

Invest in Sweden  
Neuroscience



*A unique source for novel therapies and techniques*

“Sweden is one of the major centers of neuroscience discovery in the world. Many of the world’s leading neuroscientists are located there.”

*Paul Greengard  
Professor and Head,  
Laboratory of Molecular and  
Cellular Neuroscience,  
The Rockefeller University  
Nobel Laureate 2000*

#### A leading health care nation

Health system performance

1. Sweden
2. Norway
3. Australia
4. Canada
5. France
6. Germany
7. Spain
8. Finland
9. Italy
10. Denmark

Source: “Measuring the health of nations: analysis of mortality amenable to health care” Ellen Nolte and Martin McKee, London School of Hygiene and Tropical Medicine

## Sweden – a unique source for novel therapies and techniques

Brain science – one of the broadest and most complex fields of research – offers tremendous commercial opportunities. Disorders of the brain and nervous system result in more hospitalizations than any other disease group, and treatments entail large costs to society. These costs will rise as a result of the developed world’s aging population. Leading international pharmaceutical companies increasingly turn to Sweden for innovative drug discovery in this highly exciting field of research.

**Research excellence** The field of neuroscience is one of Sweden’s finest. Of thirty-one Nobel Prizes that have honored advances in neurosciences, Swedes have received five. Today, you will find Swedish researchers among the world’s foremost neuroscientists in several key disciplines.

This has resulted in achievements within numerous areas of basic science with considerable scope for direct clinical applications. These include research advances concerning the origin and repair of nerve cell damage following stroke and spinal cord injury, as well as research into major degenerative diseases such as Parkinson’s and Alzheimer’s.

Sweden holds a large share of human embryonic stem cell lines eligible for US public funding and has been selected by the NIH (National Institutes of Health) for research cooperation. A 2003 NIH stem cell conference was held in Sweden.

**Exceptional breadth** Although the neuroscience field of research is almost infinitely large, Swedish research excellence covers many of the most relevant fields. Sweden’s position is also strong in areas closely related to neurology, such as behavioral research, bio-informatics, biotechnology, epidemiology, genetics, information and communications technologies, imaging technology, health care research, learning and cognition, man-machine interaction, and telemedicine.

Other Swedish advantages are outstanding levels of cooperation between universities, hospitals and the pharma industry, attractive cost of operations and the ease with which Swedes collaborate internationally. Researchers are respected for their ability to deliver on time.

**Renowned research institutions** By international comparisons, Swedish neuroscience research is largely human-based, with many projects addressing both basic and clinical research issues. As a result, the Swedish patient-oriented clinical neuroscience enjoys widespread international recognition.

Research is performed at prominent Swedish medical research institutions such as Karolinska Institutet in Stockholm, Sahlgrenska Academy in Göteborg and Lund University. The recently formed Center of

Excellence in Developmental Biology at Karolinska Institutet is a strategic research center that coordinates nine research groups from three institutions.

**Knowledge base for early diagnostics** In a new initiative, "Swedish Brain Power", a number of influential Swedish groups have consolidated efforts to create a new, multidisciplinary concept for the treatment of neurodegenerative diseases<sup>1</sup>. Sweden's health and medical care systems offer unique conditions for projects involving understanding the causes of CNS diseases and for developing methods of testing and evaluation of drugs and other treatment methods for neurodegenerative diseases.

The goal is to establish a center of excellence for early diagnostics and treatment of neurodegenerative diseases. The multi-disciplinary center will build on the entire portfolio of Sweden's strengths in neuroscience and related disciplines. All key Swedish organizations are represented: the pharma and biotech industry, regulatory authorities, primary and municipal care, and research institutes.

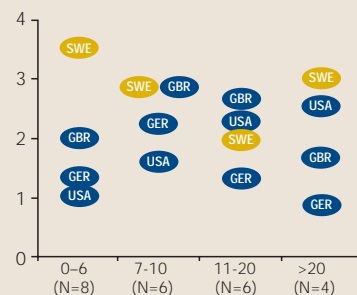
**Choosing Sweden for innovative drug discovery** Sweden has attracted research activities involving several of the world's largest pharmaceuticals companies. These include AstraZeneca, which chose the town of Södertälje, south of Stockholm, as one of two global neuroscience R&D sites. Sumitomo Pharmaceuticals conducts Alzheimer research from a center in Stockholm. Companies such as Merck and Eli Lilly capitalize on Sweden through strategic partnerships and alliances with Swedish biotechnology firms focusing on neuroscience. The Swedish venture capital market is another investment route. Numerous firms are specialized in life science, covering all segments and stages of company growth.

**Turn promises into results** Swedish excellence in basic, clinical and applied neuroscience can help you progress in this potentially rewarding field of life science. Choose Sweden to strengthen your competitive advantage!

**Leading pharmaceuticals choose Sweden for R&D in neuroscience**

Company/Agency	Partner
Eli Lilly (US)	Melacure Therapeutics
Lundbeck (Denmark)	Neuronova
Merck (US)	Carlsson Research
NIH (US)	Cell Therapeutics
Sumitomo Pharmaceuticals (Japan)	Karolinska Institutet
Tanabe Seiyaku (Japan)	Cell Therapeutics Scandinavia

**High quality output from Swedish neuroscience\***



Impact factor interval. N=Number of journals within impact factor interval.

\*Average share of publications in scientific journals/million inhabitants 1998-2001 (%). Publications in 24 scientific journals were classified according to each journal's impact factor.

Source: Boston Consulting Group, "Swedish Brain Power"

**Swedish life science venture capitalists (a selection)**

- Health Cap
- H&B Capital
- Innovationskapital
- Investor Growth Capital
- Karolinska Investment Mgmt.
- Scandinavian Life Science
- SEB Företagsinvest
- Swedfund

<sup>1</sup> Founding partners are Invest in Sweden Agency and five major research foundations: the Knut and Alice Wallenberg Foundation, the Swedish Agency for Innovation Systems, the Swedish Foundation for Strategic Research, the Swedish Foundation for Health Care Sciences and Allergy Research, and the Swedish Knowledge Foundation.

## Areas of research excellence – basic and clinical neuroscience

### Umeå

Umeå University

Molecular neurobiology

Neurophysiology

Imaging

Genetics

Neurogeriatrics

Psychiatry

Neurology

[www.umu.se](http://www.umu.se)

### Göteborg

Sahlgrenska Academy

Neurochemistry

Neuropharmacology

Molecular neurobiology

Neurogeriatrics

Psychiatry

Neurology

[www.sahlgrenska.gu.se](http://www.sahlgrenska.gu.se)

### Lund

Lund University

Molecular neurobiology

Neurogeriatrics

Neurology

[www.lu.se](http://www.lu.se)

### Stockholm/Uppsala

Karolinska Institutet

Royal Institute of Technology, KTH

Uppsala University

Neurochemistry

Neuropharmacology

Molecular neurobiology

Neurophysiology

Imaging

Epidemiology

Genetics

Neurogeriatrics

Psychiatry

Neurology

[www.ki.se](http://www.ki.se), [www.kth.se](http://www.kth.se), [www.uu.se](http://www.uu.se)

### Linköping:

Linköping University

Neurophysiology

[www.liu.se](http://www.liu.se)



For further information about key research institutions, distinguished researchers and the particular direction of research activities, please consult the report "Swedish Brain Power", available for download on the ISA web site: [www.isa.se](http://www.isa.se)

### Five Nobel Prizes to Swedes in neuroscience

Allvar Gullstrand, 1911
Ragnar Granit, 1967
Ulf von Euler, 1970
Torsten N Wiesel, 1981
Arvid Carlsson, 2000

### Sweden's ranking, publication volumes in relation to population 1986-2001

	86-89	90-93	94-97	98-01	Total 86-01
Biochemistry & biophysics	2	2	2	2	2
Biotechnol. & applied microbiology	3	4	3	1	2
Cell & developmental biology	3	3	2	2	2
Immunology	1	2	2	2	2
Microbiology	2	2	4	3	3
Molecular biology & genetics	2	2	3	2	2
Neurosciences & behavior	1	1	1	1	1

Source: IVA/Innova "Swedish Biotechnology", 2003

## Sumitomo Pharmaceuticals: “Outstanding quality in both basic and applied research, excellent environment for clinical trials.”

Sumitomo Pharmaceuticals, one of Japan’s major pharmaceutical companies, chose Sweden over the US, UK, and Germany as the location for its outsourced research center focused on Alzheimer’s disease. “I am deeply impressed both with the quality of Swedish research and with academic institutions’ abilities to collaborate with industry,” says Akira Ito, senior research scientist and group leader at Sumitomo’s neuroscience group.

Sumitomo’s endeavors in neurology, one of three key therapeutic areas, have so far made commercially available Dops, an anti-Parkinson’s agent, Sediol, an anxiolytic drug, and Lulan, an anti-schizophrenic drug.

Alzheimer’s disease is one of the primary targets of the company’s current research activities. “So far, no drugs are available to attack the underlying cause of the disease, the infiltration of brain tissue by amyloid plaques,” says Ito.

The company chose to look outside of Japan for research excellence, and reviewed research centers in Boston,

Glasgow, Heidelberg, London, Oxford and Stockholm. The decision came in favor of Karolinska Institutet in Stockholm.

“Karolinska Institutet is certainly one of the world’s most prominent institutes for research into Alzheimer’s disease – both in terms of talented staff and facilities as well as availability of valuable brainbanks. The ability to integrate basic and clinical research is exceptional,” says Ito.

Today, the joint research center, labeled KASPAC (The Karolinska Institutet Sumitomo Pharmaceuticals Alzheimer Center), employs 20 people in facilities at the Novum Research and Science Park, just steps away from the Karolinska University Hospital in Huddinge, south of Stockholm.

Ito is highly satisfied with the collaboration to date. “Several patents have been applied and a number of potential targets have been identified. I am convinced our efforts will bear fruit in the near future.”

[www.sumitomopharm.com](http://www.sumitomopharm.com)

“I am deeply impressed both with the quality of Swedish research and with academic institution’s abilities to collaborate with industry.”

*Akira Ito  
Senior Research Scientist  
Sumitomo Pharmaceuticals*



### The Alzheimer’s Disease Research Center at Karolinska Institutet

The Alzheimer’s Disease Research Center at Karolinska Institutet is Europe’s largest. The 175-strong staff includes eight professors, over 60 post-docs and 80 PhD students. Headed by Bengt Winblad, one of the world’s leading Alzheimer researchers, the center performs Alzheimer’s disease research within genetics, cell biology and biochemistry, coordinating multi-disciplinary research activities in locations around Stockholm. At present, 15 pharmaceutical companies conduct clinical trials with the research center.

A long tradition of high-quality neurology research, and close links between clinical and basic research have yielded a number of research breakthroughs. Laura Fratiglioni (epidemiology), Agneta Nordberg (imaging), Anders Wimo and Bengt Jönsson (health economics) are among the distinguished researchers. A number of instruments and methods vital to Alzheimer research have also been developed; to measure levels of dementia, dosage efficiency in clinical trials, resource utilization of dementia patients and more. These include the GBS scale and the RUD instrument (Resource Utilization in Dementia). The center’s access to high quality tissue banks is a particular advantage. The brainbank at the Huddinge University Hospital comprises a total of 600 brains from dementia patients and 200 control brains.

[www.ki.se](http://www.ki.se)

## Corporate activity

Sweden has a strong and diversified life science industry, with companies active in all stages of drug discovery and development and with a presence of both 'Big Pharma' and innovative biotech firms. AstraZeneca, the world's fifth largest pharmaceutical company, leads global R&D in neuroscience from Swedish sites. Numerous Swedish biotechnology firms are devoted to drug discovery and development in neuroscience, including:

### BioArctic Neuroscience

#### Business

Founded by Professor Lars Lannfelt and his colleague Pär Gellerfors, building on research achievements at the Karolinska Institutet and Uppsala University. Based in Uppsala, the company intends to develop treatments for Alzheimer's disease by exploring proprietary and disease-specific drug targets.

#### Achievements

Dr. Lannfelt and his laboratory have identified two human mutations that affect the level of amyloid peptide in the brain, a key discovery in the Alzheimer's field. Collaboration with IcoGen, a US biotech that specializes in high throughput proteomics screening technology.

### Carlsson Research, [www.carlssonresearch.com](http://www.carlssonresearch.com)

#### Business

Pharmacological treatment principles for psychiatric and neurological disorders. Founded by Arvid Carlsson, inventor of L-dopa and Nobel Laureate in Medicine. Raised SEK 60 million (EUR 6.7 million) in equity financing in 2000, 35 employees work at laboratories in Göteborg.

#### Achievements

Merck has acquired a license to develop and market compounds from Carlsson Research's dopamine stabilizer program. SEK 72 million (EUR 8 million) was paid upfront, subsequent research and clinical milestone fees amount to SEK 360 million (EUR 40 million), excluding royalties.

### Cell Therapeutics, [www.celltherapeutics.se](http://www.celltherapeutics.se)

#### Business

Founded by leading stem cell researchers at Sahlgrenska Academy in Göteborg: Christer Betsholtz, Sven Enerbäck, Peter Eriksson, Lars Hamberger, Anders Lindahl, and Henrik Semb. Aims to launch therapies for human diseases and other significant application of stem cell technologies. Initial focus: arthritis and arthrosis, diabetes, neurodegenerative diseases, and cardiac infarction.

#### Achievements

In 2003, received an infrastructure award from the US National Institutes of Health (NIH) to make two additional human embryonic stem cell lines (hESCs) available to US researchers. Also entered an agreement with the Japanese pharmaceuticals company Tanabe Seiyaku, to develop a therapy for Parkinson's disease based on embryonic stem cells.

### Neuronova, [www.neuronova.com](http://www.neuronova.com)

#### Business

Founded by two leading neuroscientists at Karolinska Institutet. Jonas Frisé and Ann Marie Janson have made important discoveries regarding brain cell function and have especially identified and localized neural stem cells in the central nervous system. Therapies based on neurogenesis to treat disorders such as Alzheimer's, Parkinson's and stroke.

#### Achievements

Completed its latest round of financing in 2003, receiving SEK 109.5 million (EUR 12 million) from owners Healthcap, Investor Growth Capital and Scandinavian Life Sciences Ventures. The company also signed its first commercial agreement with Danish Lundbeck. Neuronova was among companies included in the Red Herring 100 list in 2002.

### Neurotherapeutics

#### Business

Founded by Karolinska Innovations, the technology transfer unit at Karolinska Institutet, and Professor Ernest Arenas. Develops stem cell processing technologies, reagents, services and drug targets for neurological diseases, initially Parkinson's disease.

#### Achievements

Neurotherapeutic's technology platform is the first procedure based on cell engineering that will make it possible to generate neurons with a specific phenotype, suitable for engraftment, to be engineered and produced in unlimited numbers.

### Reglia

#### Business

Drug discovery for the treatment of diseases such as CNS injury, stroke and Alzheimer's. Founders Milos Pekny and Marcela Pekna, at Sahlgrenska Academy in Göteborg, have discovered a mechanism that regulates neuroregeneration in the central nervous system.

#### Achievements

Reglia's method, based on modulation of astroglial cells, the main cell type surrounding neurons, has been proven in genetic mice models, with good effects on nerve cell regeneration. By modulating the mechanism Reglia says it can greatly improve neuroregenerative capacity.

# 10 good reasons to choose Sweden for R&D in neuroscience

## 1. Strong medical research foundation and tradition

Sweden's position in neuroscience builds on a long history of R&D achievements. One out of six Nobel Prizes honoring advances in neuroscience have been awarded to Swedes.

## 2. Cost-efficiency in R&D

Industry executives typically put Sweden's cost advantage relative to the US in the range of 40 to 50 percent. Swedish researchers are also noted for their ability to deliver on time.

## 3. Collaboration opportunities with leading researchers and research institutions

Sweden is recognized for close collaboration between academia, the health care system and pharmaceuticals industry. Models for industrial cooperation with universities, researchers and research institutions are in place.

## 4. World-class research

Sweden is a recognized world-leader in numerous neuroscience fields, such as Alzheimer's disease, neuronal stem cell research, regenerative medicine and Parkinson's disease.

## 5. Exceptional integration between basic and clinical research

Swedish research emphasizes the need to be close to patients and basic research activities are often integrated with clinical research, a major advantage in the development of new therapies and treatments.

## 6. Uniquely positioned for clinical trials

All of the world's best-selling drugs have been investigated on Swedish patients. Sweden offers unique features for clinical trials, a result of its homogenous health care system, the ability to track patients over time and excellent biobanks and registers.

## 7. Ability to transform R&D into innovation and products

Sweden has a strong track-record of turning research advances into products. Companies in search of innovative collaboration partners will find plenty of opportunities in Sweden.

## 8. Outstanding ability in early diagnostics

Sweden offers unique conditions for projects that seek to understand the causes of neurological disorders and for the development of diagnostics tools and treatment methods.

## 9. Neuroscience is a national priority

Biotechnology in general, and neuroscience in particular, are a priority within the Swedish government. There is firm commitment to advance Sweden's position in this field.

## 10. Excellence in complementary sciences

Sweden has a remarkably strong position in areas such as behavioral research, bioinformatics, biotechnology, epidemiology, genetics, information and communications technologies, imaging technology, health care research, learning and cognition, man-machine interaction, and telemedicine.

“Sweden is a world leader in neuroscience. When it comes to pioneering studies in testing new techniques and therapeutic drugs for the disorders of the central nervous system, Sweden often leads the whole world.”

*Khalid Iqbal  
Chairman, Department of  
Neurochemistry  
New York State Institute  
for Basic Research in  
Developmental Disabilities*

### A leading life sciences nation

Life sciences companies employ more than 45,000 people, making it one of Sweden's major industries.

Sweden has Europe's fourth-largest biotechnology industry, employing some 6,000 people in over 200 companies.

Sweden invests heavily in R&D, and is one of the world's largest producers of life science knowledge, per capita.

AstraZeneca leads global R&D in three of its six therapeutic areas from Swedish research sites.

Companies that have formed strategic research alliances with Swedish biotech firms include Amgen, Bristol-Myers Squibb, GlaxoSmithKline, Merck and Wyeth.

## *ISA – Business facilitator*

Invest in Sweden Agency (ISA) is the government agency responsible for informing foreign investors about business opportunities in Sweden. Companies planning to establish or expand business operations in Sweden can, free of charge, obtain information and assistance from ISA and its regional and international network.

With headquarters in Stockholm, ISA has international operations and representation in major European, North-American and Asian cities. The vast majority of ISA staff has a background in the corporate sector and expertise in the investment process. These attributes help ensure professional guidance for successful business launches in Sweden.

*Welcome to the ISA web site at [www.isa.se](http://www.isa.se)*

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