

The Finnish Programme for Centres of Excellence in Research is one of the key funding instruments through which the Academy of Finland seeks to promote the development of creative research environments. The third Centre of Excellence Programme in 2006–2011 involves 23 units, all at the international cutting edge in their respective fields. This brochure describes how the Academy implements the national Centre of Excellence strategy and introduces the Centres of Excellence appointed for the 2006–2011 term.

Partners 2006–2011



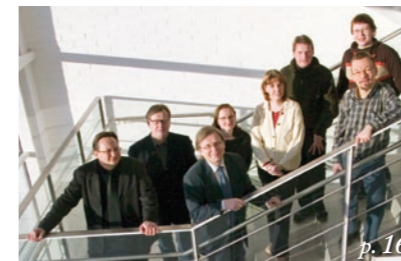
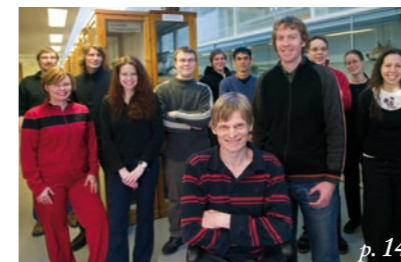
Finnish Programme for Centres of Excellence in Research 2006–2011

AT THE CUTTING EDGE
OF FINNISH RESEARCH


ACADEMY OF FINLAND
RESEARCH FUNDING AND EXPERTISE

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ACADEMY OF FINLAND
RESEARCH FUNDING AND EXPERTISE



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ACADEMY OF FINLAND – A MAJOR RESEARCH FUNDING AGENCY

The Academy of Finland provides funding for high-level basic research. All its funding decisions are based on external peer reviews and science policy expertise. The Academy's aim is to ensure that the results of research are put to use in society in the interests of welfare, culture, the economy and the environment. Its priorities include the promotion of internationalisation as well as close collaboration between the research community and funding bodies.

Each year more than 5,000 people work on Academy funding, which amounts to more than 240 million euros annually.

Centres of Excellence: roots and fruit of cooperation

National Centre of Excellence Programmes are among the most important means of financing internationally cutting-edge research. A Centre of Excellence (CoE) is a research and researcher training unit that shares a clearly defined set of research objectives and works under a common management. The unit may consist of one or more high-level research teams based at a university, research institute or at several different organisations, and possibly has cooperation with business companies.

CoEs are funded for a period of six years, which means that they are well placed to venture into totally new research and even to take risks. This is particularly important in technically oriented lines of research where funding typically is provided only for shorter periods. The funding comes not only from the Academy, but also from the host organisations of the CoEs, i.e. universities and research institutes. In addition, Tekes as well as a number of foundations and business companies have committed to providing contract-based funding.

Both the public and private sector benefit from the transfer of know-how from CoEs. There is a growing opinion that CoEs should work more closely with business and industry. As well as putting research results to use in practical applications, businesses can themselves get involved in research by networking with a CoE or even by operating as part of a CoE.

In this kind of setting researchers can flexibly move from one research team to another. Long-term co-operation between the science community, business and industry, public administration and research funding bodies also helps to boost the international competitiveness and impact of Finnish research.

Out into the world and back again

Researchers are keen to find the best possible partners so that they are in the best possible position to promote their own work. Research at the cutting edge is therefore characteristically an exercise in international cooperation that also requires national funding.

The Academy of Finland has bilateral agreements with science funding agencies and research organisations in India, Japan, China and many other countries. These agreements provide a solid foundation for the funding of cooperation between Centres of Excellence. Support is provided for long-term research cooperation, researcher mobility and training as well as for organising joint seminars and scientific meetings. CoEs have worked to promote not only the international visibility of research and international cooperation, but also multidisciplinary and interdisciplinary cooperation.

A decade of Centres of Excellence

On the Academy's proposal, the Ministry of Education appointed the first twelve Centres of Excellence in research for the 1995–1999 term; five further units were subsequently appointed for 1997–1999. During the first years of the new system there was no funding specifically earmarked for this purpose, but in 1997 dedicated funds were made available through the Government's additional funding programme and allocated to the CoEs via the Academy. The National Strategy for Centres of Excellence in Research was developed and adopted in 1997. The strategy is based on general principles of national science and technology policies, which are aimed at raising the quality, strengthening the international

| 1995–1999 • 17 Centres of Excellence | | | | | 2002–2007 • 16 Centres of Excellence | | | | | 2008–2013 • in preparation | | | | | | | | |
|--------------------------------------|------|------|------|------|--------------------------------------|------|------|------|------|----------------------------|------|------|------|------|------|------|------|------|
| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| | | | | | Present-form Centres of Excellence | | | | | | | | | | | | | |

competitiveness and increasing the visibility and esteem of Finnish research. Responsibility for the development and implementation of this strategy rests with the Academy of Finland.

In the first Finnish Centre of Excellence Programme in 2000–2005, funding was provided for 26 CoEs and seven core facilities organisations. A core facilities organisation comprised at least one CoE and other high-level research teams for which the organisation provided various support services.

Academy funding for this programme amounted to 54.8 million euros. The Finnish Funding Agency for Technology and Innovation (Tekes) gave 10.8 million euros to eleven units.

The second Centre of Excellence Programme in 2002–2007 involves 16 units, to which the Academy has granted a total of 33.1 million euros. Tekes has earmarked 5.3 million euros to finance six units in the programme. Both the Academy and Tekes also provide other competitive funding to the CoEs and their projects.

A new generation of Centres of Excellence

The third national Centre of Excellence Programme runs from 2006 through to 2011. The programme involves 23 units: seven are complete newcomers, 16 were funded in the first Centre of Excellence Programme but have now revised their research plans in many ways. During 2006–2008 the Academy will be spending 28.5 million euros to finance

the third Centre of Excellence Programme. Tekes is contributing 2.0 million and Nokia 0.3 million euros.

A total of 143 units applied for participation in the third Centre of Excellence Programme, and 53 went through to the second round on the basis of international expert statements and the Academy's science policy decisions. At the second stage the applications were reviewed by international experts, who also made visits to the units concerned. The evaluation criteria included the scientific quality and innovativeness of the research plan, the general action plan, researcher training and research environment as well as the scientific merits of senior researchers on the team.

There are ever more high-level research groups in the country, and therefore the selection of the final Centres of Excellence in the third round was extremely difficult. For reasons of programme dynamics and renewal, many of the units involved in the 2000–2005 Centre of Excellence Programme are not financed in this new programme, even though the quality of their research is at least as good as before. In other words, the heavy investments made in research over the past few years have clearly paid off: Finnish research shows a stronger multidisciplinary orientation than before, it enjoys greater international exposure, it is nationally and internationally better networked and it is also more competitive than before.

For more information on Centres of Excellence and the National Strategy for Centres of Excellence in Research go to www.aka.fi/coe

CENTRES OF EXCELLENCE (CoE) IN RESEARCH 2006–2011

Centre of Excellence in Evolutionary Research

*Director: Academy Professor Rauno Alatalo
University of Jyväskylä*

The CoE bases its work on a novel concept of evolution. The new paradigm has it that evolution and adaptation may also be a rapid and dynamic process, which is constrained by complex genetic, ecological and environmental interactions. Research projects at the CoE are concerned, among other things, to identify the kind of factors that maintain variation in viability characteristics and to explore the role of sexual selection in this process. Other research concerns include analyses of various evolutionary phenomena, such as the onset of the evolution of conspicuous signals and the role of selection in host-parasite and predator-prey co-evolution. The CoE uses the results of its research to develop insecticides for pest control and improve the management of game bird populations.

Centre of Excellence in Cancer Biology

*Director: Academy Professor Kari Alitalo
University of Helsinki*

The CoE consists of five research teams whose major aim is to analyse the DNA damage in human cancer, its growth regulation, vascular and lymphangiogenesis and stem cells. The CoE will be working to identify new mechanisms that regulate the growth and transformation of cancer and testing their relevance in mouse models and further in pre-clinical trials with potential translational and therapeutic applications.

The CoE has access to broad and innovative approaches of functional genomics that will also allow researchers to identify factors driving changes in new genes and to evaluate their importance in vivo in human tumours and mouse models. In addition, the CoE will be using new technological applications, such as molecular image analysis.



Centre of Excellence in Signal Processing

*Director: Academy Professor Jaakko Astola
Tampere University of Technology*

The CoE has specialised in several modern areas of signal processing. It is involved in developing fundamental theories and efficient algorithms for the translation of theories and models into usable tools for real world applications. The study of fundamentals will be extended into two rapidly developing areas: multimedia applications and the modelling of biological systems. Signal processing provides a way to create and improve techniques and tools for the analysis of measurement data, natural communication between humans and a deeper understanding of the dynamic processes of living organisms and systems.

Finnish Centre of Excellence in Virus Research

*Director: Academy Professor Dennis Bamford
University of Helsinki, University of Jyväskylä*

The CoE is interested to explore enveloped viruses which infect bacteria and archaea. Its aim is to describe the essential nature of these membrane-containing viruses. In addition, researchers at the CoE are working to develop new methods for analysing the structure of viruses. Information on virus

structure is used among other things to study virus evolution and how viruses are related to each other. The CoE includes experts in the fields of microbiology, genetics, biochemistry, biophysics and structural biology.

Centre of Excellence in Ancient Greek Written Sources

*Director: Professor Jaakko Frösén
University of Helsinki*

The CoE is concerned to study ancient and medieval Greek writings that have received only little attention in previous research. The projects are aimed at saving, conserving, publishing and interpreting sources that in earlier studies have been considered particularly challenging for example on account of the way they have been preserved; examples include mummy cartonnages and carbonised papyri.

The CoE's five research projects are: Papyri research and Excavations at the Monastery of St. Aaron in Petra, Jordan; the Library of the Greek-Orthodox Patriarchate of Alexandria; Stone-inscribed Greek poetry; and Substandard Greek and Latin in contact situations of the ancient languages.

Finnish Centre of Excellence in Metapopulation Research

*Director: Academy Professor Ilkka Hanski
University of Helsinki*

The CoE is concerned to research both empirically and theoretically the ecological and evolutionary consequences of fragmentation from molecular level to landscape level. Habitat fragmentation is often caused by human activity and therefore research results are also needed in regional land use planning and nature conservation. Besides ecologists, the CoE also involves researchers from the fields of molecular biology, mathematics and computer science.



Centre of Excellence in Systems Neuroscience and Neuroimaging Research

*Director: Professor Riitta Hari
Helsinki University of Technology, University of Helsinki*

The CoE is developing new brain imaging methods with the goal to provide more in-depth understanding of the functions of the human brain at the systems level. Researchers at the CoE study brain functions in both adults and children. The research spans a broad range of issues from sensory systems, cognition, emotion and language to social interaction. The CoE is also developing clinical applications that facilitate rehabilitation of stroke and brain tumour patients. The basic research carried out at the CoE helps to understand the brain basis of reading disorders (dyslexia), eating disorders and chronic pain.

Centre of Excellence in Process Chemistry

*Director: Mikko Hupa
Åbo Akademi University*

At the foundation and core of the CoE's work are its unique analytical capabilities, experimental laboratory techniques, advanced chemical engineering models and a good understanding of the technical state and challenges of modern industrial processes. The CoE will make new research openings: among other things, researchers at the CoE will study the potential of ionic liquids in process chemical applications. New functions will also be planned for chemicals and fibres in papermaking.

Finnish Centre of Excellence in Nuclear and Accelerator Based Physics

*Director: Professor Rauno Julin
University of Jyväskylä*

The Finnish Centre of Excellence in Nuclear and Accelerator Based Physics is built around the experimental and theoretical research conducted at the University of Jyväskylä Accelerator Laboratory.

Experimental research in nuclear physics is concerned with such questions as the development of elements in the universe, the maximum number of nucleons in a nucleus, the dependence of inter-nucleon forces on the proton-neutron relationship, and the associations of the collective properties of the nucleus with the movement of individual nuclei.

Experimental applied research works to develop new, more effective methods for the production of ion beams, new ion beam applications as well as new equipment for industrial and research purposes. Ion beams are also used to produce 3D structures that are of particular interest to nanotechnology and cell research.

The focus of theoretical research includes such questions as the role of the atom's nucleus in detecting the neutrino mass and dark matter.

Finnish Centre of Excellence in Translational Genome-Scale Biology

*Director: Academy Professor Olli Kallioniemi
VTT Finland, University of Turku, University of Helsinki*

The CoE is concerned to study the impacts of the human genes on cell growth and premature ageing. The CoE will be using the results of these studies to identify cancer genes and to translate genome-scale discoveries towards diagnostics and therapeutics. In addition, researchers at the CoE will be working to develop new technologies for cell-based functional screening. The CoE is a multidisciplinary unit working in the fields of bioscience, medicine, information technology and engineering.



Centre of Excellence in Computational Complex Systems Research

*Director: Academy Professor Kimmo Kaski
Helsinki University of Technology*

The CoE is interested to study complex systems appearing in the physical, biological and social world. A complex system is one whose function cannot be fully understood simply by looking at its constituent parts. Research at the CoE is divided into four areas involving both work to develop theoretical models and methods for the study of complex systems and practical applications for such fields as systems biology and cognition research.

Centre of Excellence in Global Governance Research

*Director: Professor Jan Klabbers
University of Helsinki, University of Turku*

Globalisation is seen as both a threat and an opportunity. The CoE takes a broad view on globalisation and questions of global governance so as not to be overly constrained by the methods and approaches of individual disciplines. Researchers at the CoE include scholars from as diverse fields as international politics, international law and social anthropology. Aiming innovatively to integrate the perspectives of different disciplines, the CoE is working to research global governance and its organisation for purposes of political decision-making

Centre of Excellence for the Study of Variation, Contacts and Change in English

*Director: Professor Terttu Nevalainen
University of Helsinki, University of Jyväskylä*

The CoE for the Study of Variation, Contacts and Change in English (VARIENG) investigates language as a social and discursive phenomenon, processes of linguistic change and variation typology. Research into language use in contact situations is focused, for instance, on relations between English and the national languages of Finland. VARIENG crosses disciplinary boundaries by integrating into the study of language approaches and methods from other fields such as social history, culture and learning research, and computer science.

Centre of Excellence in Computational Nanoscience

*Director: Academy Professor Risto Nieminen
Helsinki University of Technology*

Specialising in theoretical and computational research on nanoscience materials, structures and components, the major research interests of the CoE include the electronic properties of materials and nanostructures, the quantum physics of multiple-particle phenomena, and the nanostructures of surfaces and interfaces. Research at the CoE is broadly based and covers phenomena that vary in size from the atom level to the macro world. As well as engaging in research the CoE produces various practical applications.

Centre of Excellence in Evolutionary Genetics and Physiology

*Director: Professor Mikko Nikinmaa
University of Turku, University of Helsinki*

The CoE aims to cross traditional biological boundaries in evolution research, which includes studies on questions related to local adaptation, natural selection and species evolution. The CoE intends to concentrate specifically on species whose ecology is



well known but whose genomes and physiological responses are poorly understood. The CoE has three research teams that represent ecological genetics, evolutionary and environmental physiology, and molecular ecology and evolution.

Finnish Centre of Excellence in Learning and Motivation Research

*Director: Professor Jari-Erik Nurmi
University of Jyväskylä*

The CoE in Learning and Motivation Research brings together two lines of research that are interested in learning difficulties, i.e. neuropsychological research and motivation studies. The integration of these two formerly separate fields is expected to create a stronger foundation for exploring how learning difficulties develop in the family and school environment and how they affect the child's subsequent school career. The results will help to develop new ways of preventing learning difficulties both at home and at school. The CoE consists of two research teams that are based at the University of Jyväskylä. Researchers from Joensuu and Turku universities are also involved in the CoE's work.

Finnish Centre of Excellence in Adaptive Informatics Research

*Director: Professor Erkki Oja
Helsinki University of Technology*

Adaptive informatics is a field of research within information technology where the aim is to discover relevant and informative concepts, components and their mutual relations from large amounts of data. The goal is to make information more compact and accessible for the end-user. Automated learning algorithms are used to handle the large amounts of data.

The CoE is aiming to build systems that process multimodal contextual information including spoken and written language, images, videos and explicit and implicit user feedback. Refining these kinds of data requires not only pattern recognition, image processing and speech recognition, but also cognitive scientific procedures. The CoE will also develop and apply its algorithmic methods to problems in neuroinformatics and bioinformatics together with experts in brain science and molecular biology. The methods will also be introduced in practice with the help of national business companies.



Centre of Excellence in Low Temperature Quantum Phenomena and Devices

*Director: Professor Mikko Paalanen
Helsinki University of Technology,
VTT Technical Research Centre*

At low temperatures, physical systems eventually condense into their quantum mechanical ground state, and may exhibit extraordinary properties. Known examples are, for instance, the superconducting state of metals, in which the electric current flows lossless, and the superfluid state of helium, in which the flow is lossless. Both are examples of macroscopic quantum-mechanical phenomena that occur at low temperatures.

The CoE investigates quantum phenomena, both in extremely ideal continuous media, such as helium liquids and crystals, and in metallic nanostructures. The goal is to produce quantum electronic components with sensors based on superconducting structures as the important circuit elements.

Centre of Excellence in Political Thought and Conceptual Change

*Director: Professor Kari Palonen
University of Jyväskylä*

The CoE consists of three research teams. The Political Thought and Conceptual History team includes both historians and political researchers, who will be aiming to reach across the boundaries of their disciplines. Researchers in the Politics and the Arts team will analyse different art genres as political activity.

The Politics of Philosophy and Gender team will be approaching the themes of gender and sexuality from a political vantage point.

The CoE will take an active part in both the academic and public debate on politics and hopes that its research will improve political literacy.

Finnish Centre of Excellence in Plant Signal Research

*Director: Professor Tapio Palva
University of Helsinki*

All living organisms need to react to both internal and external cues and to reprogramme their gene expression accordingly. Research at the CoE is aimed at understanding how environmental and developmental cues are integrated in plant growth control. The purpose is to gain a deeper understanding of plant signal networks and molecular interactions between signal pathways.

The CoE integrates research in functional genomics, structural biology and bioinformatics with modern plant physiology, genetics and cell biology. The purpose of this multidisciplinary approach is to gain a mechanistic understanding of plant signalling and signal networks.

Centre of Excellence in Complex Disease Genetics

*Director: Academy Professor Leena Peltonen-Palotie
National Public Health Institute, University of Helsinki, Folkhälsan, Karolinska Institutet*

The CoE aims to produce novel understanding of the biological as well as life-style and environmental risk factors predisposing to common human diseases. The main focus of the CoE's research is on disorders of central nervous and cardiovascular systems. The CoE will be working to explore the genetic background of these diseases and their trait components with the aim of increasing our understanding of the relationship between genetic as well as lifestyle and environmental risks. Using the results of its studies, the CoE expects to build up databases and develop novel biocomputational and biostatistical methods for risk profile analyses.

Finnish Centre of Excellence in Computational Molecular Science

*Director: Professor Pekka Pyykkö
University of Helsinki*

The CoE is concerned, firstly, to develop and apply new theoretical and computational methods in molecular science. Secondly, its aim is to predict and identify new molecules and nanoclusters. The third goal is the multiscale modelling of reactions of atoms and small molecules to each other and to surfaces, and its fourth goal is to study the quantum chemistry of extended systems.

Finnish Centre of Excellence in Inverse Problems Research

*Director: Professor Lassi Päivärinta
University of Helsinki, University of Kuopio,
Helsinki University of Technology, University of Oulu, Lappeenranta University of Technology*

An inverse problem is defined as a problem of recovering information from indirect, incomplete or noisy observations by means of mathematical models. Inverse problems are one of the most important and topical fields of applied mathematics. The CoE represents the leading inverse problems research unit in the world, bringing together several internationally highly respected groups in Finland. It provides new applications for example in medical imaging, space studies and industrial material testing. The CoE consists of five research teams.

A NEW PERSPECTIVE ON THE MECHANISMS OF CANCER



*Finnish Centre of Excellence in
Translational Genome-Scale Biology
Director: Academy Professor Olli Kallioniemi
VTT Finland, University of Turku,
University of Helsinki*

Human genome contains about 25,000 genes, which constantly control the activity of about half a million protein molecules in our cells.

“Most diseases, such as cancer, are caused by a large number of mechanisms that can’t be explained by studying genes one at a time,” states Academy Professor Olli Kallioniemi, who heads the Finnish Centre of Excellence in Translational Genome-Scale Biology.

The unit’s target is to create a comprehensive picture of the mechanisms that influence the onset and progress of cancer, and to look for new treatments based on the so-called systems biology research approach. Systems biology involves large-scale comprehensive laboratory experiments with data analysis in order to mathematically model and explain

cellular processes, such as how genes are transcribed and translated into proteins and how proteins interact with one another.

“The typical properties of a cancer cell include the disruption of three control mechanisms – growth, senescence and death. Growth is uncontrolled, senescence doesn’t occur, meaning the cell remains young forever and doesn’t die as a normal cell does after a certain lifecycle,” explains Kallioniemi.

“Now that we know most human genes, there are better opportunities for a comprehensive analysis and understanding of their role in the disease processes. We’re focusing on the molecular dissection of cell growth, senescence and death, as the deregulation of these processes is likely to lead to cancer development.”

Interdisciplinarity of research

The extensive utilisation of genome information requires input from many different fields of science. The CoE is made up of six research teams that combine biosciences, medicine and engineering and include the research input of more than one hundred people. Many of the researchers have already completed their doctorates or are senior researchers at VTT’s Turku unit, Biomedicum at the University of Helsinki or the Turku Centre for Biotechnology. In addition, there are almost 50 PhD students.

“These disciplines all need each other. Our research problems at the cellular level are biological, but very relevant to medical needs. We use genetic engineering tools and state-of-the-art biotechnological methods to examine the cells and will also translate the findings towards medical and industrial applications, such as in the form of diagnostic and therapeutic leads. The categories aren’t strictly defined, instead we carry on active dialogue and influence each other,” says Kallioniemi.

The CoE also considers various means of commercialisation.

“We combine basic and applied research and our intention is to develop innovations further in the value chain than is traditionally done in academic research. This helps to bridge the gap between academic research and industrial development. The fact that we’re bringing two universities and a government technology research institute, VTT Technical Research Centre of Finland, together in the same unit is meant to open new avenues for translational research and development,” explains Kallioniemi.

Becoming a CoE is no easy task. “The preliminary phase takes about a month of work, followed by another two months in the second application phase. Then it’s time for the site visit”, he says. “However, the overall benefit and importance of the Centre of Excellence system is significant both for the research consortium and the host organisations. It provides a long-term funding opportunity and makes it possible to consolidate the domestic element of top-level research, both within the Centre of Excellence and, hopefully, increasingly also between Centres of Excellence.”

NEW CENTRE OF EXCELLENCE HOUSES BROAD-BASED EVOLUTIONARY RESEARCH

*Centre of Excellence in
Evolutionary Genetics and Physiology
Director: Professor Mikko Nikinmaa
University of Turku, University of Helsinki*



The Centre of Excellence in Evolutionary Genetics and Physiology is one of the national Centres of Excellence in research selected by the Academy of Finland for 2006–2011.

“We study the link between genotype and phenotype and the significance of function-heritability interactions for vertebrate adaptation, population differentiation and ultimately speciation. A key question is how the functions of individuals adapt to environmental changes such as global warming, and which functional responses are heritable,” says Professor Mikko Nikinmaa from the Department of Biology at the University of Turku. Nikinmaa heads the new Centre of Excellence in Evolutionary Genetics and Physiology.

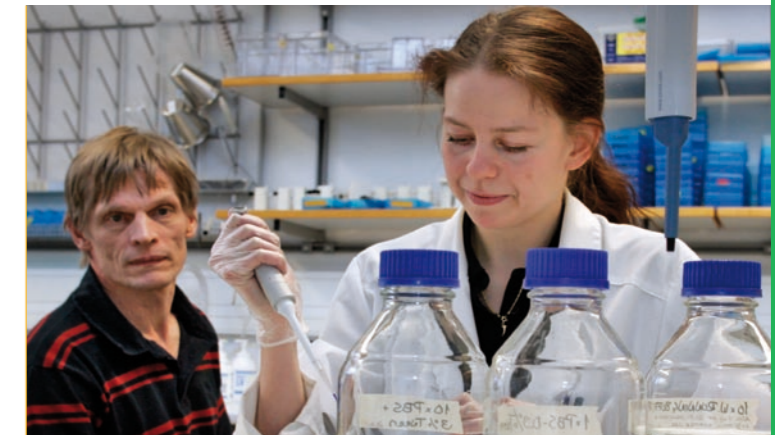
“We’re combining ecological, evolutionary, physiological and genetic vertebrate research in a single unit for the first time in Finland. Separately, much research has been conducted in all these fields, but often, for instance, with a tendency to jump directly from the genetics of populations to population biology.”

This work will help in laying the foundation for practical environmental management and protection – a point that Nikinmaa feels is one of the cornerstones of the unit.

Starring birds, frogs and fish

The major research subjects of the CoE are birds, frogs and fish, i.e. groups of organisms that are of interest from the viewpoint of ecology, evolution and environmental protection. With regard to birds, the focus is on pied and collared flycatchers and red-billed gulls. Studies aim to answer questions such as: Why is there no interbreeding between closely related species? How do the species differ from each other genetically? Are the genetic differences between species functionally important?

Studies on frogs explore how changes in the environment are seen in the genotype and in functional characteristics, with stress proteins as one studied factor. The target area is Fennoscandia, which provides a good research setting with its extensive



north-south dimension providing a wide diversity of environmental conditions.

Inland water grayling has long been the subject of studies of population genetic structure and the impact of natural selection on population divergence. In the future, similar studies will also be carried out on Baltic Sea salmon and three-spined stickleback. Key questions include: What are the causes of population level differences and have populations adapted to their local environment?

High hopes for the research

The Centre of Excellence in Evolutionary Genetics and Physiology brings together three research teams that represent the international cutting edge in their fields. Professor Juha Merilä’s team (at the University of Helsinki) studies ecological genetics, Professor Craig Primmer’s team (at the University of Turku) studies molecular ecology and evolution, and Professor Mikko Nikinmaa’s research team studies evolutionary and environmental physiology.

The teams comprise in total some 30 experts in different fields: mathematicians, statisticians, physiologists, geneticists and ecologists. The teams include researchers from almost ten different countries and they also cooperate actively with researchers worldwide.

Nikinmaa finds the selection of his unit into the centre of excellence programme very significant, since it increases the prestige of work done in the field. He also much appreciates the long-term funding: the teams can now focus on research, instead of the annual writing of proposals.

LEARNING AND MOTIVATION RESEARCHERS BROUGHT TOGETHER

*Centre of Excellence in
Learning and Motivation Research
Director: Professor Jari-Erik Nurmi,
University of Jyväskylä*



Learning difficulties make it hard for children to progress in their studies, and may also have a negative effect later in life – resulting in, for instance, anxiety, behavioural problems and even social exclusion.

That is how Jari-Erik Nurmi, Professor of Psychology from the University of Jyväskylä, describes the framework and need for research on learning difficulties. “The topical nature of this issue is accentuated by the fact that many professions in modern-day society require a long period of education and many different skills,” he adds.

Nurmi heads the Learning and Motivation Research Unit that is included in the Finnish Centre of Excellence Programme 2006–2011.

Knowledge and tools

Key research questions for the Centre of Excellence in Learning and Motivation Research are: How do learning difficulties and low learning motivation develop at home and at school? How do they reflect on later educational choices and difficulties?

“In addition to increasing our understanding of learning and learning difficulties, the target is to develop practical methods, such as educational and training programmes, that can help prevent learning difficulties. For example, we’re studying whether an appealing Internet game would help children practise the necessary skills and conquer their learning difficulties,” explains Professor Heikki Lyytinen from the University of Jyväskylä, Vice Director of the CoE.

Another important question is how the beliefs and actions of teachers and parents affect a child’s learning and the onset of learning difficulties – and vice versa: how a child’s success and learning difficulties influence teachers’ beliefs and actions. The

target of this research sub-project is some 200 children and their parents and teachers. Some of the children have been diagnosed with learning difficulties.

An opportunity for major breakthroughs

The research unit originally comprised two teams operating in the field of psychology at the University of Jyväskylä, one specialised in studying the neuro-psychological and cognitive foundation of learning difficulties and the other in learning motivation.

Experts in preschool, elementary and special education, experts in the related fields of psychology and education as well as statistics professionals have supplemented the teams.

In the future, a group of some 50 people will be working with learning and motivation research. Be-

sides the University of Jyväskylä, the Universities of Joensuu and Turku are also involved, as well as experts from outside Finland.

“Our concept, i.e., the combination of neuro-psychological research with learning and motivation research, is a rare event, even in global terms. As a result of long-term funding, it should lead to major breakthroughs in the challenging research field of learning difficulties,” Nurmi assesses.



SIFTING OUT THE RELEVANT FROM THE FLOOD OF INFORMATION



*Centre of Excellence in
Adaptive Informatics Research
Director: Professor Erkki Oja
Helsinki University of Technology*

“I’ve always been fascinated by intelligence as a ‘physical’ phenomenon, by how it’s founded and how it could be simulated in computer software,” says Professor Erkki Oja, who heads the Centre of Excellence in Adaptive Informatics Research (2006–2011) at Helsinki University of Technology in Espoo.

It is indeed on answering these kinds of IT-related questions that the research team under Professor Oja is currently focusing its attention. Adaptive informatics is a field of research that uses automated learning algorithms to analyse large bodies of data and to make them more compact and easily accessible to end-users.

“It seems the world is changing in a direction where our line of research is becoming ever more important. As the volume of digital data continues to increase, we’re in danger of becoming swamped by a flood of information.”

Professor Oja’s unit has set itself the target of producing cutting-edge research: the aim is to make genuine scientific breakthroughs that attract global attention. However, there are also practical applications, either directly or as a research by-product. The methods developed by the unit are put into practice in close partnership with business companies.

Key areas of application include speech recognition or the conversion of digital speech into text, and more recently the analysis of text corpuses, particularly translation.

“The computer program ‘reads’ huge volumes of texts and automatically creates a model of the content and language structure. This provides a stepping stone to highly efficient statistical language

models that can be used in computer-based speech recognition, for example. One application of these models is for purposes of text-based searches in speech data that haven’t been transcribed.”

Other areas of application include searches from major image and video databases, bioinformatics and neuroinformatics, and the automatic processing of gene databases and biomedical measurement data. Industrial applications include the analysis of measurement data in processing industries.

“I was keen to joint this research unit because it’s the most advanced in Europe and probably one of the best in the whole world. Besides, Finland invests more heavily in research than most other countries.”

Dr Amaury Lendasse from the Université catholique de Louvain, Belgium

Wide-ranging expertise and international cooperation

The adaptive informatics research team has a staff of four professors, 20 postdoctoral researchers and 40 postgraduate students with a Master’s degree in information technology, physics, bioinformatics or language technology. There are twelve foreign researchers on the team.

“Good research depends above all on good students and on good organisation. In the supervision of postgraduate

students it’s also necessary to have good contacts both at home and abroad with universities as well as with industry,” Professor Oja points out.

“We have a few world-class researchers and several promising young talents. Together, they give us a good reputation, they inspire young people and attract excellent visiting scholars from the outside. Strong international contacts are essential for knowing how and where to focus our research and for measuring its current standard. If you’re aiming for the top, you need to choose your partners from the very best.”

CENTRES OF EXCELLENCE IN RESEARCH 2006–2011

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CENTRES OF EXCELLENCE IN RESEARCH 2002–2007

- Applied Microbiology Research Unit
- Bio- and Nanopolymers Research Group
- Centre for Environmental Health Risk Assessment
- Centre of Excellence for Research in Cardiovascular Diseases and Type 2 Diabetes
- Centre of Population Genetic Analyses
- Developmental Biology Research Programme
- Finnish Research Unit for Mitochondrial Biogenesis and Disease (FinMIT)
- Formal Methods in Programming
- From Data to Knowledge Research Unit
- Helsinki Brain Research Centre
- History of Mind Research Unit
- Research Unit of Geometric Analysis and Mathematical Physics
- Research Programme on Male Reproductive Health
- Research Unit on Economic Structures and Growth
- Research Unit on Physics, Chemistry and Biology of Atmospheric Composition and Climate Change
- Smart and Novel Radios Research Unit

CENTRES OF EXCELLENCE IN RESEARCH 2000–2005

- Ancient and Medieval Greek Documents, Archives and Libraries
- Cell Surface Receptors in Inflammation and Malignancies
- Center for Activity Theory and Developmental Work Research
- Centre of Excellence in Disease Genetics
- Computational Condensed-matter and Complex Materials Research Unit
- Evolutionary Ecology
- Helsinki Bioenergetics Group
- Institute of Hydraulics and Automation
- Low Temperature Laboratory: Physics and Brain Research Units
- Molecular Biology and Pathology of Collagens and Enzymes of Collagen Biosynthesis
- New Information Processing Principles
- Nuclear and Condensed Matter Physics Programme at JYFL
- Plant Molecular Biology and Forest Biotechnology Research Unit
- Program in Cancer Biology, Growth Control and Angiogenesis
- Programme of Molecular Neurobiology
- Programme on Structural Virology
- Research Centre for Computational Science and Engineering
- Research Unit for Forest Ecology and Management
- Research Unit for Variation and Change in English
- Research Unit on the Formation of Early Jewish and Christian Ideology
- Signal Processing Algorithm Group
- The Human Development and Its Risk Factors Programme
- The Metapopulation Research Group
- Tissue Engineering and Medical, Dental and Veterinary Biomaterial Research Group
- VTT Industrial Biotechnology
- Åbo Akademi University Process Chemistry Group

For more information go to www.aka.fi/coe