Stockholm
The Capital of Scandinavia

STOCKHOLM–UPPSALA:

A world-class centre of life science excellence

A review of life science research in the region

LIFE SCIENCE

STOCKHOLM - UPPSALA LIFE SCIENCE

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Foreword

Welcome to Stockholm-Uppsala: one of the most innovative and productive life sciences clusters in Europe.

This exciting and dynamic region combines world-class scientific excellence through organisations including Karolinska Institutet and Uppsala University with major companies such as AstraZeneca and GE Healthcare.

Employing over 25 000 specialists in 500 life sciences companies and more than 300 major research projects, we are one of the largest European clusters. The region has a a strong track record of developing innovative products – launching the heart pacemaker, Gamma Knife, recombinant human growth hormone and Healon among countless others onto the world stage, changing the face of modern medicine. In fact, Stockholm belongs to the most innovative regions as reported by EU in the most recent European Regional Innovation Scoreboard January 2007: 2006). We are also home to the Nobel Prize in Medicine and Physiology as well as in Chemistry and Physics.

A major strength of the region lies in its ability to collaborate across academia and the commercial world. It is this philosophy which has been instrumental in building a sustainable and productive region – one which hosts many of the world's largest life sciences companies. It is this approach that positions the region for growth as the life sciences sector is poised to move into the next decade.

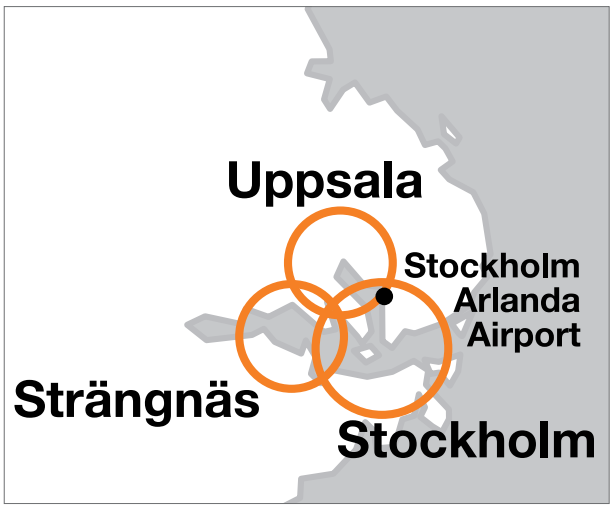
Innovative, world-leading research sits at the heart of the region and has inspired this report. I hope you find this both informative and interesting and look forward to reporting back on the regions achievements in twelve months' time.

Regards,

Ola Bjorkman
CEO, Stockholm-Uppsala Life Science.







An accessible region – most geographic sites in the region can be reached within one hour.

Executive summary

This report provides an overview of ongoing, world-leading academic research projects within life science in the Stockholm-Uppsala region.

Stockholm-Uppsala is Scandinavia's leading life science cluster and a European centre of excellence. A full complement of world-leading researchers, universities, big and small companies, key regulatory authorities and a complete healthcare infrastructure all call the region their home. The opportunities, the resources and the skills are all here – in one productive network.

The leading position of the region is founded on the successful history of scientific research, a tradition of close collaboration between academia and commercial companies, and strong links to other leading universities world-wide.

The presence of a large pool of highly-qualified, competent people with a reputation of conducting and delivering cost-efficient research on time is one major factor why global companies such as AstraZeneca, GE Healthcare and Pfizer have made major, strategic investments in the region in recent years.

Another factor – and a prerequisite – for the region's success is its continued ability to attract funding from national and international sources. The region typically brings home more than half of the national funding in life science research, and of the recently announced funding of strategic research areas, as much as 70% of that allocated to life science went to Stockholm-Uppsala.

Extensive international collaboration

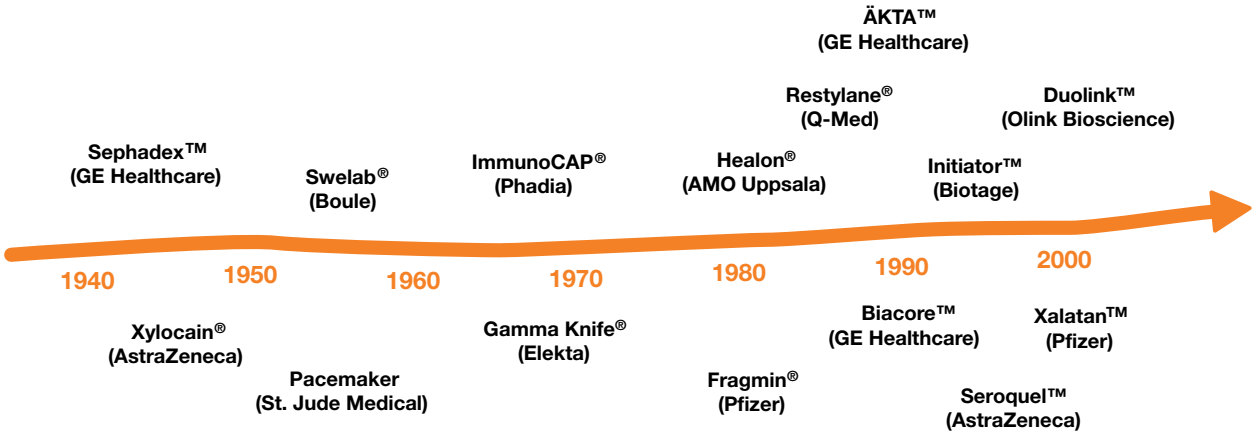
171 out of 591 projects (almost one third) of the collaborative life science project funding within the European 6th framework programme have at least one partner from the Stockholm-Uppsala region, putting it firmly in Europe's top-five list. The region's participation in the 7th framework programme more than matches that in the previous programme as illustrated by the performance of Karolinska Institutet, which is already involved in 90 collaborative projects.

LEADING RESEARCH AREAS OF LIFE SCIENCE

This report provides an overview of ongoing, world-leading academic research projects within life science in the Stockholm-Uppsala region. The projects, grouped by research area, are each presented with a short introduction of research and related industry activities.

The selection of research areas considered to be particularly strong has been based on the following three criteria:

- Each should encompass several, major, well-funded strategic research initiatives within more than one university



Time and time again, highly successful innovations now recognized throughout the world have emerged from this fruitful network of frontline academic research and innovative enterprise.

- Feature strong participation in EU-funded projects or projects financed from other international sources
- Have a critical mass of companies with related development activities.

Protein research/molecular bioscience is a world-class research area with a strong tradition both in academia and industry. Many of the products now on the world market as well as those in the company's pipelines are based on innovations within this area.

A significant part of the region's life sciece activities focuses on application or therapy areas, of which the following are particularly strong:

- Neuroscience
- Cancer
- Infectious diseases and immunology
- Inflammation
- Regenerative medicine
- Cardiovascular diseases
- Metabolic diseases.

A selection of other, high-level complementary research projects are also presented in this report.
Protein research in the region dates back to the invention of the ultracentrifuge by The Svedberg, Nobel Laureate 1926. Today, the broader definition, molecular bioscience, which includes both genomics and protein research is probably more relevant.

Molecular bioscience is one of the region's strongest areas, with world-class research including a major collaboration to map the human proteome, between scientists at the Royal Institute of Technology, Stockholm, and Uppsala University. The region is not only at the forefront of academic research in this field, it also is home to GE Healthcare, the market-leader in protein separations. This world-leading position can be traced back to Pharmacia. While the company no longer exists, its heritage can be found in a number of other companies, including Pfizer, which recently inaugurated a new multi-million dollar production facility in Strängnäs for their recombinant human growth hormone Genotropin®.

In the recent strategic research bill from the Swedish government, all of the funding in molecular bioscience (close to 150 million SEK), was awarded to four of the universities in the Stockholm-Uppsala region, Karolinska Institutet, Royal Institute of Technology (KTH), Stockholm University and Uppsala University. The four universities involved are now developing a collaboration programme under the common name Science for life Laboratory (SciLifeLab), where laboratories and research infrastructure will be set up both in Stockholm and in Uppsala and constitute a national resource centre for high-throughput molecular bioscience. Fully operational, this joint venture with two geographic sites represents cutting-edge research infrastructure and programmes of significant size, comparable with leading centres in Europe, USA and Asia.

Science for Life Laboratory (SciLifeLab)
SciLifeLab is a developing partnership between Royal Institute of Technology (KTH), Karolinska Institutet (KI), Stockholm University (SU) as one part and Uppsala University (UU) as the other part. The activities within the two sites (SciLifeLab Stockholm and SciLifeLab Uppsala) will be coordinated to complement each other and increase synergistic effects. SciLifeLab Stockholm is a center for high-throughput bioscience with focus on genome- and proteome profiling, bioimaging and bioinformatics with relevance for human diseases. SciLifeLab Uppsala aims to explain the molecular basis for human complex disease by applying novel technologies to well characterized patient samples uniquely available in the Nordic countries thereby identifying genetic risk factors, molecular markers, and molecular mechanisms in human diseases.

"New methods for analyzing biomaterial in combination with biobanks and health registers open truly unique possibilities to study the relationship between genetic and environmental factors for the expression and prognosis of disease."

Professor Nancy Pedersen, Karolinska Institutet.

Neuroscience has traditionally been a strong focus in the region and today hundreds of scientists are working in this research area. A significant proportion of them work at AstraZeneca's global centre for neuroscience research. Major academic research projects within neuroscience include the Stockholm Brain Institute's focus on dysfunctions from a neurological perspective; Swedish Brain Power, a nationwide project led from the region focusing on Alzheimer research; and Uppsala's Berzelii Technology Center for Neurodiagnostics, which aims to develop new tools for early disease diagnosis of neurodegenerative diseases.

Cancer research is particularly prominent in the region and has a strong history. Karolinska Institutet ranks 14 in the top 20 institutions in the world, with the most cited research articles in specialized cancer journals. It is the only European institute in the top 20. Cancer research is also one of Uppsala University's strategic research areas. The research conducted covers a broad spectrum of focus areas from basic research on the regulation of the cell cycle to the function of biomembranes in cancer diagnostics, drug development and radiation therapies. Translational research and cooperation with the region's two university hospitals (human and veterinary) is emphasized. A number of small and medium-sized companies are active in the cancer field. Elekta, a global company in image-guided and stereotactic clinical solutions for radiosurgery and radiation therapy, has its historic roots in the region and still has its head office here.

Infectious diseases and immunology are major areas of interest. One of the reasons for selecting Stockholm as the site for the European Center for Disease Control was the already prominent research at the neighboring Karolinska Institutet and the Swedish Institute for Infectious Disease Control. Major research projects at the universities, many with international partners, comprise studies on antibiotic resistance, zoonosis research, chronic infectious diseases and vaccines. One example is Action on Antibiotic Resistance–ReAct. This international network is taking concerted action to respond to antibiotic resistance and is led from Uppsala. Phadia, another example of a company with a heritage from Pharmacia, is a world-leader in allergy diagnosis.

Patient-based research into inflammation and autoimmunity constitute particularly strong research areas. The unique ability to explore patient registers was fundamental for the identification of the genes involved in the etiology of rheumatoid arthritis, a discovery made by the Center for Molecular Medicine, Karolinska Institutet.

Several research groups in the region carry out world-class research within Regenerative medicine, stem cell research and developmental biology. Applications based on this research are being developed within a number of small to medium-sized companies. Examples of application areas are chronic infection, cancer, diabetes, liver disease and neurodegenerative diseases. Two programmes that have received particular interest are cell therapy research at Uppsala University and the Human Regenerative Map, a collaboration between Karolinska Institutet and Uppsala University.

Research within Cardiovascular diseases is carried out within several focus areas, e.g. angiogenesis, inflammation mechanisms, metabolic factors, the genetics behind cardiovascular diseases, and development of new therapies. The foundation of elements of this research dates back to the Nobel Prize awarded to Sune Bergström and Bengt Samuelsson in 1982 for their discoveries concerning prostaglandins and related biologically active substances. The world's first pacemaker was implanted in a patient from Stockholm 50 years ago. The further development of new models of pacemakers and other medical devices for cardiovascular disease, is still conducted in the region by St. Jude Medical.

Research within Metabolic diseases is focused on diabetes and obesity. Several promising projects are ongoing, e.g. the development of a diabetes vaccine and transplantation of insulin-producing cells.

The Human Regenerative Map is a research project aimed at establishing a map of cell turnover in the human body in health and disease. By integrating biomedical approaches with recent developments in nuclear physics, the turnover of cells in human tissues can be established. The research strategy is based on measuring the DNA content of 14C derived from nuclear bomb tests in the 1960s and then retrospectively establish the birth date of cells and directly measure cell turnover and tissue regeneration in humans.

COMPLEMENTARY RESEARCH

Interdisciplinary research has always been of vital importance to the sector. One of the region's most important assets is its combination of technology-driven and biology-driven research. In many of the region's truly multi-disciplinary projects, micro-system technologies, nanotechnologies and new materials are applied.

Other examples of complementary research and competences are projects within drug development or epidemiology in combination with patient registers and biobanks. Clinical research, including resources and competence for conducting clinical trials, is another strong area, not only due to academic centres for clinical research within the university hospitals, but also the strong, international reputation of the Swedish Medical Product Agency.

Patient Registers and Biobanks

In Sweden, personal identity numbers have been in use since 1948 and data on drug use, clinical information and personal data has been collected in a number of registers for decades. In addition, blood and tissue samples from patients are continuously collected and stored in biobanks enabling the combination of epidemiological research and genetic studies. This puts Sweden in a unique position for longitudinal studies around the cause of disease and disease prognosis, as well as for studies of effects, side effects and health economics.



Photo: Markus Marcetic

Leading life science areas

PROTEIN RESEARCH/MOLECULAR BIOSCIENCE

Research and development in protein chemistry and protein analysis have long been one of Stockholm-Uppsala's key strengths. The region is the home of the ultracentrifuge - an innovation for which The Svedberg was awarded the Nobel Prize in chemistry in 1926.

The importance of protein research and molecular bioscience in life science research has increased significantly over time. Mapping the human genome opened the field for understanding why, how and where a number of important diseases develop on a molecular level. This has in turn opened up for new ways to diagnose disease through molecular bioscience-based technologies. In addition, the share of protein-based pharmaceuticals continously increases; an estimated 50% of all new medicines originate from biotechnologies and according to the most recent report from The Pharmaceutical Research and Manufacturers of America, more than 600 biotech medicines have been or are beeing tested to treat more than 100 diseases[1].

All universities in the region have strategic efforts contributing to the science and understanding of proteins. Some are clearly focused on specific application areas, while others are basic, curiosity-driven, research projects. In some cases, e.g. the Human Proteome Resource, the research is a collaboration between the universities.

Molecular bioscience was a major priority in the 2009 Swedish government's strategic research bill, with close to 150 million SEK allocated to a major research project in the Stockholm-Uppsala region. Science for Life Laboratory (ScilifeLab) is being developed as a partnership between Uppsala and Stockholm. SciLifeLab Stockholm brings scientists from Karolinska Institutet, the Royal Institute of Technology and Stockholm University together in one building. This part of the collaboration will be a national resource centre for high-throughput molecular bioscience. Together with SciLifeLab Uppsala, with its base at Uppsala University, the initiative will represent cutting-edge research infrastructure and programmes within molecular bioscience.

The Swedish Human Proteome Resource (HPR) program

The HPR program, developed at the Royal Institute of Technology and Uppsala University, has been set up to allow for a systematic exploration of the human proteome using Antibody-Based Proteomics. This is accomplished by combining high-throughput generation of affinity-purified (mono-specific) antibodies with protein profiling in a multitude of tissues and cells assembled in tissue microarrays. Confocal microscopy analysis using human cell lines is performed for more detailed protein localization. The Stockholm site generates high-quality, monospecific antibodies and performs the immunofluorescence analysis while the Uppsala site performs large-scale protein profiling in tissues and cells using immunohistochemistry. The programme also collaborate with Lab Surgpath, Mumbai, India. The programme hosts the Human Protein Atlas (HPA) portal with expression profiles of human proteins in tissues and cells.

Atlas Antibodies

Atlas Antibodies was founded in 2006 by the researchers involved in HPA and handles the production, marketing and sales of the antibody products developed and validated in the Human Proteome Resource Center.

GE Healthcare, with 1,200 employees in the region, supplies equipment for separating such proteins and leads its global separations business from Uppsala. It is most associated with protein analyses and today the group also includes Biacore. A number of the 'biotech tools' companies, e.g. Biotage, Affibody, Gyros, apply technologies based on or related to advances in protein science/molecular bioscience. Atlas Antibodies supplies

[1]Source:EuropaBio

antibodies developed and validated by the Swedish Human Protein Atlas (HPA) Program.

Biovitrum and Pfizer operate facilities for the manufacturing of protein-based pharmaceuticals. Pfizer recently inaugurated a new multi-million dollar production facility in Strängnäs for its recombinant human growth hormone, Genotropin®. Biovitrum is today the sole global manufacturer for Wyeth of the protein-based drug ReFacto®, used for treatment of hemophilia. Octapharma manufactures plasma-based products for patients with hereditary coagulation disorders and disorders of the immune system.

Protein science/molecular bioscience is also increasing in importance for the diagnostics industry, including Phadia and Ortho Clinical Diagnostics (previously Åmic). Olink and ModPro are start-up companies closely related to breakthroughs in protein research with possible applications for diagnostics. AlphaHelix Molecular Diagnostics develops products for DNA identification. AroCell is active in the biomarker segment.

Biovitrum recently announced that Biovitrum and Swedish Orphan will merge to form Swedish Orphan Biovitrum. The focus of the new company, with a more extensive product portfolio, remains on specialist drugs which are mainly prescribed by clinical specialists and aimed at small, well-defined patient groups.

Recently formed Recipharm Biologics and iNovacia are two examples of companies offering contract research services to biopharmaceutical companies.

Other companies active in the area are 3H Biomedical, which develops primary human adult stem cells; Attana, offering its biosensor solution for biomolecular interaction analysis to universities and biotech companies; Beactica, which evaluates the biophysical interaction of molecules; Denator, which develops instruments that stabilize biological samples; and Ridgeview Instruments, a university spin-off that develops instruments for analysing protein-cell interactions.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN PROTEIN SCIENCE/ MOLECULAR BIOSCIENCE

Organisation/ Principal investigator	Project/Programme	Area of research
KTH, KI, SU Mathias Uhlén, Juha Kere, Gunnar von Heijne	Science for Life Laboratory – Stockholm	A national resource center for high-throughput molecular bioscience e.g.technology platforms for genome sequencing, proteomics, functional genomics, bio imaging and bioinformatics.
UU Kerstin Lindblad-Toh, Ulf Landegren	Science for Life Laboratory – Uppsala	Studying the molecular basis for human complex disease by applying novel technologies to well characterized patient samples.
KTH, UU Mathias Uhlén, Fredrik Pontén	HPR - Human Proteome Resource	Mapping of the human proteome, including new antibodies. New antibodies are commercialized via Atlas Antibodies.
KTH Amelie Eriksson Karlström	AlbaNova Center for Protein technology	Utilizes newly-discovered information about the human genome in order to investigate the corresponding proteins (the proteome).
UU, UAS Fredrik Nikolajeff	Uppsala Berzelii Technology Center for Neurodiagnostics	Biomarkers and tools for molecular diagnostics of neurodegenerative diseases. Collaboration with AstraZeneca, GE Healthcare, Gyros, Olink.
UU Leif A. Kirsebom	Uppsala RNA Research Center (URRC)	Constellation of RNA researchers interested in the biology and chemistry of RNA. Covers different aspects of protein synthesis, mRNA modifications and RNA's role in infections.
SU Gunnar von Heijne	Strategic Centre for Biomembrane Research	Collaboration with GE Healthcare, AstraZeneca. Basic research on the role of biomembranes and membrane proteins for the transmission of information and vital substances at a cellular level.
KI Pär Nordlund, Johan Weigelt	Structural Genomics Consortia	Aims to determine the three-dimensional structures of proteins with relevance to human health comprising those associated with diabetes, cancer, genetic, epigenetic and infectious diseases. Intends to place them in the public domain without restriction.

UU Leif Andersson	Centre for Functional Genetics	The centre has two main focuses: -Genes, phenotypes and animal welfare. -Metabolism and disease.
UU Ulf Landegren	Diagnostic analyses of endogenous protein interactions	Aims to establish protein interaction events as markers for tumor diagnostics and for the evaluation of drug treatment.
UU Lars Baltzer	Drug development	Designing peptides for catalysis and, more generally, for binding molecules for practical purposes and to understand molecular recognition.
UU Helena Danielson	Drug development	Drug discovery based on enzyme inhibition: Characterisation of selective inhibitors of matrix-metaloproteinase.
SU J-E Bäckvall	Structural chemistry	One research focus is on methods for the synthesis of stereo-isomeres of organic molecules with applications within pharmaceuticas.
UU Måns Ehrenberg	Biochemical and structural analysis of the ribosome	To understand the structural rearrangements of the ribosome that underlie the different phases of protein synthesis in bacteria and yeast.
UU Kerstin Lindblad-Toh	Center for genetics and genomics of comparative diseases	The center will focus on dog disease gene mapping and on comparative genomics.
KTH Stefan Ståhl	Biotechnology	Bioprocessing resources, including a pilot plant, for diagnostics development (high-throughput facilities, nanobiotechnology).

KTH: Royal Institutie of Technology; KI: Karolinska Institutet; SU: Stockholm University; UU: Uppsala University

Therapy areas

NEUROSCIENCE

Stockholm-Uppsala's neuroscience focus covers a broad spectrum of research from developmental biology and experimental molecular neurobiology to clinical studies. Relevant, complementary competence and research within proteomics, computer science, functional and comparative genomics, behavioral science, material science and biotechnology can all be found in the region. Clinically-oriented research focuses on neurodegenerative diseases such as Alzheimer's and Parkinson's diseases, neurotrauma, psychiatric diseases, cognition, pain, addiction and diseases related to sensory organs or the aging brain. New technologies, in particular Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI), that are crucial to the elucidation of normal and pathological states of the brain, are important resources in many of the region's ongoing research programmes. A number of larger strategic ventures, such as the Stockholm Brain Institute, Swedish Brain Power and Uppsala's Berzelii Technology Center for Neurodiagnostics underscore the strong position of neuroscience.

AstraZeneca's global center-of-excellence for neuroscience research is located in Södertälje, just south of Stockholm. The main focus is on neurological diseases such as Alzheimer's disease and multiple sclerosis but also on neuropathic and nociceptive pain.

The following medium-sized companies are also active in the field of neuroscience: Medivir, Neuronova, Orexo, St. Jude Medical and Cogmed Systems. Examples of start-ups active in the field are: BioArctic Neuroscience and Premacure.

Medivir specialiszes in the understanding of proteases and polymerases and in the development inhibitor drugs for the treatment of diseases with particular emphasis on infections.

NeuroNova has two drug candidates in phase I/II clinical trials for Parkinson's disease and amyotrophic lateral sclerosis.

Orexo develops and commercializses superior drugs by combining well-known substances with innovative drug delivery technologies, resulting in new patentable drugs. Its first proprietary drug for the treatment of cancer pain, Abstral, was launched in Europe in 2008.

St. Jude Medical develops and markets medical technology products and services within the field of cardiology. The company recently acquired Uppsala based Radi Medical Systems.

CogMed has developed software for memory training in patients with working memory deficits. The product is on the market including the US.

BioArctic Neuroscience develops antibodies for the treatment and diagnosis of disorders in the central nervous system, based on the company's proprietary technology to make conformation specific monoclonal antibodies.

Premacure is a biopharmaceutical company dedicated to the development of diagnosis and prevention of complications in neonates due to premature birth.

Uppsala Imanet, part of GE Healthcare, is built principally around PET–a quantitative imaging technology that provides information on biochemical and physiological processes and drug-receptor interactions at a molecular level in the brain.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN NEUROSCIENCE

Organisation/ Principal investigator	Project/Programme	Area of research
KI, KTH, UmU Hans Forssberg	Cognitive and motor functions in health and disease during the lifespan	Studies of cognitive and motor function and dysfunction using methods that extend from genetics through to behavioral studies and clinical application.
KI, UU Bengt Winblad	Swedish Brain Power	Diagnosis, treatment and care of subjects affected by neurodegenerative diseases.
KI, KTH, SU Hans Forssberg	Stockholm Brain Institute	Goal: To enhance the understanding of higher brain functions.
KI Urban Lendahl	Developmental Biology for regenerative medicine	Focuses on developmental biology, stem cell research and neurobiology.
KI Mats Ulfendahl	Centre for Hearing and Communication Research	Conducting, promoting and integrating research related to hearing and communication.
KI, SU Laura Fratiglioni	Aging Research Centre	Goals include carrying out and supporting high-quality aging research from a medical, psychological and social perspective and directing the acquired knowledge into interventions.
KI Ola Kiehn	Spinal cord research	Collaboration between research groups on function, dysfunction, protection and repair of the spinal cord.
UU Lars Hillered	Uppsala Brain Injury Center (UBIC)	Translational research on molecular mechanisms, plasticity, repair, intensive care and rehabilitation.
UU Fredrik Nikolajeff	Uppsala Berzelii Technology Center for Neurodiagnostics	To find diagnostic biomarkers for neurodegenerative diseases like Alzheimer's and Parkinson's disease.
SU, UU, KI Lars-Göran Nilsson	Betula - aging, memory and dementia	Research on memory, genetics, brain imaging and early diagnostics.
Based at KI Sten Grillner	International Neuroinformatics Coordination Facility (INCF)	Aims to coordinate and foster international activities in neuroinformatics.
KI Juha Kere, Torkel Klingberg	Learning and memory in children and young people	Increase knowledge about the learning of children and youths; how they are motivated, how they create concepts and how their memory functions.
KI Ulf Eriksson	Stroke and traumatic brain injuries	Clinical trials and new methods for finding drugs against stroke and traumatic CNS injuries.
UU Dan Larhammar	Neuropharmacology	Study of the neuropeptide Y system whose peptides can potently stimulate and inhibit appetite.
UU Lars Lannfelt	Molecular Geriatrics	Focuses on understanding the molecular mechanisms behind Alzheimer's disease and other types of dementia.

KTH: Royal Institutie of Technology; KI: Karolinska Institutet; SU: Stockholm University; UU: Uppsala University; UmU: Umeå University

CANCER

Cancer research is one of the strongest research areas in the region and it compares favourably from an international perspective. According to the Swedish Cancer Society's 2008 annual report, Karolinska Institutet is the only European institution among the top 20 institutions with the most cited research articles published in specialized cancer journals (rank 14). Cancer research is also one of Uppsala University's strategic research areas and the Ludwig Institute for Cancer Research has two well-established sites here (one in Stockholm and one in Uppsala). Research activities include close cooperation on translational research with the region's university hospitals, including one veterinary.

Cancer research programmes comprise a broad spectrum of focus areas from basic research on the regulation of the cell cycle to the function of biomembranes in cancer diagnostics, drug development and radiation therapies.

Worldwide interest in cancer is reflected by the number of companies in the region actively developing and distributing drugs, new diagnostics or medical technologies for cancer treatment.

Orexo's product Abstral®, for the treatment of moderate to severe acute pain related to cancer, is on the market in several European countries and has reached phase III in the US.

In collaboration with the Swedish University of Agricultural Sciences, Oasmia Pharmaceuticals is developing a new generation of drugs with the emphasis on human and veterinary oncology. Oasmia's Paclical® Vet is based on the natural plant substance paclitaxel and makes possible, for the first time, the treatment of cancer in companion animals.

Founded in the seventies, Elekta belongs to the group of companies with a long history in the region. Built around its Gamma Knife® concept, a non-invasive method for treating brain disorders, Elekta is now a world-leading company in image-guided and stereotactic clinical solutions for radiation surgery and therapy.

RaySearch develops software for cancer radiation therapy. It aims to enhance the efficiency of radiation therapy by optimizing the radiation dose for each individual cancer patient.

Three companies spun out from Karolinska Institutet and involved in cancer diagnosis and treatment are Axelar, Oncopeptides and Aprea. Axelar recently completed phase I/II clinical trials with its anti-cancer drug AXL1717 that inhibits the IGF-I- receptors over-expressed by cancer cells. Oncopeptides is presently in phase I/IIa trials with peptides that target cancer cells. Aprea develops target-specific drugs for the treatment of cancer with non-functional p53. Its first investigational drug (for treatment of refractory hematologic malignancies or prostate carcinoma) is in phase I.

SentoClone is a life science research company focusing on the development of a therapeutic method to fight cancer based on the activation and utilization of the patient's own immune system.

Other companies active in the cancer area are Affibody, Betagenon, Uppsala Imanet, IDL Biotech and C-Rad.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN CANCER

Organisation/ Principal investigator	Project/Programme	Area of research
KI Rune Toftgård	Center for Integrated Cancer Studies	Translational cancer research with four focus areas on the future of cancer diagnosis, treatment, prevention and commercialization.
UU, UmU, SU, KTH Lena Claesson-Welsh	The U-Can Comprehensive Cancer Consortium	Main objective is to establish a new infrastructure for longitudinal sampling of tumor, blood and serum before, during and after therapy.
KI Arne Östman	STARGET – a cancer research network	Studies of the diagnostic, prognostic and therapeutic potential of mesenchymal cells of the tumor stroma.
KI Henrik Grönberg	Individualized prediction and prevention of breast and prostate cancer	Individualized prediction and prevention programmes will be developed and adopted on persons at high risk of developing cancer.
KI Gunnar Steineck	Prostatectomy vs. watchful waiting – a randomized trial	Compilation and evaluation of published studies on the effects of radical prostatectomy on mortality in cancer patients.
KI Per Kogner	National research network	Research on neural cancer tumors in children and tumors of the central nervous system.
KTH, UU Mathias Uhlén, Fredrik Pontén	Human Proteome Resource (HPR)	Mapping of the human proteome, including new antibodies, which are commercialized via Atlas Antibodies.
UU Ulf Lindahl	Glycoconjugates in Biological Systems	A national network for glyco biological research with a school for graduate and postgraduate training.
UU Bengt Långström	Imanet center	The unique Imanet/PET centre produces tracers for detection of several mechanisms.
UU Kjell Öberg	Neuroendocrinology	Imaging of neuroendocrine tumors using positron emission tomography with specific tracers.
Olink Mats Gullberg	Enhanced Ligase-based Histochemcial Techniques (ENLIGHT)	Development of new analytical procedures for improved therapeutic targeting using cancer as the primary application area.
KI, KTH Johan Hansson	CHEMORES	Molecular mechanisms underlying chemotherapy resistance, therapeutic escape, efficacy and toxicity Aims to improve the outcome of cancer chemotherapy by developing novel tools to predict tumor response to treatment.
KI Klas Wiman	Mutant p53 as a target for improved cancer treatment	Exploring mutp53 as a target for novel anti-cancer therapies.
LIU Carl-Henrik Heldin	Ludwig Institute research programme	Studies on the signaling pathways in cells that control cell growth and exploring the possible clinical utility of signal transduction antagonists.
UU Ulf Landegren	Diagnostic analyses of endogenous protein interactions	The procedures and results of this project will establish protein interaction events as markers for tumor diagnostics, and for evaluating drug treatment.

KTH: Royal Institutie of Technology; KI: Karolinska Institutet; LIU: Ludwig Institute, Uppsala;
SU: Stockholm University; UU: Uppsala University; UmU: Umeå University

INFECTIOUS DISEASES AND IMMUNOLOGY

Infectious diseases caused by bacteria, viruses, parasites and fungi account for one quarter of all deaths in the world. Research in the region covers the whole spectrum from host-microbe interactions (as in malaria and gastro-intestinal infections), infection and cancer, infection and immunology (particularly relevant for the development of vaccines) and zoonosis research addressing antibiotic resistance. Stockholm-Uppsala also features research programmes in international health problems, such as HIV and AIDS, tuberculosis, malaria and diarrhea, that are often related to poverty in low-income countries.

Infection biology for domestic animal production and public health is an area of focus in the region and the presence of the European Center for Disease Control, combined with strong local research, puts the Stockholm-Uppsala region at the forefront of international R&D. Yet another regional competence center is the National Veterinary Institute in Uppsala with the Swedish Zoonosis Center with the mission to prevent spread of zoonotic agents to humans, including food borne zoonoses.

The Swedish Institute for Infectious Disease Control (SMI) is a governmental expert agency that both monitors the epidemiological situation for infectious diseases in humans and promotes protection against such diseases. SMI performs vaccine research mainly devoted to the development and trial of new HIV vaccines.

A number of companies with a base in the region have products within infectious diseases in their portfolios or drug development pipelines.

One of Medivir's major projects is for the treatment of hepatitis C virus (HCV) infection for which phase IIa studies in patients are ongoing.

Crucell/SBL Vaccines is the leading vaccine distributor in Sweden. Its core product Dukoral is an oral vaccine that protects against cholera and travellers' diarrhoea.

Vironova is developing a potent class of antivirals. Proof-of-concept has been shown against all eight human herpes viruses.

Bactiguard develops a solution for reducing device-related hospital and care-acquired infections. The technology comprises coating any medical device with an extremely thin noble metal alloy.

Several vaccines on the market (for use in veterinary medicine and one for human use in clinical phase development) are based on Immune Stimulating Complex (ISCOM) technology developed by Isconova, a company collaborating with vaccine development partners for the production of vaccines.

Svanova Biotech offers products for diagnosing infectious diseases in livestock and companion animals.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN INFECTIOUS DISEASES AND IMMUNOLOGY

Organisation/ Principal investigator	Project/Programme	Area of research
KI Hans-Gustaf Ljunggren	Strategic Research Centre for Infectious Medicine (CIM)	Research focuses on chronic infectious diseases and their role in the occurrence of several major common diseases. The center has about 60 active researchers.
KI Klas Kärre	Strategic Research Centre for Recognition in the Immune System (IRIS)	The main vision behind this centre is to understand recognition and regulation in complex systems in inflammation and immunity.
UU Alwyn Jones	Strategic Research Centre for Rational Approaches to Pathogen Inhibitor Discovery (RAPID)	The centre brings together structural biology and medicinal chemistry with the purpose of designing drugs against malaria and tuberculosis.
UU Olle Korsgren	Innate immunity in clinical islet transplantation	Porcine islets represent a realistic source of donor tissue that will be transplanted into human diabetic recipients in the future.
UU Otto Cars	Action on Antibiotic Resistance (ReAct)	International network aiming to preserve the effectiveness of antibiotics.
UU Dan Andersson	Bacterial adaptation and evolution	Understanding how antibiotic resistance affects the whole lifecycle of the bacteria and which factors determine how rapidly resistance develops in a population.
UU Jan Sjölin	Infectious diseases	Major indications addressed are infections caused by HIV and Hepatitis C Virus as well as the infectious diseases malaria and tuberculosis.
SLU Sandor Belak UU Björn Olsen	Zoonosis research	Avian influenza – new methodologies for early detection
SLU Johan Schnürer	Microbiology	Domestication of microorganisms for biological control of plant diseases.
UU Ann-Christine Syvänen	Autoimmmunity	Mapping of risk factors for autoimmune diseases like Systemic Lupus Erythematosus and Amyotrophic Lateral Sclerosis by SNP genotyping.
SU, KTH, KI Johan Giesecke	Stockholm Group for Epidemic Modelling (S-Gem)	A multi-disciplinary network of researchers with an interest in the development of epidemic modelling and epidemiology from statistics and medicine to sociology.

KTH: Royal Institutie of Technology; KI: Karolinska Institutet; SU: Stockholm University; UU: Uppsala University; SLU: Swedish University of Agricultural Sciences

INFLAMMATION

Abnormal chronic inflammation underlies a number of our most common severe diseases such as rheumatic diseases, multiple sclerosis and psoriasis. Inflammation is a key factor in asthma and allergy. Patient-based research into inflammation and autoimmunity includes the development and testing of specific new biological drugs (antibodies, soluble receptors and recombinant proteins) in the treatment of chronic inflammatory diseases; including rheumatoid arthritis (RA), inflammatory bowel disease (IBD), allergy and psoriasis.

In addition, translational research within immunology and inflammation is a focus where access to unique patient registers makes longitudinal studies possible. Another strength is the comprehensive knowledge base of specific cell types, a factor that is very relevant for certain types of cell therapies.

Aerocrine develops and commercializes a product (NIOX Flex) for monitoring nitric oxide (NO) as an inflammatory marker. The purpose is to improve the management and care of patients with inflammatory disorders such as asthma.

Karo Bio's compound Eprotirome/KB2115 has successfully completed three phase II studies in patients with dyslipidemia, i.e. high LDL cholesterol levels strongly associated with the risk for cardiovascular disease.

Phadia's allergy test system assays ImmunoCAP® Rapid are the first to be FDA approved for the quantitative measurement of specific IgE.

Other companies in the region active in the area of inflammation include Biovitrum, Medivir, Orexo and Meda.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN INFLAMMATION

Organisation/ Principal investigator	Project/Programme	Area of research
KI Lars Klareskog	Controlling chronic inflammatory diseases with combined efforts (Combine)	A national consortium for studies on chronic inflammatory diseases.
KI Göran Hansson	Center for Research on Inflammation and Cardiovascular Disease (CERIC)	Chronic inflammation and the pathobiological process that links inflammatory disorders, such as multiple sclerosis, rheumatoid arthritis and psoriasis, with atherosclerotic cardiovascular disease.
KI Sven-Erik Dahlén	Centre for Allergy Research	The centre is a forum for inter- and multi-disciplinary research, development and education in allergy, promoting collaboration between society, healthcare, research and industry.
UU Per Venge	Diagnosis of inflammations in respiratory tracts and intestines	Aims to develop methods for diagnosing inflammations in respiratory tracts and intestines. In collaboration with Phadia, Aerocrine and Alimenta Diagnostics.

KI: Karolinska Institutet; UU: Uppsala University

REGENERATIVE MEDICINE

Regenerative medicine and stem cell research are evolving rapidly. The potential to use stem cells to repair damaged tissue in the human body for previously incurable diseases are very promising. Over the past few years, several world-leading research centers have been formed in the region, gathering internationally-prominent stem cell scientists and bringing together academia, society and industry for research within regenerative medicine. For example, researchers have managed to manipulate stem cells in vitro to form dopamine-producing nerve cells. This represents the first step towards being able to replace dopamine cells that have been lost during Parkinson's disease.

A number of small to medium-sized companies engaged in regenerative medicine are located in the Stockholm-Uppsala region, often supported by research conducted at the regional universities. The companies are focused on the discovery, development and commercialization of innovative treatments of immune diseases and cell therapies. Avaris is a start-up company specialized in cell and gene therapy in the fields of chronic infection, cancer and inherited disease. A vaccine against HIV (AutoCell) is about to enter Phase I studies.

TikoMed's lead product is developed to improve islet cell transplantation for patients with severe diabetes type I. Novahep uses liver cells as a base for gene therapy of liver diseases such as Hepatitis C. Neuronova has two projects within neurodegenerative diseases in phase I/II clinical trials and several projects in early preclinical development and late discovery.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN REGENERATIVE MEDICINE

Organisation/ Principal investigator	Project/Programme	Area of research
KI Li Tsai, Urban Lendahl	Center for Regenerative Medicine	Collaborative network within basic and translational research with the aim to develop new cell therapy treatments.
KI, UU Jonas Frisén	The Human Regenerative Map	Proposes to establish a map of cell turnover in the human body in health and disease.
KI Urban Lendahl	Developmental biology for regenerative medicine	Focuses on developmental biology, stem cell research and neurobiology.
KI, LuU Johan Ericson, Thomas Perlmann	Stem cell therapy for Parkinson's Disease	Research focuses on engineering dopamine neurons from stem cells, efforts that hopefully will be critical for developing stem cell-based therapy in Parkinson's disease.
UU Olle Korsgren	Innate immunity in clinical islet transplantation	Porcine islets represent a realistic source for donor tissue that will be transplanted into human diabetic recipients in the future.
UU Thomas Tötterman	Cell therapy	Enrichment of T-cells for cancer treatment.
LuU, UU Olle Korsgren Jöns Hilborn	National initiative on Stem Cells for Regenerative Therapy	To demonstrate that stem cell-based cell replacement therapy is effective and safe.

KI: Karolinska Institutet; UU: Uppsala University; LuU: Lund University.

CARDIOVASCULAR DISEASES

Cardiovascular disease is the most common cause of death in Sweden and around the world. Research in the field, carried out in close collaboration with clinical departments at regional hospitals, aims to identify new treatments using new drugs to improve prognoses. The research focus includes signal molecules in blood vessels, angiogenesis, inflammation mechanisms in cardiovascular disease, metabolic factors in cardiovascular disease, the genetics behind cardiovascular diseases, and development of new therapies.

Stockholm-Uppsala has a strong tradition in developing innovative new treatments for cardiovascular disease. Several research breakthroughs of great international importance have been made in the region: the pacemaker treatment; heart valve surgery; discovery of several coagulation factors; development of heparin and coagulation factors for drug usage; and the discovery of prostaglandins (Nobel Prize 1982).

Larger companies active within cardiovascular diseases include Maquet Critical Care (product development) and St. Jude Medical (with historic links to the application of the world's first pacemaker and recent buyer of Radi Medical Systems). Examples of small to medium-sized companies are Athera Biotechnologies (diagnostics), Mercodia (diagnostics) and Gripping Heart (diagnostics).

The prominent of the ICT sector in Stockholm-Uppsala plays an important role for the sector's overall competitiveness on a world stage and has enabled a rapid inclusion of technology-based solutions in new medical products. Ortivus' support system for patient monitoring and decision-making in the area of acute cardiac disease and pre-hospital monitoring uses bluetooth, a standard for wireless communication developed by Ericsson in Sweden in the late 1990s.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN CARDIOVASCULAR DISEASES

Organisation/ Principal investigator	Project/Programme	Area of research
KI Göran Hansson	Center for Research on Inflammation and Cardiovascular Disease (CERIC)	Chronic inflammation and the pathobiological process that links inflammatory disorders such as multiple sclerosis, rheumatoid arthritis and psoriasis with atherosclerotic cardiovascular disease.
UU Lars Wallentin	Personalized cardiology	To develop individual diagnostics and treatment for heart patients.
KI Jan Sundquist	Relationship between cardio-vascular disease, nutrition, physical activity, obesity, life style and living environment	A project within CeFAM, a collaboration between KI and Stockholm County Council focusing on the relationship between cardiovascular diseases, cardiovascular prevention, diabetes, and physical activity.

KI: Karolinska Institutet; UU: Uppsala University.

METABOLIC DISEASES

This research area encompasses diabetes, obesity, hypertension, osteoporosis and hormonal disturbances. The research involves nutrition, physical activity, anesthesia and intensive care, drug metabolism, psychiatry, neurology, nephrology and gastroenterology.

The majority of the initiatives in industry are directed towards diabetes, and in some cases also obesity.

Mercodia develops and distributes ELISA assays for research and clinical use within cardiovascular disease, obesity and diabetes.

Diamyd Medical, a start-up company developing a diabetes vaccine, is currently conducting two clinical Phase III studies in type I diabetes. Results are expected by the end of 2010.

Another start-up company, spun out of the Swedish University of Agricultural Sciences, is Spiber Technologies, who are developing spider dragline silk for possible application in culturing insulin-producing cells. Oxthera and Betagenon are others with pharma projects in their respective pipelines.

Karo Bio's KB3305 is a liver glucocorticoid receptor antagonist that has shown good results in clinical phase I programmes for type 2 diabetes.

EXAMPLES OF STRATEGIC RESEARCH PROJECTS WITHIN METABOLIC DISEASES

Organisation/ Principal investigator	Project/Programme	Area of research
KI Juleen Zierath	Translational Programme in Diabetes Research, Education and Care	Translational research consortium focused on metabolic aspects of type II diabetes and its complications, creating a complete infrastructure platform.
UU , LuU Olle Korsgren	Excellence of Diabetes Research in Sweden (EXODIAB)	A joint diabetes research initiative to develop new strategies for early risk assessment and novel therapies for prevention and treatment of diabetes and its complications.
KI Jan Sundquist	Relationship between cardio-vascular disease, nutrition, physical activity, obesity, life style and living environment	A project within CeFAM, a collaboration between KI and Stockholm County Council, focusing on the relationship between cardiovascular diseases, cardiovascular prevention, diabetes, and physical activity.
SU Barbara Cannon	Metabolism and energy consummation in relation to obesity	Research on the role of active brown adipose tissue in adult humans.

KI: Karolinska Institutet; UU: Uppsala University; SU: Stockholm University; LuU: Lund University.

OTHER AREAS

Other areas that merit inclusion in any review of the Stockholm-Uppsala region are the strong tradition and knowledge around heparin and hyaluronic acid, two further examples of the heritage from Pharmacia.

The broad competence in the properties of heparin and its analogues that already existed was vital for the development of Dilafor's new product now showing promising results in normalizing protracted childbirth labor in phase II clinical trials. Based on the long-standing experience and knowledge of applications of hyaluronic acid, Uppsala-based Abbott Medical Optics Uppsala develops, manufactures and markets Healon® for cataract surgery. Another company developing, manufacturing and marketing primarily medical implant products based on hyaluronic acid is Q-Med.

Complementary research

Not all life science-relevant academic research in the region can be assigned to a specific therapy or research area. In fact, a significant proportion of this research can be described as complementary, yet vital for research breakthroughs and/or the development of new products and treatments.

Many of these programmes which are complementary to medicine are technology-driven but with a clear aim to find applications within life science. Examples of such developments are projects within the Royal Institute of Technology, Stockholm University and Uppsala University where micro-system technologies, nanotechnologies or new materials are applied in the development of e.g. medical device, delivery systems and pharmaceuticals to improve efficiancy and/or safety of the products.

Other examples are projects within drug development, particularly at Uppsala University, where new tools are developed and various aspects of drug discovery are explored. The new insights and knowledge gained then become an important element of the region's resource and competence base within drug development.

Extensive biobanks and patient registers are unique and invaluable resources available to researchers here. The wealth of biobanks in Stockholm-Uppsala is well organized, and patient medical records can be tracked via civic registration numbers. Epidemiological and genetic research in combination with access to biobanks and a number of different types of registers, e.g. disease-specific registers, drug registers and national quality registers, provide unique possibilities to study how genetic and environmental factors influence health. These registers and access to biobanks also open the possibility to monitor safety and evaluate the effectiveness of a drug as it is used in clinical practice, something that is performed at the Centre for Pharmacoepidemiology, Karolinska Institutet.

The region has a long history of clinical research and the trials of many of today's leading drugs have been performed at the Karolinska University Hospital and Uppsala University Hospital. Two major centres serving industry and scientists today with expertise and resources for clinical trials are the Uppsala Clinical Research Center and Karolinska Trial Alliance. The highly-competent advice available at the Medical Products Agency (MPA), Sweden's regulatory authority is a key asset for the region. The agency is one of the EU's most frequently consulted authorities under both centralized and mutual recognition procedures.

The table below also includes a number of other important projects and programmes ranging from basic and fundamental curiosity-driven research to applied research within healthcare science.

A fundamentally important sector in the region is that represented by service companies. These offer services and skills ranging from specialist consultancy within narrow fields to broad operative support in product development.

This all adds up to a combined competence pool and research infrastructure that represents the backbone of one of Europe's most prominent life-science regions.

EXAMPLES OF COMPLEMENTARY RESEARCH PROJECTS AND RESOURCES

Organisation/ Principal investigator	Project/Programme	Area of research
UU Karin Larsson	Strategic Research Centre for Materials Science for Nanoscale Surface Engineering	Design of new nano-structured materials for application in biotechnology.
SU Xiaodong Zou	EXSELENT on Porous Materials	Synthesis of new functional and porous materials. Collaboration with the Institute for Surface Chemistry and industry (i.e. AstraZeneca, Biovitrum, Perstorp and Nobel Biocare).
KTH Göran Stemme	Material science	Miniaturization with applications within diagnostics and drug delivery.
UU Mehran Salehpour	Drug development	Accelerator mass spectrometry in developing methods for microdosing.
KTH Anders Lindquist	Strategic Research Centre for Industrial and Applied Mathematics (CIAM)	Studies on diffusion in biological tissue and metabolism in cells with application within drug design.
UU Per Artursson	Drug development	Applying new tools to study drug absorption at the molecular and cellular level and the distribution and function of important drug-transporting proteins in order to better understand drug disposition and drug interactions.
KI Nancy Pedersen	Epidemiology	Studies using the Swedish Twin Registry. Research includes evaluation of the relative importance of genetic and environmental influences and how the impact of genes changes over time and with increasing age.
UU, LuU Björn Olsen	Epidemiology for Health (EpiHealth)	A two-university collaboration in basic and applied epidemiology. One focal area is surveillance of epidemics and well defined categories of infectious disease, e.g. bird flu and SARS of potential to induce pandemias.
KI Anders Ekbom	Centre for Pharmacoepidemiology	Post-marketing monitoring of safety and evaluation of the effectiveness of a drug.
UU/UUH Lars Wallentin	Uppsala Clinical Research Center (UCR)	UCR focuses on clinical research, clinical trials, quality registries, statistics, data management, information technology and biomedical analysis, predominantly within cardiology, cancer and microbiology.
KUH Pierre LaFolie	Karolinska Trial Alliance (KTA)	KTA works as a knowledge and resource centre for advice, education and coordination of clinical trials.
KI, UmU Carlos Ibáñez	Context, competence and combinatorial signaling in vertebrate development	How do the various organs and tissues of vertebrates form from a group of immature cells? This question unites four research groups at KI and Umeå University in a shared research environment.

KI Nils-Göran Larsson	Mitochondrial Medicine Centre	The centre brings together different disciplines at KI and Karolinska University Hospital in Huddinge to attack a single biological problem; mitochondrial disease.
KTH Harry Brumer	Biomedical materials	CarboMat – Consortium for advanced carbohydrate materials.
UU Hans Ellegren	The Genomics of Phenotypic Diversity in Natural Populations	Combination of in-silico approaches and in-house DNA sequencing and SNP analysis to study evolutionary processes at the sequence and genomic levels.
KI Lena Borell	Health Care Science	Bridging research and practice for better health: the Comprehensive Care Science Centre
SU Torbjörn Åkerstedt	Working life	Interdisciplinary research on work-related stress and health.
UU Louise von Essen	Health Care Science (U-CARE)	Better psychosocial care at a lower cost? Evidence-based assessment and psychosocial care via internet.
KI and UU	Biobanks	Both KI/Karolinska University Hospital and UU/ Uppsala University Hospital have biobank resources of strategic importance.

KTH: Royal Institutie of Technology; KI: Karolinska Institutet; KUH: Karolinska University Hospital; SU: Stockholm University; UU: Uppsala University; UUH: Uppsala University Hospital; LuU: Lunds University, UmU: Umeå University.

Appendices

METHODOLOGY

This document provides an overview of ongoing research considered to be world-class within life science in the Stockholm–Uppsala region. Individual researchers and their projects for presentation in this report were selected in close dialogue with the relevant universities. This provided us with a list of over 90 projects plus the names of the respective principle investigators (PIs). The information was then structured by research area and supplemented with information on which companies are active within the respective area. Some important projects either have a broad scope or represent enabling technologies/complementary disciplines and do not, therefore, easily fit into a specific research area. These projects are presented as complementary research.

Considering the large volume of broad life science research in the region, selecting some areas in preference to others is a real challenge. To provide a useful and relevant overview of those areas that do appear particularly strong, we therefore used the following three selection criteria:

- The research area should be supported by strategic research initiatives within several universities, i.e. attract fundamental external funding and/or be selected by the universities in their strategy documents.
- There should be research groups in the region who participate in, or preferably coordinate, EU-funded projects or projects financed from other international sources.
- The selected areas should not only comprise strong basic research, but also display a critical mass of companies with development activities within that particular area.

Before finalising the list, representatives from the universities and companies in the region were asked to provide their expert opinion in a workshop setting.



Photo: Markus Marcetic

LIST OF UNIVERSITIES AND RESEARCH INSTITUTES

Karolinska Institutet

Karolinska Institutet (KI) is one of the leading medical universities in the world and one of the largest in Europe. It is also the only university in Sweden to specialize in medicine, and the country's principal centre for medical education and research. Each year, the Nobel Assembly at Karolinska Institutet awards the Nobel Prize in Physiology or Medicine. Basic research is conducted at pre-clinical departments at Karolinska Institutet's main campus and within Karolinska University Hospital in Solna and in Flemingsberg.
www.ki.se

Royal Institute of Technology – KTH

KTH (Kungliga Tekniska högskolan - Royal Institute of Technology) accounts for one-third of Sweden's technical research and engineering education capacity at university level. Education and research cover a broad spectrum – from natural sciences, including biotechnology, to all branches of engineering as well as architecture, industrial engineering and management, urban planning, work science and environmental engineering. The School of Biotechnology at Albanova University Center hosts the Human Proteome Resource Program and the School of Technology and Health hosts the Center for Technology in Medicine and Health located in Flemingsberg.
www.kth.se

Stockholm University

Stockholm University is a centre for higher education and research in humanities, law, the natural and social sciences, and a focus for the work of leading international researchers. Stockholm University is one of the largest universities in Sweden and one of the largest employers in Stockholm. Stockholm University has the Sweden's largest faculty of Natural Sciences.
www.su.se

Swedish University of Agricultural Sciences

SLU (Sveriges lantbruksuniversitet – Swedish University of Agricultural Sciences) is a university focusing on the development of learning and expertise in areas concerning biological resources and biological production. Activities span the wide-ranging fields of agriculture, forestry and food industry to environmental questions, veterinary medicine and biotechnology.
www.slu.se

Uppsala University

Uppsala University is a comprehensive research university dedicated to advancing science, scholarship, and higher education. In a great many fields, Uppsala University research is on the international cutting edge. Uppsala is the oldest university in the Nordic countries – founded in 1477. For more than 500 years, Uppsala University has been a distinguished seat of learning with rich opportunities for students and researchers at all levels.
www.uu.se

Karolinska University Hospital

Karolinska University Hospital has two major centers: Karolinska Huddinge and Karolinska Solna. Karolinska University Hospital delivers care to patients in the Stockholm area and is the teaching hospital for Karolinska Institutet's research and education programmes. Research is conducted in close collaboration with Karolinska Institutet both at the north campus in Solna where some 2/3 of Karolinska Institutet's research takes place and at the south campus in Flemingsberg where the remaining 1/3 of the research is performed.
www.karolinska.se

Uppsala University Hospital

Uppsala University Hospital's main fields of activity are medical care, teaching and research. Education and research are undertaken in close collaboration with the Medical Faculty of Uppsala University.
www.akademiska.se

The Ludwig Institute for Cancer Research

Cancer research within the institute is carried out at ten different branches around the world, of which two are located in the region. The Uppsala branch is localized at the Biomedical Center in Uppsala and operates under a contract with Uppsala University and the University Hospital. The Stockholm branch is located at Karolinska Institutet, Stockholm, and affiliated with the Department of Cell and Molecular Biology.
www.licr.org

LIST OF EUROPEAN AND NATIONAL AGENCIES

European Center for Disease Prevention and Control (ECDC)

The European Centre for Disease Prevention and Control (ECDC) was established in 2005 and is seated in Stockholm. The aim of this EU agency is to strengthen Europe's defences against infectious diseases by identifying, assessing and communicating current and emerging threats to human health posed by infectious diseases.
www.ecdc.europa.eu

Medical Products Agency

The Medical Products Agency (MPA) is the Swedish national authority responsible for regulation and surveillance of the development, manufacturing and marketing of drugs and other medicinal products.
www.lakemedelsverket.se

National Veterinary Institute (SVA)

The National Veterinary Institute, SVA, is a Swedish national authority that strives for good animal and human health, a good environment and sustainable food production.
www.sva.se

Swedish Institute for Infectious Disease Control (SMI)

The Swedish Institute for Infectious Disease Control (SMI) is a governmental expert agency with the mission to monitor the epidemiological situation for infectious diseases in humans. It is also responsible for promoting protection against such diseases.
www.smittskyddsinstitutet.se

LIST OF COMPANIES

3H Biomedical AB

3H Biomedical develops, manufactures and markets primary cells, cellular products and cell-based assays for cell research, drug discovery and tissue engineering research. Its offerings comprise a variety of 'ready-to-use' high-value primary human adult stem cells, dendritic cells, lymphocytes, NK cells, monocytes and EPCs.
www.3hbiomedical.com

Abbot Medical Optics Uppsala AB

Abbott Medical Optics Uppsala develops, manufactures and markets Healon® and related products for cataract surgery and vision care.
http://www.amo-inc.com/

Aerocrine AB

Aerocrine develops products for measuring airways inflammation. The principle is based on the identification of nitric oxide (NO) as a marker of inflammation. The company markets two products globally, NIOX Flex and NIOX MINO, both used to assist in the diagnosis and control of airways diseases such as asthma.
www.aerocrine.com

Affibody AB

Affibody focuses on developing products for therapy, diagnostic imaging, and other applications based on its proprietary technology platforms: Affibody® molecules and Albumod™. Affibody® molecules can be designed to bind specifically to a large number of target proteins. Albumod™ enhances the efficacy of biotherapeutics by extending their circulation time.
www.affibody.com

AlphaHelix Molecular Diagnostics AB

AlphaHelix Molecular Diagnostics develops, manufactures and markets products for DNA identification and quantification. Its proprietary technology enables very rapid qPCR, High Resolution Melting (HRM) analysis and cycle sequencing reactions.
www.alphahelix.com

Aprea AB

Aprea develops target-specific drugs for the treatment of cancer with non-functional p53, associated with resistance to conventional cytostatics. Aprea's first investigational product is in clinical Phase I. Aprea is seeking partners for co-development for Phase II.
www.aprea.com

AroCell AB

AroCell develops and commercializes innovative biomarkers for cell growth in the field of diagnostic, prognostic and therapeutic applications. The initial project is an ELISA assay based on a universal tumor marker. The aim is to license the product to diagnostic companies for further adaptation to clinical routine laboratories, and later find applications in point-of-care testing.
www.arocell.se

AstraZeneca AB

AstraZeneca is a world-leading pharmaceutical company with a world-class biologics capability and more than 65,000 employees in over 100 countries. The corporate office is in London, UK, while world-wide R&D is headquartered in Södertälje, Stockholm. AstraZeneca conducts research and development in neuroscience in Södertälje, and has its production and Nordic marketing organization based there.
www.astrazeneca.com

Athera Biotechnologies AB

Athera Biotechnologies develops products for risk assessment and treatment of cardiovascular disease (CVD). The company was founded to exploit findings on the immunological components in atherosclerosis, the inflammatory process leading to cardiovascular disease, based on antibodies against phosphonyl choline (PC). Its pipeline consists of risk markers and drug candidates.
www.athera.se

Attana AB

Attana has developed a dual-channel biosensor for the automated analysis of biomolecular interactions for use in biomolecular research. With quartz crystal microbalance (QCM) core technology, the biosensor can be used to determine specificity, off-rates, kinetics, affinity, active concentrations and thermodynamics using crude samples of biomolecules of varying species.
www.attana.com

Axelar AB

Axelar focuses on research related to the insulin-like growth factor-1 (IGF-1) receptor inhibitors and their applications in human diseases, especially cancer. Axelar's overall objective is to develop innovative small molecule compounds that inhibit the IGF-1 receptor and use these to treat IGF-1 receptor-dependent diseases.
www.axelar.se

Avaris AB

Avaris develops new cell therapies for chronic infections, cancer and inherited diseases up to proof-of-concept in humans (Phase II). The company is based on four technology platforms within cell and gene therapy.
www.avaris.se

Atlas Antibodies

Atlas Antibodies is a biotech company that supplies the Prestige Antibodies® developed and validated by the Swedish Human Protein Atlas (HPA) Program.
www.atlasantibodies.com

Bactiguard AB

Bactiguard develops a solution for reducing all device-related hospital and care-acquired infections. The product Bactiguard® consists of an extremely thin noble metal alloy, with antimicrobial and biocompatible properties. The physical and chemical properties of the Bactiguard® coating make it applicable on any medical device.
www.bactiguard.com

Betagenon

Betagenon is a biotechnology company active in the discovery and early-stage development of novel, safe and effective therapies for treatment of obesity-related disorders including type 2 diabetes, fatty liver, disorders linked to hyperinsulinemia, and various forms of cancer.
www.betagenon.com

Beactica AB

Beactica utilizes its proprietary methodologies to evaluate the biophysical interaction of molecules in order to generate novel therapeutics. Beactica is also progressing its own drug discovery programmes.
www.beactica.com

BioArctic Neuroscience AB

BioArctic Neuroscience develops antibodies for treatment and diagnosis of disorders in the central nervous system based on the company's proprietary technology to make conformation-specific monoclonal antibodies.
www.bioarctic.se

Biotage AB

Biotage offers instruments, reagents and service in the area of medicinal chemistry, e.g. synthesis, purification, sample preparation and evaporation.
www.biotage.com

Biovitrum AB

Biovitrum develops and markets specialist pharmaceuticals in several global regions. The company focuses on the development and production of biotechnology therapeutics within hemophilia, inflammation/autoimmune diseases and malabsorption. In the future, Biovitrum and Swedish Orphan International will be combined forming Swedish Orphan Biovitrum.
www.biovitrum.com

Cogmed AB

Cogmed develops and markets software-based working memory training products for improving attention. The products are based on a combination of research in neuroscience, original software design and effective support methodology.
www.cogmed.com

C-Rad AB

C-RAD and its three subsidiaries supply products and solutions for radiation therapy.
www.c-rad.se

Crucell | SBL Vaccines AB

Crucell | SBL Vaccines (SBL) has in-house research, development and manufacturing capabilities in vaccines and markets its specialist vaccines internationally. SBL also distributes vaccine products from different manufacturers directly to customers in the Nordic markets.
www.crucell.se

Denator AB

Denator develops and markets instruments and consumables that stabilize biological tissues and fluids from the moment of sampling. The technology stops the degradation process and maintains sample stability.
www.denator.com

Diamyd Medical AB

Diamyd Medical conducts therapeutic development based on the GAD65 (Glutamic Acid Decarboxylase) molecule. The project developed furthest is the GAD65-based vaccine Diamyd for autoimmune diabetes. Diamyd Medical has demonstrated significant and positive results in a Phase II clinical trial.
www.diamyd.com

Dilafor AB

Dilafor develops pharmaceuticals from heparin with low anticoagulant activity (LAH). Tafoxiparin, a drug candidate void of anticoagulation properties, is an active substance for normalizing protracted labor that has demonstrated promising results in a Phase II clinical trial. Further research is ongoing to define other indications, e.g. diminishing severe clinical manifestations in malaria.
www.dilafor.com

Elekta AB

Elekta develops tools and treatment planning systems for radiation therapy and radiosurgery, as well as workflow-enhancing software systems across the spectrum of cancer care. Elekta is a world leader in image-guided and stereotactic clinical solutions for radiosurgery and radiation therapy and has its head office in Stockholm.
www.elekta.com

GE Healthcare Life Sciences AB

GE Healthcare Life Sciences offers systems and chemicals for the purification of biopharmaceuticals as well as a range of tools for protein and cellular research. It is part of GE Healthcare, with its broad range of products, service and expertise in medical imaging and information technologies, medical diagnostics, patient monitoring systems, performance improvement, drug discovery, and biopharmaceutical manufacturing technologies. GE Healthcare Life Sciences is headquartered in Uppsala.
www.gehealthcare.com

Gripping Heart AB

Gripping Heart is an early-stage company that has developed a platform for heart and circulatory diagnostics that fully describes all functions of the heart and the circulatory system mathematically, from the cellular level and up. The platform can be implemented in all kinds of existing cardiac medical devices in order to multiply information and reduce the source of errors related to the heart and circulatory system.
www.grippingheart.com

Gyros AB

Gyros develops, produces and markets Gyrolab for rapid analyses needed to optimize and execute immunoassays. Gyrolab is based on a microfluidic technology platform using only nanoliter volumes of reagents and sample.
www.gyros.com

IDL Diagnostics AB

IDL Diagnistics offers in vitro diagnostic tumor markers for various carcinomas, such as breast, gastrointestinal, lung and prostate cancers.
www.idl.se

iNovacia AB

iNovacia is a drug innovator providing discovery services to pharmaceutical and biotech companies. iNovacia specializes in accelerating the generation of preclinical candidates, applying technologies to build a strong foundation for the understanding of structure-activity relationships, biomarkers and predictive ADMET. iNovacia holds a number of CNS and metabolic diseases projects in the lead optimization phase, ready to be partnered.
www.inovacia.se

Isconova AB

Isconova develops its proprietary Immune Stimulating Complex (ISCOM) adjuvant technology. The ISCOM technology induces a strong, long-lasting immunological response and is used, for example, by vaccine producers to create and manufacture highly effective and safe vaccines, both for human and veterinary vaccine development.
www.isconova.se

Karo Bio AB

Karo Bio specializes in targeting nuclear receptors as target proteins for the development of novel pharmaceuticals. The company has a project portfolio that primarily targets dyslipidemia, diabetes, inflammation, and women's health.
www.karobio.se

Maquet Critical Care AB

Maquet Critical Care develops and manufactures ventilators for intensive healthcare. Maquet has three specialty Divisions: Surgical Workplaces, Critical Care and Cardiovascular.
www.maquet.se

Meda AB

Meda is an international specialty pharma company with a focus on marketing and pharmaceutical development in the late clinical phase. Meda's prioritized therapy areas are allergy/respiratory, cardiology, dermatology, pain/inflammation and CNS.
www.meda.se

Medivir AB

Medivir specializes in the understanding of proteases and polymerases and in the development inhibitor drugs for the treatment of diseases with a particular emphasis on infections. Medivir collaborates with both small biotechs and large pharmaceutical companies.
www.medivir.se

Mercodia AB

Mercodia develops, manufactures and markets in vitro diagnostic immunoassay kits based on ELISA assays for clinical as well as research applications. Areas addressed are cardiovascular disease, human and mammalian diabetes, and obesity.
www.mercodia.com

ModPro AB

ModPro has developed a proprietary concept for recognition and binding of proteins in vitro and in vivo that is used to design and produce synthetic binders for proteins for applications in diagnostics, drug development, molecular imaging and protein purification.
www.modpro.se

NeuroNova AB

NeuroNova has two drug candidates in clinical development for Parkinson's disease and ALS. NeuroNova is working with neurogenesis and neuroprotection for the treatment of several currently incurable neurodegenerative diseases.
www.neuronova.com

Novahep AB

Novohep is an early-stage company applying liver cells as a base for gene therapy of liver diseases such as Hepatitis C.
www.novahep.com

Oasmia Pharmaceuticals AB

Oasmia Pharmaceuticals develops a new generation of drugs with an emphasis on human and veterinary oncology. In addition, Oasmia holds a number of patents and candidates in other therapy fields including infection, asthma and neurology. The first product, Paclical® is in Phase III clinical trials in 2009. Paccal® Vet for treatment of cancer in dogs is in late Phase III clinical trials.
www.oasmia.com

Octapharma AB

Octapharma is a plasma fractionation specialist. Its core business is the development, production and sale of high quality plasma derivatives for treatment in coagulation disorders, immune disease and intensive care. Stockholm-Uppsala is home to the company's recombinant R&D department for recombinant manufacturing development.
www.octapharma.se

Olink Bioscience AB

Olink Bioscience controls significant IP-covering technologies related to detection and analysis of proteins and nucleic acids. The Duolink® product line is intended for in situ detection of proteins, protein interactions and protein modifications.
www.olink.com

Oncopeptides AB

Oncopeptides has developed a group of DNA-reactive (alkylating) peptides (DR-peptides). In vitro, the DR-peptides have proven to be effective against a number of different tumor types that are known to be resistant to other cytotoxic drugs. DR-peptide J1 is under evaluation in a phase I/IIa clinical trial.
www.oncopeptides.se

Orexo AB

Orexo develops and commercializes drugs for various therapeutic indications by combining well-known substances with innovative drug delivery technologies, resulting in new patentable drugs developed within a shorter time-frame. Orexo has partnering agreements for several of these projects with large global pharmaceutical companies.
www.orexo.com

Ortho Clinical Diagnostics

Ortho Clinical Diagnostics is a Johnson & Johnson company that delivers high quality in vitro diagnostic products. Through its acquisition of Åmic, OCD gained access to a technology platform in development for use in Point-of-Care (POC) and near-patient settings. The technology uses a chip-based micro-fluidic platform to enable fully-quantitative immunoassay tests in POC or near-patient settings, an advance in this area of diagnostics.
www.amic.se

Ortivus AB

Ortivus offers solutions for accurate medical treatment by combining expertise in wireless, IT and medical technology with clinical knowledge. One example is a support system for patient monitoring and decision-making in the area of acute cardiac disease and pre-hospital monitoring using bluetooth.
www.ortivus.se

Pfizer Health AB

Pfizer is the world's leading pharmaceutical company and its Swedish roots date way back, thanks to Pharmacia, which Pfizer acquired in 2003. Its Swedish production site in Strängnäs, which will be ready for use in 2010, will manufacture the world's most commonly used growth hormone as well as an anti-thrombotic.
www.pfizer.se

Phadia AB

Phadia develops, manufactures and markets complete blood test systems to support clinical diagnosis and monitoring of allergy, asthma and autoimmune diseases. Besides strategic management, administration and business development, the center in Uppsala incorporates research and development, production and a cold-store and distribution system. Phadia supplies seven out of ten allergy laboratory tests worldwide.
www.phadia.com

Premacure AB

Premacure, based in Uppsala, is a biopharmaceutical company dedicated to the development of diagnosis and prevention of complications in neonates due to premature birth. The first of several indications to be developed is retinopathy of prematurity, a retinal disease that is one of the major causes of blindness in infants throughout the world.

OxThera AB

OxThera is a clinical stage biotechnology company developing products, based on its cell and enzyme-based proprietary technologies, for metabolic disorders, i.e. hyperoxaluria and kidney stones, in indications such as primary and enteric hyperoxaluria (orphan drug area).
www.oxthera.com

Q-Med AB

Q-Med is a medical device company that develops, manufactures, markets and sells primarily medical implants. The majority of the products are based on the company's patented technology, NASHA, for the production of stabilized non-animal hyaluronic acid.
www.q-med.com

RaySearch Medical AB

RaySearch is a medical technology company that develops software for radiation therapy of cancer. The company's products are used to enhance the efficiency of radiation therapy by optimizing the radiation dose for each individual cancer patient.
www.raysearchlabs.com

Recipharm Biologics AB

Recipharm Biologics is a contract service provider supporting pharmaceutical companies and biotechs in the development and manufacture of mammalian cell culture-derived products for clinical trials. The facility holds a GMP license from the Swedish Medicinal Products Agency for the production of recombinant biological products.
www.recipharm.com

Ridgeview Instruments AB

Ridgeview Instruments is a university spin-off company developing, manufacturing and selling semi-automated instruments for analysis of protein-cell interactions.
www.ridgeviewinstruments.com

ScandiDos AB

ScandiDos offers quality assurance solutions for advanced radiotherapy to meet new advanced application demands.
www.scandidos.se

SentoClone AB

SentoClone develops a patented method to produce SentoClone®, a product where the patient's immune system is activated and strengthened to combat cancer. The white blood cells in the patient's blood are isolated and cultivated in a GMP laboratory setting to be given back later to the patient by means of an intravenous transfusion.
www.sentoclone.se

Spiber Technologies

Spiber Technologies is a start-up company, spun out of the Swedish University of Agricultural Sciences, that has developed spider dragline silk for a possible application in culturing insulin-producing cells.
Contact: www.sluholding.slu.se

St. Jude Medical AB

St. Jude Medical develops, produces and markets medical technology products and services within the fields of cardiac rhythm management, atrial fibrillation, cardiac surgery, cardiology and neuromodulation. The company recently acquired Uppsala-based Radi Medical Systems, adding complementary products in the cardiovascular segments.
www.sjm.se

Svanova Biotech AB

Svanova offers a wide range of products for diagnosing infectious diseases in livestock for large-scale laboratories and for clinical and practical veterinarians. The majority of the products, based on ELISA technology, detect antibodies against viruses, bacteria, parasites or mycoplasmas in various animal species.
www.svanova.com

Syntagon AB

Syntagon is a contract research organization (CRO) for preparation, analysis and documentation of small molecules for use in clinical and pre-clinical studies. Capabilities include up-scaling, analytical development and GMP-manufacturing of clinical material as well as supply of mg and gram quantities for pre-clinical development.
www.syntagon.se

TikoMed AB

TikoMed is focusing on the development and commercialization of innovative treatment of auto-immune and inflammatory diseases and cell therapies. Advanced innate immunology is applied to identify mechanisms and develop new products.
www.tikomed.com

Uppsala Imanet

Uppsala Imanet, part of GE Healthcare, is built principally around Positron Emission Tomography (PET), a quantitative imaging technology that provides information on biochemical and physiological processes and drug-receptor interactions at a molecular level in the brain.
www.imanet.com

Vironova AB

Vironova is developing a potent class of antivirals called maturation inhibitors. Proof-of-concept has been shown against all eight human herpes viruses. Two further projects have been initiated against influenza and HIV. Based on proprietary technology to analyze viruses in digital images acquired by transmission electron microscopy (TEM), Vironova also provides services for the pharmaceutical industry, cutting time and costs in viral-related R&D and production of biologicals.
www.vironova.com

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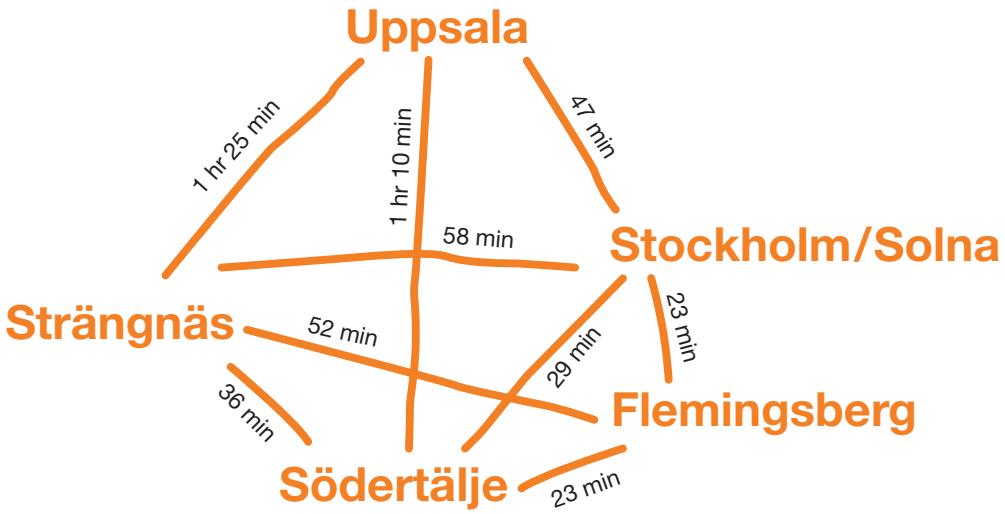

Source Eniro.se Sept 2009

Over 50% of Sweden's life-science sector is concentrated in the Stockholm-Uppsala region.

LIFE SCIENCE

STOCKHOLM - UPPSALA LIFE SCIENCE

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STOCKHOLM-UPPSALA LIFE SCIENCE WAS FOUNDED BY THE CITY OF STOCKHOLM, UPPSALA BIO AND BIOTECH VALLEY TO SHOW OUR REGION'S OPPORTUNITIES TO THE GLOBAL LIFE SCIENCE COMMUNITY.