Strategies for Stockholm University
2019–2022
Artificial intelligence and digitalisation, climate crisis and sustainability issues, migration and integration, knowledge resistance and populism, democracy and human rights – many things are coming to a head in these changing times. The university’s task is to stand firmly grounded in their centuries-old tradition, present in the now, looking towards the future. Students, teachers and researchers develop the university together and contribute to society with science-based knowledge.

Stockholm University has identified 16 profile areas, each of which includes several large and strong research environments with comprehensive education. Together, these profile areas demonstrate what we are: a research university largely characterised by independent basic research.

The University’s strategies set out the overall direction for the next four years. They are a common starting point for the area-specific strategies developed for Science and Human Science. The central strategies are complemented by a two-year action plan, and action plans are also being developed within the two scientific areas as well as for operational support. All action plans are continuously followed up.

Stockholm University strives to have internationally competitive research and education. With the highest number of students in Sweden, and with our strong basic research profile, we also have a central role in society. Follow-up reviews show that our position is strong, but we must continue to constantly develop quality across our operations. I hope that these strategies will contribute to a continued positive development for the University, as well as for higher education and research in the capital city.
The idea of a modern university in the spirit of the Enlightenment has characterised Stockholm University ever since its inception. With roots in Europe’s millennial tradition, the universities are closely associated with the evolution of science and today’s knowledge society. Throughout history, society has changed fundamentally; higher education has gone from being reserved for a privileged elite to being a possibility for everyone, and research and education have revolutionised the world and our view of it. The modern research university with academic freedom, collegial governance and research-based education at its core has a key position in society, although this position must constantly be developed and defended.

In a changing and globalised world, universities should contribute to a sustainable democratic society on a long-term basis through a solid and broad scientific foundation. This foundation evolves constantly through the search for new knowledge, and through the dissemination of this knowledge in education and outreach activities. We now live in a time of upheaval and global political unrest that affects our universities, and to which the universities must respond.

Stockholm University is committed to the fundamental academic values of autonomy and academic freedom. Integrity and equity should characterise the University’s operations in both research and education, as well as in the exercise of authority and administration. Knowledge, enlightenment and the pursuit of truth are ideals that have characterised Stockholm University ever since its inception in 1878. It was founded as a modern institution for the capital city in the spirit of the Enlightenment, with the aim of producing new knowledge, fostering critical thinking and serving society.

An overarching goal for the University is that the strategic work should permeate all levels of decision-making. These levels are linked in a simple line organisation governed by a clear decision-making and delegation order, running from the President to the two scientific areas with their faculties and sections and then continuing onward to the department level. On the administrative side, the line runs directly to the Director of Administration and the administrative units. The Senior Management Team pursues and initiates strategic issues, and the scientific areas and faculties make strategic prioritisations. At the same time, an important part of the strategic work is carried out at the departments. This requires that the departments are sufficiently large and have skilled management teams that can make active prioritisations regarding research, education and collaboration, as well as operational support. A gradual process towards larger departments has been successfully driven by the faculty and scientific area management teams for a long time, and this will continue. The guiding principle should be to create departments that feel natural in terms of their subjects, while simultaneously being large and broad enough to pursue a strategic development that initiates new directions within research and education while discontinuing outdated ones. These processes are driven in collaboration with the scientific area and faculty management teams. The close communication and interaction between different levels within the University are important for creating short decision paths. The Interdisciplinary Council includes the Senior Management Team, the management teams of the scientific areas and faculties, student representatives, and representatives of the administration. The Council creates opportunities for strategic discussions and collegial cooperation across the line organisation’s internal boundaries in order to continue to develop the core operations – research and education – in collaboration with the operational support.

Stockholm University is a prominent research university characterised by both independent basic research and strong applied research, where the broad research across scientific areas is key to social development and Agenda 2030. The University’s
research is of high international quality and is tested continuously and actively, both externally through various review processes and internally through evaluations of research conditions and research results, for example in the form of publications and external research grants. Together, the independent basic and applied research provides good opportunities to meet the global societal challenges.

International collaboration in research is fundamental to the University’s operations and an integral part of excellence; hence the international mobility within education should increase. Global collaboration and good international relations should be based on needs identified by the core operations and business intelligence. The continued development of our work with strategic partner universities as well as our active participation in international networks, particularly at the European level, are important components of the University’s international profile.

Collaboration between research universities in Sweden has great potential and is increasingly important. The complete, nationally leading and internationally very prominent, academic environment that Karolinska Institutet, KTH and Stockholm University form together should be promoted and utilised. This applies both to concrete internal collaborations and international contexts, as well as relations with public actors in the region, such as the City of Stockholm and the Stockholm County Council. Stockholm University should be a driving force in national and regional collaboration on infrastructure issues and offer a suitable, high-quality infrastructure. In addition, the University should be a driving force in the transition to open science, both open access to publications and open research data.

Stockholm University focuses on education in close interaction with research. This clear connection to research leads to high-quality courses and programmes that are constantly evolving. As a university in the capital city, Stockholm University should place special emphasis on offering courses and programmes that meet the needs of the region and society. Programmes at the bachelor’s and master’s levels that provide relevant professional skills should constitute the core of the University’s range, but at the same time, the University’s profile with many freestanding courses for personal enrichment and lifelong learning should be safeguarded. The University should carry out active, forward-looking pedagogical development work and intensify the efforts to promote widening participation.

The appointments of teachers are the single most important decisions made at the University. The teacher recruitment processes should be monitored and developed to ensure that they are internationally adapted and lead to the strongest possible recruitments. The recruitment of academic and administrative leaders also has top priority. Stockholm University should promote good, strong leadership at all levels and in all areas of operation.

As a university in the capital city, Stockholm University should, through its education and research, pursue active collaboration and contribute to sustainable social development on a broad front. Utilising results and innovations by employees and students, as well as pursuing strategic partnerships with external parties both in and outside the Stockholm region are important components of this broad collaboration.

The University’s core operations, education and research, are dependent on a well-functioning support system, which should also ensure legal certainty, transparency and efficient use of resources. A professional operational support system should aim to simplify the administrative work at all levels and provide strong support to heads of departments and other managers. The development of an operational support system should solve urgent problems for the core operations in now critical areas such as financial management, procurement, collaboration and laboratory renovations.

The strategic operational support includes work relating to premises and the physical environment, which is of great importance to the overall quality of the University’s operations. The University thus works actively to promote a vibrant campus with suitable premises and environments that facilitate collaboration, interaction and sustainability.

Stockholm University should promote equal treatment and equal opportunities. The work and study environment should utilise the resources that staff and students with different backgrounds, life situations and skills bring to the table. Staff and students should be treated equally and with respect.
Stockholm University aims for its research and education to be of the highest international quality. The University’s core operations should develop through collegial work at the departments in close dialogue with the faculties, scientific areas and Senior Management Team.

Stockholm University is, through its prominent research, involved in a multitude of international and national collaborations. Researchers are free to pursue those collaborations and approaches that best facilitate the development of knowledge, which provides good opportunities to run projects at the absolute forefront of research. The University’s professors, senior lecturers and assistant professors should be active in both research and education, which will provide conditions for excellence in both areas. Consequently, to further assure, strengthen and follow up the quality of research at Stockholm University is of the highest priority. The wide range of research and the location in the capital region are attractive for collaboration and provide good opportunities to recruit students with different backgrounds.

Each of the University’s two scientific areas has close to a thousand doctoral students, while Human Science has many more students at the bachelor’s and master’s levels. The scientific areas should, based on their respective conditions, consolidate and further develop the close ties between research and education. In addition, the University should strive to develop collaboration across departmental, faculty and scientific area boundaries.

Maintaining high quality in the University’s education and research is of key importance. The recent years’ work on developing systematic quality assurance systems for both research and education should thus continue. The systems should be university-wide, quality driven and resource efficient. The University’s national and international position, as reflected in international rankings, the allocation of external research grants, bibliometric surveys, the number of applicants to the University’s courses, etc., should also be critically monitored and followed up.

Stockholm University aims to hire the best teachers and researchers, and vacancies are advertised internationally in the vast majority of cases. Recruitment procedures should be open and transparent and offer competitive working conditions. Promotion procedures should be given special attention and include a thorough review.

Regional collaboration on research and education between the major universities in the Stockholm-Uppsala region is prioritised by the University. Together with Karolinska Institutet and KTH, Stockholm University forms a complete university environment that includes all major disciplines. This academic environment is one of the strongest in Europe and has no competition in Sweden. Joint foreign investments help strengthen the universities’ international attractiveness and ensure successful international recruitments. Several joint centres already exist today, including the Stress Research Institute, SciLifeLab and AlbaNova University Center, but the collaboration should be further developed – not least on the education side. It is an overarching long-term goal to facilitate collaboration between the three universities and eliminate administrative problems. It is particularly important to develop Albano and Hagastaden, not least the physical communications, in order to create a cohesive campus.

The total available research funds – both government funding and awarded grants – have increased in recent years, and Stockholm University has been successful in acquiring external grants, both nationally and internationally. The free project grants, which account for most of the external funding of basic research, are a top priority for the University. They are absolutely crucial for breadth, versatility and excellence, as well as to facilitate the growth of new ideas and new fields of research. The University should strive to further improve its results with national and international research councils and foundations. The University should actively support larger research applications to, for example, various EU programmes or foundations such as the Knut and Alice Wallenberg Foundation. In addition, the University, in collaboration with research councils and foundations, should strive to improve the long-term conditions for innovative research. Stockholm University should make strategic use of new and existing national facilities and promote a more efficient use of research infrastructure through international, national and regional collaboration.
In addition, the University should further develop the internal strategy for the use and operation of international, national and local infrastructure for research, as well as the guidelines on how to identify the needs for new infrastructure. Stockholm University Library is its own infrastructure, which includes both the physical library and electronic resources. The library is essential to both scientific areas and has a nationally and internationally leading role in how data and open science are stored and made available.

To Stockholm University, education and personal enrichment are cornerstones of the advancement of knowledge in society. As a university in the capital city, Stockholm University has traditionally prioritised a wide range of courses and programmes with a balanced composition of general programmes, vocational programmes and a wide selection of free-standing courses, the latter of which provide unique opportunities for lifelong learning. The University should continue to offer courses that focus on direct contact between teachers and students, but should also expand upon the opportunities offered by digitalisation, both for distance learning and campus-based instruction. In order to provide students with the best possible education, the University should also actively carry out pedagogical development work in which the subject-specific teaching expertise at the University is utilised.

Based on the departments’ continuous work on courses and programmes, the University should continuously review and follow up these courses and programmes in order to achieve the highest possible quality and meet societal needs. This includes providing and developing attractive science-based programmes that prepare students for the labour market of the present and the future. The continuous review of what courses and programmes are offered by the University is thus important and needs to be given priority. This strategic work on course dimensioning and range should be governed by quality, student interests and labour market needs. International collaboration should increase within courses and programmes at the bachelor’s and master’s levels, for example by encouraging students to take courses or carry out degree projects at foreign universities. Stockholm University is committed to the EU’s goal that 20 per cent of students who graduate in 2020 should have spent at least three months abroad.

Many of the University’s courses and programmes are in high demand, and the large number of students and alumni is a strength. The University should strive to recruit broadly – locally, nationally and internationally – so that diverse groups of students are given the opportunity to study at Stockholm University. Opportunities to study in languages other than Swedish, mainly English, should be communicated further. An important step in widening participation is also to actively strive to attract students from non-academic backgrounds, which increases opportunities to recruit the best students regardless of background. By doing so, the University contributes to sustainable social development. Widening participation also contributes to ensuring heterogeneous study environments and that more perspectives are reflected in the University’s education and research, which in turn benefits the quality of education.

A challenge for Stockholm University, as well as for other universities in Sweden, is to achieve and maintain high student completion rates on all courses and programmes. Low student completion rates mean that both the students’ and the government’s resources are underutilised. In order to increase completion rates while maintaining quality, the University should work actively with preventive measures in connection with communication and recruitment, as well as pedagogical development and student support.

A qualitative development of courses and programmes requires active student participation, which gives students the opportunity to influence their education during their studies. Student influence is a shared responsibility between the University, student unions and student associations. Stockholm University prioritises working closely with students, both in student unions and student associations, on the future development of the University and its courses and programmes. Active student influence is also an important prerequisite for involvement and satisfaction, which, in turn, can lead to better study results and higher completion rates.

As Sweden’s largest institution for teacher education, Stockholm University has a special responsibility to provide teacher education of the highest quality. The University should continuously improve and develop the teacher education programmes, which should be based on well-established research results and tried-and-tested practices. Contacts between the environments within the University where teacher education is conducted should be strengthened through concrete collaboration, for example by giving prospective teacher trainers the opportunity to conduct research in a specific subject in addition to subject-based teaching. Continuing professional development for active teachers and school managers is a priority collaboration project. In addition, the University should expand the opportunities to complete parts of the teacher education abroad, for example the teaching placement.
Collaboration, outreach and social development

A university’s main contribution to collaboration, outreach and social development is educating students at all levels. Moreover, the University plays a key role in democratic society, as its research produces and disseminates knowledge; research collaboration makes the University’s expertise and results available. Collaboration should lead to mutual benefits through the exchange of ideas and knowledge between the University and various actors in society, as well as contribute to the development of society, both nationally and internationally.

Collaboration should promote the quality of education and life-long learning. The generic expertise that students will acquire in the courses and programmes should be emphasised more clearly, both towards the labour market and towards the students themselves. The links to the labour market, as well as the relevance and usefulness of the studies, should be continuously considered through increased dialogue with the surrounding community. With the largest number of students in the country, Stockholm University also has great opportunities for collaboration through its alumni. These activities should be further developed with and for Swedish and international alumni.

As a university in the capital city, Stockholm University engages in broad collaboration: through external assignments in education and research, through the dissemination of new research findings and results, through consultation responses and commissions, and through participation as experts in the media. The University’s visibility through open lectures has a long tradition that should be maintained and developed further. In addition, the University should play an active role in increasing regional collaboration. Collaboration with the business community, the public sector and non-profit organisations takes place in a number of joint projects, both within and outside the country’s borders. One example in the public sector is the collaboration agreement between the University and the Stockholm County Council on health care and public transportation, which aims to solve societal challenges in these areas. Another is the agreement with the City of Stockholm, which consolidates the collaboration that has taken place in a wide range of areas ever since Stockholm University College was founded.

Sustainable development is a key issue for Stockholm University. In Agenda 2030, all UN member states have agreed on 17 global goals aiming to address the societal challenges. The University should, on the basis of strong and broad research that includes the many different aspects of social, economic and environmental sustainability, increase the breadth and depth of the collaboration with the business community, the political world and civil society in order to achieve the global goals for sustainable development together. A step in this direction is Stockholm University’s Sustainability Forum: an arena for dialogue, networking, exchange of knowledge and experiences, collaboration and cooperation relating to these crucial issues. Sustainability issues should also be highlighted in the University’s courses and programmes. In addition, the University should, through its environmental work, strive to continuously reduce its negative environmental impact, disseminate knowledge about the environment and sustainable development, as well as create awareness of and commitment to environmental issues at the University and in the surrounding community.

An important form of collaboration is the appointment of adjunct teachers from organisations outside academia. These are particularly valuable in vocational training programmes, where the teacher education has special status through its central role in social development. Even more generally, collaboration with schools is extensive and increasingly important, and its forms are continuously evolving.

Research and education contribute to and consolidate knowledge and critical thinking. Stockholm University’s communication is thus an important part of outreach and interaction with the community, and contributes to the University’s profile. The communication should draw attention to and disseminate research results in order to highlight new knowledge and how it may be used today or in the future. It is also important to further communicate the crucial importance of the scientific method and how research and education contribute to well-informed decision-making and positive social development. Furthermore, active communication should provide continuous insight into all of the University’s operations.
Operational support

In order for Stockholm University to be able to conduct research and education of high quality in a sustainable and responsible fashion, it requires an effective and cohesive operational support system. In both administrative units and departments, the support should be closely connected to research, education and collaboration.

Based on the University’s conditions, the operational support should actively contribute to operational development and suitable regulations. Sustainable and effective solutions should be secured through business intelligence, preferably in collaboration with other universities.

The operational support should be professional, proactive, solution-oriented and well-coordinated at all levels. Management and staff should work strategically on operational development, which requires that there is an open and permissive organisational culture that encourages new solutions and an active dialogue between different parts of the organisation. Cooperation within the operational support should run smoothly, and the work and decision-making processes should be efficient and transparent. The operational support should ensure good long-term conditions for research, education and collaboration, and well as for management at different levels. In order to ensure regulatory compliance, good internal governance and control throughout the University, efficient use of resources and rational overall processes remain a priority.

The operational support provides expertise and advice, as well as support tools in the form of various handbooks and support systems. All members of staff should be able to easily find the right information and the right support. New working methods and systems should be developed with the aim of simplifying the work and reducing the administrative load. Professional operational support requires good competence maintenance at all levels. Competence issues should be strengthened, handled actively and clarified throughout the organisation, for example through careful recruitment, continuous skills development and a focus on career development opportunities.

Information management should focus on accessibility and information security, while also protecting the integrity and interests of the individual. Continued digitalisation of operations should further improve efficiency. The support systems should be developed further, and the University should aim for uniformity in order to increase user-friendliness and reliability over time for both students and staff.

Facility management should be transparent and conducted on a long-term basis, as well as be based on needs, accessibility and sustainability. A good dialogue with the property owners should be a starting point, and a rent level that is sustainable in the long term should be ensured. Good environments for research, learning and social interaction, as well as an appealing campus that attracts students and staff to the University, should be in focus. The physical preconditions for newly recruited teachers and researchers, especially young researchers, to settle in quickly should be a priority.

The operational support should be characterised by an awareness of sustainability issues and actively strive to be a role model in the work on these issues in the higher education sector.
Human science

CULTURAL HERITAGE & HISTORICAL PROCESSES
This profile area studies how both material and immaterial remnants of the past are preserved and given meaning in interactions between people over time. Key actors include nations, states and their institutions, as well as international organisations and, to an increasing degree, local and regional entrepreneurs. The area studies how conservation processes include both trading and reinterpretation, and how the designation of cultural heritage is a fundamentally political process that is often linked to issues of identity and recognition. In addition, it studies the underlying mechanisms of societal development trends and progression patterns. The proximity to national archives, museums and other institutions in the region provides access to empirical data and opportunities for extensive collaboration with the surrounding community.

INTERNATIONALISATION & MIGRATION
This profile area studies the economic, cultural, linguistic, social and environmental consequences of global flows of individuals, goods and information, as well as the infrastructure and networks that are created as a result of internationalisation and globalisation. Subsequently, it studies changes that result from migration, both in the present and historically, as well as multilingualism as a consequence of migration. The research explores how the world is affected by and changes through international flows, contacts and exchanges of ideas and services. The area is involved in outreach activities on a regular basis, and collaboration takes place with several national and international organisations.

LANGUAGE & LEARNING
Language is a tool for thinking, communication, learning and identity formation, as well as for various aesthetic and cultural expressions. Stockholm University conducts research and education in more than thirty languages. The profile area focuses on issues relating to language acquisition, multilingualism, language history, language philosophy, language education, language development and linguistic changes in different stages of life. Language is central to, for example, law, literature, media and various aesthetic processes, which means that the area includes research that focuses on both the instrumental functions of languages and their cultural and representative expressions. Contact between languages, in the form of translation and other multilingual practices, is also explored. The area’s researchers move between thousand-year-old written artefacts and the problems and opportunities of the digital age.

NORMS, LAWS & ETHICS
This profile area reflects on and analyses norms, laws and regulations, as well as boundaries of norms and possibilities and limitations of normativity. Research and education in this area include ethical issues relating to human and social attitudes. Research on crime and punishment is conducted in a wide range of disciplines. The profile area covers issues relating to human rights, international conflict management and norm-critical perspectives. Researchers in the profile area engage in extensive outreach activities by acting as experts, communicating knowledge through the media, and writing consultation responses on legislative matters.

POWER, DEMOCRACY & WELFARE
This profile area studies power, democracy and welfare, as well as their interactions with each other. The research encompasses societal challenges including climate change, migration, globalisation, digitalisation, a reformed education system, an ageing population and a changing media landscape. Moreover, the research studies how these challenges influence, and are influenced by, management and governance at different levels, as well as by democratic institutions. The proximity to government agencies and national politics nourishes the area, and both research and education are conducted in close collaboration with public and private actors at the local, national and international levels.

SOCIETY, ORGANISATIONS & INDIVIDUALS
Society’s institutions are created by individuals with both common and conflicting desires. The challenges faced by human societies change over time and are subject to continuous analysis and discussion. Research and education in the area focus on the
Strategies for Stockholm University 2019-2022

wellbeing, attitudes, values and actions of individuals, both individually and in social contexts. This profile area studies various goals and forms of governance within nations, regions, companies and other organisations, as well as the media. Collaboration with government agencies and international organisations is well established and well developed.

VISUAL REPRESENTATIONS & INTERFACES
Research and education in Human Science works increasingly with various types of images and visualisations in order to explain, highlight, interpret or illustrate complex phenomena and contexts. Examples include graphs, charts, diagrams, illustrations, aesthetic expressions and, to an increasing extent, different types of digital interfaces. In addition, research is conducted on how people relate to, interact with and create visual representations. All of this places great demands on the continuous development of methods and theories. In addition, it creates opportunities for new types of interdisciplinary meeting places within the University, as well as between the University and various external actors – everything from cultural and research institutions to companies and government agencies.

WORLDS & CONDITIONS OF CHILDREN AND YOUTH
This profile area includes studies of children and youth as active participants in school, peer life and family life, as well as their ideas, rights and vulnerability. Learning, communication and identification are studied from the perspective of children and adolescents. In addition, the area studies children’s culture: literature, music, film and theatre productions aimed at children, as well as the portrayal of children and young people in various artistic expressions, including style and fashion. Practice-oriented collaboration with schools in Stockholm County is extensive, and a continually running series of open seminars is organised with participants from academia and the community.

Natural Science

ASTROPHYSICS, COSMOLOGY AND PARTICLE PHYSICS
The research in particle physics and astronomy at Stockholm University covers a wide area: from the smallest building blocks of the universe to the formation and evolution of galaxies over billions of years. How do particles get their mass, and will the Higgs boson provide the final answer? Why is there more matter than antimatter in the universe – is this related to hypothetical axions or the processes that are responsible for neutrinos mass? What happens when compact stars – such as neutron stars and black holes – merge, and how are the gravitational waves that are generated by this process linked to other signals of light and neutrinos? How can energetic particles that reach the Earth provide us with information about processes in distant galaxies? How are galaxies and stars formed? What is the dark matter and the dark energy that dominates the universe? Research at the Departments of Astronomy and Physics seeks to answer these and related questions. The research area includes theoretical research as well as large-scale experiments and observations.

ATOMIC, MOLECULAR AND COMPLEX QUANTUM SYSTEM PHYSICS
This profile area covers a wide range of research: from studies on the properties of isolated atoms, molecules and dynamic processes when such systems interact with photons or each other, to studies of entangled photon and particle states, quantum encryption, quantum information, cold atomic gases and topological quantum materials. In addition, the profile area includes studies of clusters, the properties of liquids – especially water – and catalytic reactions on surfaces. The research is pursued with development of new theoretical and experimental methods, in the latter case often with strong elements of instrument development. Atoms, molecules and clusters are studied and manipulated using ion traps and ion storage rings; laser radiation is used to control the properties of individual photons, and the time structure of the radiation is used to study ionisation dynamics and achieve intertwined photon states and the teleportation of quantum states, as well as manipulate quantum materials out of equilibrium on ultra-fast time scales. Free-electron lasers and synchrotron light facilities are crucial for catalysis studies, studies on new properties of water in various forms, as well as studies of other materials. Using ion storage rings, ion-ion collisions are studied with new powerful methods – including applications in astrophysics.

BIOLOGICAL MEMBRANES
Cell membranes have a central function in biochemical processes inside the cell. Stockholm University conducts unique research on the proteins that constitute a large part of the cell membranes. Many central processes in the cell are dependent on membrane proteins, and a majority of future pharmaceutical drugs are expected to target these proteins. Cellular processes are closely tied to the function of membranes to regulate what substances
pass in and out of the cell. Membrane proteins, which control these processes, are thus the focus of many research groups, both in Sweden and internationally. What makes the research at Stockholm University unique is its breadth. There are more than twenty research groups that use both experimental and theoretical methods within areas such as biochemistry, biophysics, cell biology, molecular biology, bioinformatics and biotechnology. Studies include how membrane proteins are structured, how they are produced inside the cell, how they move, and what role they play in the cell's energy metabolism.

**Catalysis in Organic Chemistry**

Stockholm University conducts successful research on new, selective synthetic methodology. Reactions that are of interest to, for example, the production of pharmaceuticals are developed using different catalysts. The research covers the development of catalysts based on organic and organometallic compounds, as well as on metallic nanoparticles. Novel synthetic methods are developed for precise control over what chemical substances are created. Modelling with theoretical chemistry is an important component to predict which reactions may occur, thus facilitating the modification of the catalysts.

**Climate, Seas and Environment**

Studies of Earth's natural climate and ecological systems and how they are affected by human activities are key to s, this profile area. The broad research being conducted at Stockholm University comprises specialised studies and interdisciplinary approaches to advance our understanding of these complex systems. Much of the research is carried out at centres and in major interdisciplinary programmes: the University’s Bolin Centre, which is an important forum for climate science and organized in collaboration with SMHI and KTH, now also includes research addressing the effects of climate and land use changes on biodiversity and ecosystem services; the Stockholm Resilience Centre (SRC) focuses on sustainable development and human impact on natural resources and ecosystems; eutrophication and the effects of toxic pollutants in the Baltic Sea are important questions for the Baltic Sea Centre, the Baltic Eye and the Baltic Nest Institute and provide a basis for political decisions that will contribute to a sustainable management of the Baltic Sea.

The impacts of climate change on Arctic regions, pollutions, environmental chemistry, and toxic effects on humans and animals are other important fields of research within the profile area.

**Gene-Environment Interactions**

The interaction between genetic heritage and the environment affects all life, both at population and individual levels. Environmentally-induced selective pressure causes changes in genetic frequencies, resulting in geographic variation in individual characteristics and the emergence of new species. Different organs in an individual communicate their status with each other and adapt the individual’s physiology and behaviour to local variations in the environment, such as after a meal, during stress, or at different temperatures. Environmental variation can cause rapid changes in genetic expressions by modifying regulatory proteins and non-coding RNA, but it can also cause global and more long-term changes. The latter include changes in the genome and its packaging through so-called “epigenetic mechanisms”; in addition to the evolution of plastic traits that adapt the individual to expected environmental variation through natural selection. At Stockholm University, interactions between genes and the environment are studied extensively, including populations adapting to their surroundings and cellular responses to environmental change at the mechanistic level. How the environment and genes interact is a central issue for all life on Earth, not least when it comes to our own health.

**Materials Chemistry**

In the field of materials chemistry at Stockholm University, important research is conducted with the aim to produce and study materials with unique properties. The results are important for sustainable systems and reduced energy use, as well as for the environment and health. Hybrid materials based on naturally occurring polymers, carbon or minerals are key, and are developed for applications in, for example, chemical and architectural engineering. Porous materials are studied for applications in, for example, catalysis and the separation of carbon dioxide from flue gas. Nanomaterials are tailored to have new and improved functions, including catalytic, mechanical, thermal, magnetic and optical properties. Ion liquids are studied in relation to the sustainable chemical synthesis of materials. Understanding the structure of a material is crucial in order to explain its properties and to optimise it for specific applications. Electron microscopy, diffraction, NMR spectroscopy and diffraction studies using synchrotron light or neutrons are examples of important methods used to characterise the structure of the materials.
**MATHEMATICAL THEORY DEVELOPMENT AND MODELLING**

Mathematical structures are a cornerstone of many scientific theories. In physics, mathematical theories and models are absolutely central tools is very extensive and, in addition, new important mathematics has developed from ideas originating from physics. In astronomy, chemistry and Earth science, mathematical modelling is becoming more and more important, and in some areas, such as quantum chemistry and meteorology, it is a fundamental tool. A new and important development is that mathematical modelling is becoming increasingly important in life science and in the social sciences. There is reason to believe that mathematical theories will become even more important than today in both the natural sciences and in other fields. This means that mathematical tools will need to be developed in collaboration with other researchers to a greater extent. This includes numerical aspects and needs identified when analysing new types of high-dimensional data. Such cross-fertilization means that new advanced mathematics, and mathematical intuition, will become useful in other scientific areas. In turn, questions in these areas will inspire mathematicians to formulate, and gain insight into, new mathematical concepts and structures. Stockholm University has strong theoretical research in many scientific disciplines, and the links between these disciplines and mathematics are becoming more important with time.