulls will sire superior milk-producing cattle.

Toronto: Canada's Largest Biotech Cluster

Toronto is home to 40 per cent of the country's biotech companies and is one of the largest centres of biotechnological research in North America.

With core strengths in biopharmaceuticals and diagnostics, Toronto and environs have broad

research capabilities, which include expanding activities in agri-food biotechnology and the emerging resource and environmental biotech industries.




Researchers at the **University of Toronto** recently isolated the gene carried by 50 per cent of Crohn's disease patients, and in March 2004 Dr Tak Mak became the first Canadian to receive the Paul Ehrlich and Ludwig Darmstaedter Prize – Germany's most distinguished biomedical research award. Dr Mak was the first scientist to clone the genes for the human T-cell receptor.

The **Medical and Related Sciences [MaRS] District**, established in 2002 and projected for completion in 2007, is a US\$279-million development project to capitalise on Canada's biotech and biomedical research expertise. Funded in two phases, through a public-private partnership, the district creates a cluster hub in the biomedical sciences that will ensure Canada's place in the future first rank of biotech nations. Closely linked to the city's hospitals, MaRS has already attracted commercial tenants to the district, such as US **NPS Pharmaceuticals** and Canadian biotech **Allelix**.

Montreal: Leading Drug Development in Canada

Montreal has the highest concentration of startup biotech companies in Canada, encouraged by the



research interests of the pharmaceutical sector. The city is Canada's leading drug development centre with more than 300 bioscience firms employing 24,000 people. The world's major pharmaceutical companies – **Abbott, Astra-Zeneca, Aventis, Boehringer Ingelheim, Bristol-Myers Squibb, Merck Frosst, Novartis, Pfizer, Schering-Plough, Servier, Shire and Wyeth-Ayerst** – all have facilities around Montreal, drawn by dozens of research centres and thousands of health-science students graduating from Montreal's universities.

Quebec City: Fast-Growing Biomedical Cluster

Some 87 biotech companies and research groups operate in and around Quebec City – mostly involved in developing drugs and diagnostic and medical devices. The industry currently employs some 4,100 people and generates sales of over US\$400 million a year.

Multinational **Aeterna Zentaris** is the biggest player in the area, developing drugs to combat cancer, endocrine disorders and infectious diseases. New therapeutic plant molecules developed at **Biopharmacopae Design International** are used in drugs, as well as in dermo-cosmetics and natural health products. **ID Biomedical**, although Vancouver-based, manufactures two influenza products at its Quebec City facility and supplies more than 75 per cent of the influenza vaccine used in Canada. Biotechnologists at **Medicago** are engineering alfalfa to produce a new generation of biopharmaceutical proteins to fight human diseases.

COMMERCIAL SUCCESS

Canadian biotechnology companies invested US\$1.9 billion (source: BIOTECCanada, 2004) in research and development in 2003, a staggering increase of 115 per cent since 2001. Canada's biopharmaceutical companies have 540 products in development or already marketed, with 22 per cent of these being in Phase II or Phase III clinical trials. To date, Canada has discovered and successfully brought to market five blockbuster drugs: Visudyne from QLT; Singular from Merck Frosst; and Epivir, Combivir and 3TC from Biochem Pharma (now Shire Pharma).



Halifax: World-Class Marine Biosciences

Halifax's marine biotech cluster is centred on the **National Research Council's Institute for Marine Biosciences** – one of the best of its kind in the world. The province of Nova Scotia is now home to some 60 biotech firms employing more than 1,000 people.

Halifax-based nutraceutical company **Ocean Nutrition Canada** is the world's largest producer of omega-3 fish oil. Starting seven years ago with two employees, the company now has a staff of 250.

Charlottetown: New Clustering Partnership

Ocean Nutrition is playing a key role in the development of a nutraceutical cluster in Prince Edward Island. The cluster will be based around the National Research Council's recently announced **Institute for Nutrisciences and Health**.

St. John's: Innovative Marine Biotech

This young cluster employs about 300 people in a dozen companies and public sector research institutions including **Memorial University's Ocean Sciences Centre**. St. John's, capital of the province of Newfoundland and Labrador, is on its way to becoming the premier global destination for marine biotechnology, with facilities for manipulating marine and freshwater organisms at the molecular level. In addition, Newfoundland's small, isolated population makes the island a good place to examine genetic diseases, adding a genomics focus to the research scene.

Aqua Bounty Technologies has developed techniques to make Atlantic salmon produce antifreeze proteins, which are normally seen in cold-water species such as cod. These cold-adapted Atlantic salmon can be bred in the chilly waters off the Newfoundland coast and, if their growth hormone is modified using the same technology, they can also be made to grow up to six times faster than standard salmon.

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Canada at a Glance

Biotechnology





INTRODUCTION

Canada is a world leader in biotechnology. It is home to more biotech companies than any other country except the United States, and it ranks first in research and development spending per employee. Canada ranks third in biotechnology revenues, which have grown by 400 per cent since 1997. In 2003, Statistics Canada recorded 496 biotechnology companies, generating revenues of US\$3.086 billion and employing almost 12,000 people.

Underlying Canada's biotechnology boom are several factors. A determined move within industry to bring products and processes to market has increased the number of companies reporting profits by about one third.



CANADIAN BIOMEDICAL RESEARCH SUCCESSES

Medical research discoveries include genetic sequencing techniques, cell death regulation, haemoglobin-based blood substitute, adult skin-derived stem cells and the role of parathyroid hormone in osteoporosis.

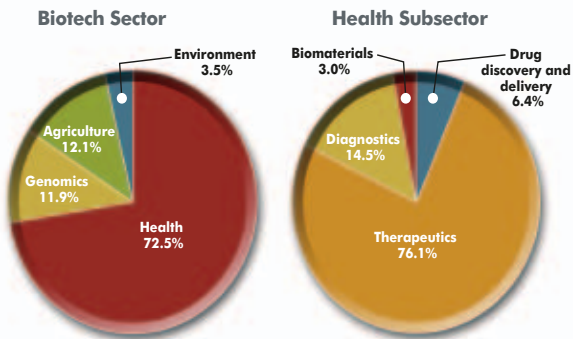
Gene research discoveries include the cystic fibrosis gene, Tay-Sachs gene, Duchenne muscular dystrophy gene, colon cancer gene and T-cell receptor gene.

Canadian Professor Michael Smith won the 1993 Nobel Prize in Chemistry for his work on site-directed mutagenesis; after his death, the University of British Columbia named a biotechnology research facility after him. It was fitting that on April 14, 2003, the DNA sequence of the SARS virus was published by the Michael Smith Genome Sciences Centre in Vancouver, which deciphered the organism's genetic code in just six days.

In their **2003 Americas Biotechnology Report**, **Ernst & Young** highlight the significant number of healthcare products Canadian biotechnology companies have in Phase II and Phase III clinical trials, pointing to this as a good indicator of a robust and sustainable product pipeline. Research, innovation and entrepreneurship are strongly supported by the **Government of Canada** through schemes to encourage startups and generous tax incentives to support commercial R&D activity. The government also provides support for the research base at universities, hospitals and other research facilities, and it encourages innovation through departments and agencies whose role is to bring discoveries to the marketplace.

Biotechnology clusters have sprung up across Canada. These hubs of activity bring together companies, research and capital, often with a focus such as healthcare, agriculture, environmental protection or aquaculture. Canada boasts several established clusters (which are leaders on the world stage), developing clusters (where biotechnology is applied in Canada's traditional industry sectors) and emerging clusters (where innovation is driving new commercial opportunities). Biotechnology is a significant and increasingly important contributor to the healthcare, agriculture, marine and environmental sectors, all of which are major planks of the Canadian economy.

Companies in Biotech and Health (%)



Source: Biotechnology Investment Today (Spring 2004).

INNOVATIVE BIOTECH CLUSTERS FROM SEA TO SEA

Vancouver: The Hot Biomedical Cluster in the West

British Columbia is home to 93 firms, six clinical trial organisations, a handful of government facilities and a major research centre at the University of British Columbia in Vancouver. More than 2,158 people are employed directly by the biotech industry, with a further 1,100 working in pharmaceutical companies.



QLT – a global company specialising in developing treatments for cancer and eye diseases – has developed, commercialised and manufactured innovative drug therapies such as Visudyne and Eligard. **Angiotech** is another successful firm. **Boston Scientific** has been marketing Angiotech's TAXUS Express2 paclitaxel-eluting coronary stent system in Europe and other non-US markets since 2003 and in the US since early 2004. The stent system is the market leader today. **Xenon Pharmaceuticals** – developer of therapies based on the genetic causes of selected metabolic, neurological and cardiovascular diseases – recently signed a US\$157-million deal with **Novartis** to develop drugs for obesity and metabolic disorders.

Edmonton: Driving the Nanotechnology Revolution

Nanotechnology is engineering science applied at the molecular level and below; its applications include biotechnology and pharmaceutical products. Thanks to the **University of Alberta** (UoA)'s strengths in engineering, medicine and computer science, Edmonton is home to a large nanotechnology cluster that has been growing for two decades. In 2001, the US\$96.9-million **National Institute for Nanotechnology** was established at the UoA, giving Canada a platform for addressing the global market for nanotechnology products, estimated at US\$1.5 trillion



by 2015. In 1993, UoA scientists successfully transplanted insulin-producing islet cells into a human pancreas. The transplant team has now helped UoA gain funds to build the **Alberta Diabetes Research Centre**, a new institute that will tackle all aspects of diabetes. (It was Canadian scientists Banting and Best who discovered insulin in 1921.)


Biomira, a spin-out from UoA, has shown impressive results with its liposome vaccine for non-small cell lung cancer. Biomira's progress attracted investment of US\$10 million in a recent funding round. Another company, **Nucryst Pharmaceuticals**, is using nanotechnology to change the molecular structure of silver to create antimicrobial materials for use in medical devices and drugs.

Calgary: Joining the Biotech Stampede

SemBioSys, a spin-out biotech company from the **University of Calgary**, specialises in oil-based technologies such as liposomes. SemBioSys has struck a series of high-profile licensing deals with companies such as Lonza (a Swiss pharmaceutical company), **Martek** (a nutraceutical company) and **Dow AgroSciences**, demonstrating the wide applicability of these patented technologies.

Saskatoon: Innovating in Agriculture

Saskatoon's 30-plus biotechnology companies are a mix of Canadian and multinational firms centred at **Innovation Place**, an 80-acre science park adjacent to the **University of Saskatchewan**. Innovation Place builds on the University's strengths in agriculture, information technologies, resources and the life sciences, as well as the strengths of federal and provincial research facilities on or close to the park. The cluster employs about



2,000 research and technical staff in fields ranging from agricultural plant inoculants to help farmers boost their yields to plant-based bio-diesel. **Canadian Light Source**, a world-class synchrotron facility also located in Saskatoon, offers very high-resolution protein crystallography to the Canadian research and industrial community. Protein crystallography is an essential tool in structural genomics and proteomics, the new frontiers in biotech research.

Philom Bios developed JumpStart, the world's first and only commercial phosphate inoculant for all crops, and TagTeam, the world's first and only phosphate and nitrogen inoculant for pulse crops. The two products helped add about US\$24.2 million to net profits for prairie farmers in 2003. **Bioriginal Food & Science**, founded in 1993, is now the world's leading supplier of essential fatty acids for use in cosmetics, animal feed, nutraceuticals and pharmaceuticals.

Winnipeg: Biotech and Health Research

Winnipeg has the fastest-growing biotechnology sector in Canada, focused on pharmaceutical and biopharmaceutical R&D and production and on agricultural applications. Winnipeg is home to several major global biotechnology companies including **Cangene, Monsanto Canada, Apotex Fermentation, Viventia Biotech, Controlled Environments** and **Advanta Seeds**.

INVESTING IN SUCCESS

In Budget 2005, the Government of Canada once again signalled its support for biotechnology with a C\$165 million grant to Genome Canada to sustain breakthrough genomics research. The budget, which makes major strategic investments in building a world-class research environment in Canada, also provided C\$375 million over five years for the three federal research granting councils. This year's support comes on top of major investments in 2004 which saw substantial budget allocations to the Business Development Bank of Canada for capital to support startups and early-stage companies; C\$45 million to Genome Canada; a budget increase to C\$500 million for the Canadian Institutes of Health; and significant support to the biotechnology sector through the Networks of Centres of Excellence and Research Chairs Canada.