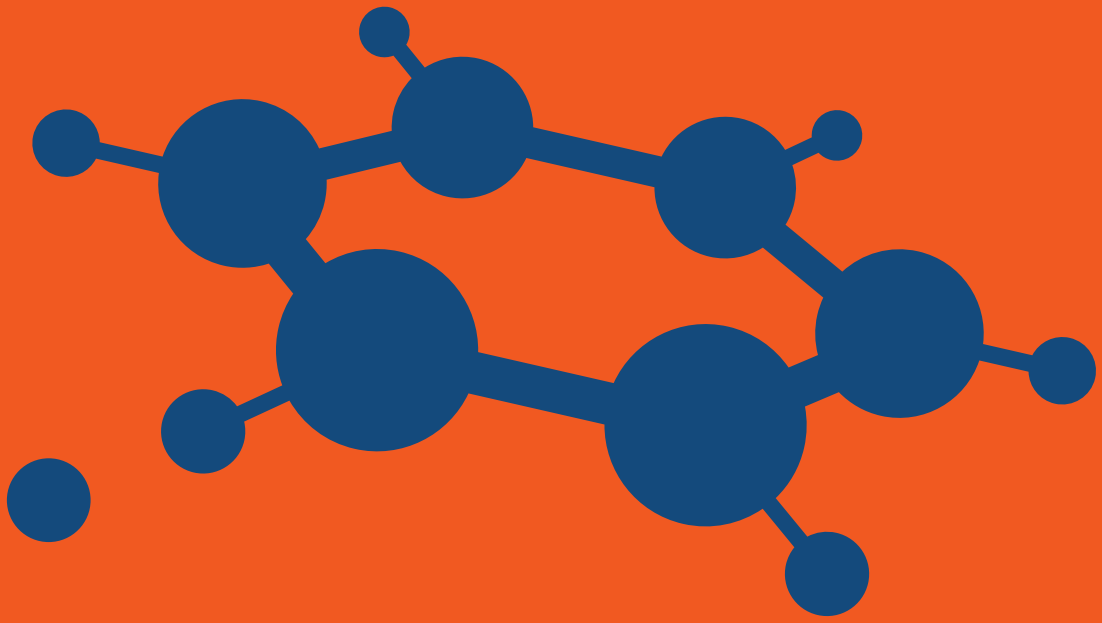
BIO NRW
The Home of Biotech



Spot on Biotechnology Science 2021/2022

ExcellenceNRW
Cluster North Rhine-Westphalia

Version 1.0

Print: XXXXXX
Design and Layout: it’s FR!TZ, Heiko Fritz, Zossen

Spot on Science
Biotechnology Universities and Research Facilities in North Rhine-Westphalia

Editorial

Dear Reader,

The last couple of years have been a stark reminder of why research in biotechnology and bioeconomy is so essential when it comes to protecting society and the environment. The global COVID-19 pandemic is just the latest example for the major challenges we face.

In the spring of 2020, we suddenly needed innovative solutions to combat SARS-CoV-2 and its disruptive effects on almost all parts of society. Biotechnology played a key role in this as an enabling technology for the development of diagnostic procedures and innovative vaccines. Moreover, innovations from biotechnology will be essential for economic recovery and the return to a post-pandemic new normal.

The EU's recovery plan invests heavily in sustainable technologies, and the German Federal Government and the state government of North Rhine-Westphalia wholeheartedly embrace this idea. Biotechnology will be a key driver of sustainable solutions and the successful implementation of a bioeconomy in NRW. We need massive research efforts and innovations to successfully manage the pressing challenges of our time. To address climate change, dwindling resources, and to achieve the structural change from a fossil fuel-based to a fully sustainable bio-based economy we need to collaborate more than ever before.

Innovation, however, does not come about naturally – collaboration between universities, research establishments and industry as well as an excellent scientific infrastructure are essential ingredients for it to develop. To this end, North Rhine-Westphalia boasts the largest concentration of

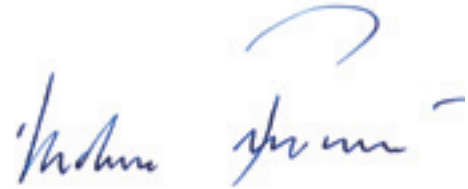
academic institutions in Germany: All major research associations and societies such as Fraunhofer, Helmholtz, Leibniz, and Max Planck are present in our state – in addition to a large number of excellent universities and universities of applied sciences.

The state government of North Rhine-Westphalia is aware of the important role it plays in promoting the transfer from research to application and has continued to launch initiatives that will help build a vibrant start-up ecosystem in the state. A recent example is the Exzellenz Start-up Center.NRW initiative that supports the establishment by six universities of a sustainable support centre that fosters young business starters from the academic world.

Since close collaboration between universities and industry is sometimes difficult to establish, the state government founded "BIO.NRW" more than ten years ago with the aim of initiating and supporting partnerships between science, industry, investors, and policymakers.

In this third edition of "Spot on Biotechnology Science", you can find out more about biotechnology and bioeconomy research in North Rhine-Westphalia. With this brochure, BIO.NRW continues to provide a network for North Rhine-Westphalia's dynamic research infrastructure.

We would like to encourage you to use it to find partners in North Rhine-Westphalia and get involved in collaborative research projects to shape a sustainable and prosperous future together.



Prof Dr Andreas Pinkwart

Minister of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia

Greetings

Spot on Biotechnology Science (3rd Edition)

When we speak about research and education in North Rhine-Westphalia, you very often hear that North Rhine-Westphalia has the highest density of academic and research institutions in Germany. But since North Rhine-Westphalia is a polycentric federal state, it is important to connect the different academic and research institutions both with each other and with industry.

Why is this important?
We have seen in the past that the fastest and most innovative results in life science are generated when different research groups work together. The outbreak of the COVID-19 pandemic and the increasingly visible consequences of climate change highlight how important it is to be innovative and fast at the same time in order to answer the major questions of our century. To do excellent research, North Rhine-Westphalia needs inquisitive scientists and research collaborations across institutions, research fields, and between academia and industry.

To identify and connect with the right collaboration partners in life science, in this 3rd edition of the "Spot on Biotechnology Science" brochure we have compiled even more profiles of all the universities, universities of applied science, research institutes, and scientific clusters of excellence along with their institutes/departments that work in the wider field of biotechnology and bioeconomy in North Rhine-Westphalia.

To make searches easier, we have sorted the profiles into chapters based on research institution categories such as universities, universities of applied science, Fraunhofer Society, Helmholtz Association, Leibniz Association, Max Planck Society, as well as other research centres and excellence clusters. Each chapter features a brief description and the relevant numbers of the respective category. In addition, we have included a list of keywords at the end of the brochure, which have been chosen by the institutions themselves.

In this year's edition, we have also incorporated a shortlist of all the medical faculties within North Rhine-Westphalia to acknowledge their usage of biotechnology tools to develop diagnostics and treatments not only for COVID-19 but also for other diseases.

You can find the online version of this brochure at bio.nrw.de or also in our searchable online academic database. If you are interested in the start-up and industry landscape of biotechnology in North Rhine-Westphalia, feel free to also visit bio.nrw.de or our searchable online company database and download our "Spot on Biotechnology Business" brochure, which lists biotech companies and start-ups in North Rhine-Westphalia with short profiles.

We hope that this brochure will help you to find the right institute/department or research group to feed your appetite for information and research or to identify the right partners to collaborate with to innovate and tackle the urgent questions and needs of the century.

Finally, this brochure will help you to discover the enormous scientific landscape and opportunities in North Rhine-Westphalia. Enjoy reading it and we look forward to seeing you contribute to the science and biotechnology community in North Rhine-Westphalia.

Yours,
The BIO.NRW Team

Content

Spot on Biotechnology Science

Science Landscape North Rhine-Westphalia (NRW)

Educating talented scientists is one of the most important investments in the future of North Rhine-Westphalia (NRW). Nowhere else is the transition from an industrial to a knowledge economy more apparent than here. The Ruhr Valley in particular has undergone enormous changes in recent decades. As the traditional coal mines and steel mills have disappeared one by one, communities and their political leaders have become engaged in an intense search for new economic opportunities that could bring new jobs and prosperity. One of the stronger candidates has been the area of life sciences, and one of the keys to success there, as in the many shoots of the new economy, is a well-educated workforce. Today, the state of NRW has a higher density of academic institutions than any other region in Europe: there are more than 770,000 students at 68 universities, universities of applied sciences (UASs) and other institutions of higher education, which corresponds to approx. 26 % of all German students. [1,2] Six of the ten largest German universities (by number of students) are located in NRW. [2] Furthermore, RWTH Aachen University and the University of Bonn were awarded the rare label of "Elite University" during the Excellence Initiative 2019. This means that two of the eleven German "Elite Universities" are located in NRW. Besides the highest national density of universities, the four large German research organizations – namely the Fraunhofer Society, the Helmholtz Association, the Leibniz Association and the Max Planck Society – operate several facilities engaged in life science activities in the state. In the following paragraphs, NRW's highly competitive and dynamic science landscape will be illustrated by a few recent examples from different areas.

Highlights of Recent Years

In May 2019, a new Max Planck Institute was founded in NRW. The MPI for Cyber Security and Privacy is the first new Max Planck Institute to be created in Germany since several new institutes were established in the course of rebuilding Eastern Germany. The digital transformation is an important topic across many academic disciplines. Examples of technical progress in the life sciences include digital biomarkers, next-generation sequencing and synthetic biology. But this rapid technical development also poses new challenges for security in information technology. In times of Big Data, the Internet of Things and cloud computing, cyber security becomes indispensable. In founding the new Max Planck Institute for Cyber Security and Privacy, the Max Planck Society aims to address the question of how data security can keep up with the rapid developments in information technology. In this context, the scientists follow an interdisciplinary approach by also focusing on economic, legal and social aspects. The new institute is expected to comprise six departments and twelve research groups by its completion. The new MPI is currently located at Ruhr-University Bochum, but a new building is planned with special funding from the state of NRW. [3]

Bochum is also the location of Germany's first Health Campus, where the Centre for Protein Diagnostics (PRODI) was opened in June 2019. The scientific building links Ruhr-University Bochum, the university hospitals and the healthcare industry. At PRODI, innovative analytical methods for the early diagnosis of cancer and neurodegenerative diseases are transferred to clinical application. The new building was funded by the German federal government and the state of NRW on the basis of a proposal submitted by researchers from the Protein Research Unit Ruhr within Europe (PURE). [4]

The recent coronavirus crisis is just one example that shows plainly how important a sophisticated health care system is for our society. The university hospitals and the medical faculties advance medical care and treatments by performing cutting-edge research and providing excellent training for doctors. To ensure the high quality of medical care, the state of NRW launched the medical modernization (MedMoP) programme with the aim of modernizing the infrastructure of several university hospitals by 2020. Within the programme, the university hospitals in Aachen, Bonn, Düsseldorf, Essen, Cologne and Münster received a total of € 2.2 billion for construction measures. These measures also comprise 20 new buildings, including the new Centre for Integrated Oncology (CIO) in Cologne, the Parent-Child Centre in Bonn, the new paediatric hospital in Essen and the extension of the operative intensive care section at the university hospital in Aachen, to name just a few. [5]

In Aachen, one of the biggest research landscapes in Europe is currently taking shape. After work began with the new Campus Melaten including six initial clusters on a 473,000 m² site, the second stage of the expansion of RWTH Aachen University, Campus West, is currently being built on an area of 325,000 m². The initial clusters consist

of interdisciplinary teams of scientists who work closely with industry consortia in new research buildings. Together, the new campuses will host several research clusters in addition to housing, shops, restaurants and cultural offerings. This innovative technology campus represents Aachen's largest city planning project in the coming years. [6] Another space for collaboration between innovative enterprises, third-party research institutions and Ruhr-University Bochum is currently under construction. The project is called Mark 51°7 and is located on the former Opel premises. The aim of the project is to facilitate the transfer between research and the industry. [7]

The science park in Münster is being expanded by the new Multiscale Imaging Centre (MIC). The building, costing around € 71 million, is located in direct proximity to the MPI for Molecular Biomedicine, the Centre for Molecular Biology of Inflammation (ZMBE), the Centre for Soft Nanoscience (SoN), the Center for Nanotechnology (CeNTech) and other institutes and clinics of the University of Münster. MIC will host the Cells in Motion Interfaculty Centre (CiM), where scientists from different disciplines investigate the behaviour of cells in organisms using imaging technologies. [8]

These are just a few examples of recent developments, and there are many more institutions worth mentioning here.

To provide as complete an overview as possible of the life science institutions in North Rhine-Westphalia, BIO.NRW has compiled this brochure of short profiles that are also indexed.

For even more detailed and up-to-date information, our online database presents NRW's science landscape down to the level of working groups, and also enables full-text searches (www.bio.nrw.de).

The German Excellence Strategy

The Excellence Strategy is the follow-up programme to the Excellence Initiative, a German funding programme first passed by the federal government and the federal states in 2005. Its general aim was to promote Germany as an outstanding location for science. It intended to support outstanding research, strengthen international competitiveness and highlight excellent research at German universities. Between 2007 and 2011, € 1.9 billion was provided for Clusters of Excellence, graduate schools and university projects encouraging outstanding research. After having extended the programme with funding of € 2.7 billion until 2017, the federal government and the federal states decided to permanently support top-level research in Germany. The follow-up programme, the German Excellence Strategy, now receives € 533 million in funding annually. [9,10] The Excellence Strategy consists of two lines of funding: the Clusters of Excellence and the Universities of Excellence. Both funding lines were first awarded in 2019 and are reassigned every seven years.

Funding line 1: Clusters of Excellence

The Clusters of Excellence aim to promote internationally competitive research projects by universities or university consortia in different research fields. In addition, cooperation between different institutions and different disciplines as well as excellent training programmes for young researchers are supported. Clusters of Excellence can receive up to € 10 million in funding, and universities with Clusters of Excellence can apply for additional subsidies.

Currently, 14 out of 57 Clusters of Excellence in receipt of funding are located in NRW. [11] Of these, five address bioeconomy or life science topics:

The Cologne Cluster of Excellence on Cellular Stress Responses in Aging-associated diseases (CECAD) investigates the cause of aging processes as well as diseases and disorders related to aging.

ImmunoSensation^2- the immune sensory system addresses the innate immune system and mechanisms of immune intelligence, i.e. the adaption of the immune system to certain situations and the ability to memorize these reactions for similar future situations.

The Cluster of Excellence on Plant Science (CEPLAS) – SMART Plants for Tomorrow's Needs researches complex plant traits that are agronomically relevant in terms of yield and the adaption to limited resources.

PhenoRob – Robotics and Phenotyping for Sustainable Crop Production focuses on sustainable crop production by monitoring plants and analysing data so that robots can specifically treat plants.

The Fuel Science Centre – Adaptive Conversion Systems for Renewable Energy and Carbon Sources aims to create knowledge about the conversion of bio-based carbon feedstocks, renewable energy and CO_2 into bio-hybrid fuels.

Funding line 2: Universities of Excellence

In 2019, 11 German universities were announced as Universities of Excellence and are allocated funding totalling € 148 million annually, of which each university can receive up to € 15 million annually. Two of these, RWTH Aachen University and the University of Bonn, are located in NRW. This funding line aims to support the universities' international top-level position based on the research undertaken by the Clusters of Excellence. Therefore, in order to be nominated as a University of Excellence, universities must at least have procured two Clusters of Excellence (or three clusters in case of university consortia).

Students of MINT/STEM subjects

In the winter semester 2020/2021, 770,434 students (more than a quarter of all students in Germany) were enrolled at one of the 68 universities, universities of applied sciences, or other institutions of higher education in NRW. [1,2] The majority of these students (approx. 64 %) were studying at one of NRW's 16 universities. [1] A topic of increasing importance that is also widely discussed in the political and public spheres is the shortage of specialists and the need for graduates of MINT (Mathematics, Informatics, Natural or Life Sciences and Technology) (or STEM (Science, Technology, Engineering and Mathematics)) subjects in the associated industries. The availability of skilled employees who are trained in MINT/STEM subjects is of economic relevance for industry.

There were about 307,000 MINT students registered in NRW in the winter semester 2019/2020 [12], which corresponds to approx. 40 % of all students (767,617 at that time [1]) in the state. Compared to the country as a whole, NRW's MINT students in the winter semester 2019/2020 represented approx. 28 % of all German MINT students (1,096,773 [13]). Although the most popular field of study is economics, when added together the MINT subjects were chosen by more than 74 % (89,000 [12]) of the university entrants in NRW in 2019 (118,848 [14]). All in all, this positive development assures NRW's position in the area of MINT subjects and shows the current importance of the life sciences.

Graduate Schools

Over the last 40 years, there has been a transformation in higher education, and especially in graduate student education. The most obvious aspect of this transformation is the sheer number of graduate students: while about 12,000 students took their doctoral exam in 1980 [15], 27,878 students received a doctorate in 2018. [16] In NRW, 5,808 students completed their doctorate in 2019. [12] In 2020, 192,270 graduate students were enrolled as doctoral students at German universities or universities of applied science, 38,283 of them in NRW. [17] Of all doctoral students in 2020, approx. 41 % were enrolled in mathematics, natural sciences and engineering. [17]

The idea of graduate programmes was born in an effort to standardize and structure doctoral studies in Germany. Analogous to the US graduate system, these programmes offer students a period of intensive supervision by a dissertation committee comprised of experienced scientists. Written or oral annual reports ensure optimal progress of research projects, and financial support helps students to focus on their research. The first graduate programme – or "Research Training Group", as they were still known at the time – was entitled "Molecular Life Sciences" and was established in Cologne in 1985. [18] The goal behind this and the many other graduate programmes that have followed was to provide an extra dimension to the education of doctoral students, in addition to the time spent working on their thesis projects. The first legally approved graduate programme – with the new designation of "DFG Research Training Group" – was established at Ruhr-University Bochum in 1990. The programme was entitled "Biogenesis and Mechanisms of Complex Cell Function" and involved a dozen professors and as many students. The students interacted with researchers and fellow doctoral students from other departments such as biology, medicine and physics on an interdisciplinary level. This kind of cooperation made departmental boundaries a thing of the past. The success of this concept triggered the development of graduate schools at other universities in the state. Today, the German Research Foundation (DFG) funds 31 such DFG Research Training Groups that focus on the life/natural sciences at universities in NRW. [19] Moreover, seven of the DFG Research Training Groups have an international scope. Additionally, the DFG covers travel expenses for the students to participate in international scientific congresses. In all seven of these programmes, training includes transferable skills such as scientific writing, career planning and project management to prepare the students for the diverse aspects of their possible careers.

In 2000, the Max Planck Society started its own graduate training programme, collectively known as International Max Planck Research Schools (IMPRS). By now, there are 68 IMPRS in Germany. Eleven of these IMPRS are located at Max Planck Institutes in NRW. [20] In order to expand the funding concept, the Max Planck Society additionally founded three Max Planck Graduate Centers and three Max Planck schools in 2018. [21] Both structures bring together leading lecturers and excellent researchers from several Max Planck Institutes, their partner institutions and other universities to offer outstanding doctoral programmes and realize synergies beyond conventional forms of graduate training.

Since 2005, 37 Helmholtz Research Schools and Helmholtz Graduate Schools have been set up at the Helmholtz Centres. [22] In Helmholtz Research Schools, which are founded jointly with universities, doctoral students collaborate on specific research topics. Since 2017, the Helmholtz International Research Schools have been funded by the Helmholtz Association, with their focus on collaborations with international organizations, these also provide students with the opportunity to participate in international research stays. [23]

In addition to these initiatives, different German federal states offer further structured programmes for doctoral candidates. The "NRW Forschungskollegs" address topics of socio-political relevance and are

characterized by a high degree of trans- and interdisciplinarity. About 10 to 15 students from different fields (e.g. engineering, natural sciences, humanities or social sciences) are assigned to each Forschungskolleg. The young scientists also cooperate with different societal stakeholders in order to include practical knowledge as well. [24]

The Graduate Institute NRW (GI NRW) allows students from universities of applied sciences to also earn a doctoral degree. Founded in 2016, GI NRW enables cooperative doctoral projects at universities and universities of applied sciences. [25] About 21 institutions are involved in GI NRW.

Besides the choice of programmes available, a large number of doctoral students do not participate in any structured programme.

The education of young scientists was also targeted by the Excellence Initiative between 2006 and 2019. As part of the Excellence Agreement between the federal government and the federal states, up to 45 graduate schools were funded with roughly € 1 million annually. After an evaluation process undertaken in 2016, the federal government decided to phase out the funding of the graduate schools by the end of 2019. At that point, structured doctoral programs had been established at many universities, which is why state support (as part of the excellence program) was no longer considered necessary. [26]

Engaging with industry

To further facilitate the transition from research to industry, several joint initiatives have been launched in NRW. One such initiative comprises six BioRegions within NRW: BIO.NRW – The Home of Biotech, BioIndustry e.V., Bioanalytik-Münster (Gesellschaft für Bioanalytik Münster e.V.), BioCologne, BioRiver – Life Science im Rheinland e.V. and MedLife e.V.. [27] While each BioRegion has a different regional focus, priorities and competencies, all six BioRegions are committed to technology transfer, business start-ups and the initiation of cooperation between industry and science. As the state organization, BIO. NRW acts as the umbrella organization for the BioRegions in NRW, and through supraregional cooperation the interests of the state are supported statewide.

Another initiative is the international Cluster Industrial Biotechnology (CLIB – Cluster Industrielle Biotechnologie e.V.) [28], based in Düsseldorf. CLIB is an international open innovation cluster of large companies, SMEs, academic institutions and universities, and other players active in biotechnology and bioeconomy. Its overall objective is to network actors along and across value chains and to identify new opportunities for innovation, projects and business ideas.

A different approach to closing the large gap between industry and academia in higher education was the foundation of the Biotechnological Student Initiative (btS – Life Sciences Studierendeninitiative e.V.). [29] This nationwide organization has had considerable success since its foundation in 1996. btS groups are active in all major university cities in NRW, and representatives of many (big) biotech companies collaborate with the student network. btS in NRW organizes a fair called ScieCon NRW to promote contact with industrial partners, which has an excellent reputation among the exhibitors. ScieCon takes place twice a year at changing locations.

Another initiative to facilitate the transition from research to applications in the chemical industry is the chemstars.nrw initiative. This statewide initiative, which will run for three years, brings together chemical companies and young founders and is supported by the state government as well as industry representatives such as Henkel, Evonik, Currenta and Covestro. [30]

One of the biggest initiatives introduced by the NRW state government in recent years is Exzellenz Start-up Center. To accelerate the transition from research to industry, six universities were selected in a competitive process. As of September 2019, a total of € 150 million was allocated over a five-year period to RWTH Aachen University, Ruhr-University Bochum, Technical University Dortmund, University of Cologne, University of Münster and University of Paderborn to increase the number and quality of innovative and rapidly growing start-ups. The universities will thus establish new strategies and initiatives to build a culture of entrepreneurship. These programmes will include the whole value chain of establishing a company, from identification of business potential, prototype development and business plan creation to early growth and demand-oriented networking possibilities with industry, business angels, venture capital funds or institutions of municipal financing options. [31]

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Academic Institutions and Research Facilities in NRW*

* with regard to Life Sciences

* no claim to completeness

Universities

Luxembourg

Universities

In Germany's federal system, almost all the universities are run and maintained by the (federal) states (Bundesländer/Länder), thus each state is responsible for building and financing its universities. Consequently, it is within the responsibility of the federal states to decide on the number and location of its universities as well as the topics, subjects and focuses of the studies that are offered. In 2020, 14 public universities and 16 + public universities of applied sciences are located within the state of North Rhine-Westphalia. [1]

University students are awarded a bachelor degree (normally after six semesters) or a master degree (after completing a bachelor and four additional semesters). In winter semester 2020/2021, more than 770,000 students [2] were enrolled at one of NRW's universities (approx. 496,000 students) or universities of applied sciences (approx. 248,000 students *) [2]. There were more than 112,000 new students in 2020. [3]

The students find a diverse landscape at universities which have a long and rich tradition (University of Cologne, founded in 1388), Germany's largest university (Distance University Hagen, ~ 69,000 students in winter semester 2020/2021) [4], one of the very few private universities (University of Witten-Herdecke) or rather young yet established universities like those that were founded as the first new universities in Germany after the Second World War (Ruhr-University Bochum and Technical University Dortmund). The latter two – together with the University of Duisburg-Essen – are also outstanding as they mark the beginning of a fundamental structural change in the Ruhr valley, shifting the area from a region of heavy coal mining and steel production towards a modern economy based on services and high technologies, especially including the life sciences. NRW's universities provide excellent education, research, scientific expertise and career development opportunities in an international environment. During the winter semester 2020/2021, about 66,000 students came from other countries to study in NRW, which corresponds to a proportion of ~13 %. [4] This value has steadily increased over the last years and clearly shows the growing attractiveness of NRW as a location of higher education for international students. ** The prestigious label "Elite University", which has been awarded to the University of Bonn and the RWTH Aachen University, highlights NRW's excellent and competitive science landscape of today.

+ Without Schools- of Administration, Arts and private Universities of Applied Sciences (UAS).

* Universities of applied sciences without those of administration

** Limited comparability to 2016 due to changes in the statistic law. (vgl. Abschnitt „Novelle des Hochschulstatistikgesetzes").

[1] https://www.mkw.nrw/hochschule-und-forschung/studium-und-lehre/ueberblick-hochschulen-nrw
Accessed 10.08.2021

[2] https://www.it.nrw/statistik/eckdaten/studierende-nach-hochschularten-1067
Accessed 10.08.2021

[3] https://www.it.nrw/statistik/eckdaten/studienanfaengerinnen-und-studienanfaenger-im-ersten-hochschulsemester-nach
Accessed 10.08.2021

[4] Statistisches Bundesamt, 2021, Bildung und Kultur, Studierende an Hochschulen – Wintersemester 2020/2021

BERGISCHE UNIVERSITÄT WUPPERTAL

Name	Bergische Universität Wuppertal/University of Wuppertal
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E-Mail	hschroeder@uni-wuppertal.de
Internet	www.uni-wuppertal.de
Founded (year)	1972
Number of employees	scientific 1,906 administrative 772
Funding	State Government NRW 100%

www.uni-wuppertal.de

Bergische Universität Wuppertal

The University of Wuppertal is a dynamic, research oriented university with a markedly interdisciplinary teaching and research profile, that is focused on 6 strategic areas:

- Building blocks of matter, experiment, simulation, and mathematical methods
- Education and knowledge in social and cultural contexts
- Health, disease prevention, and movement
- Language, narration, and editing
- Natural environment, engineering, and safety
- Entrepreneurship, innovation, and economic change

An interdisciplinary nature, innovation, and team spirit are the hallmarks of teaching and research in Wuppertal, and the university's many successes are also reflected in good rankings. Generous staff-student ratios, as well as many service and support facilities for students and researchers, distinguish the University of Wuppertal from the large mass universities and lead in turn to lively interest from prospective students.

The University of Wuppertal is located in the heart of North Rhine-Westphalia (NRW), which is economically the most significant German state with an outstanding educational and cultural landscape. We possess an international network of more than 150 partner universities worldwide, with regional focal points in Asia (especially China), Latin America and the USA. Our international cooperations provide not only for student and staff exchanges, but also for joint research projects at faculty and departmental level.

The university's high-profile international presence, with a network of partners across Europe and overseas, is complemented by deep regional roots. Active knowledge transfer and intense cooperation with numerous business partners and social organizations have created an excellent regional network from which graduates, faculty members, and researchers profit as much as do innovations and start-ups.

Faculty of Mathematics and Natural Sciences, Food Chemistry

The Food Chemistry is part of the Faculty of Mathematics and Natural Sciences at the University of Wuppertal (BUW). The food chemistry at the BUW uses instrumental analytical and bioanalytical methods to study food ingredients (e.g. lipid-mediators or metals) and potential beneficial or adverse effects on health. At the BUW you can study food chemistry which is only offered at 3 universities in NRW.

International Collaborations

Departments of Molecular Pharmacology and Neurosciences, Albert Einstein College of Medicine, NY, USA.

National Collaborations

Heinrich Heine University, Düsseldorf
University of Münster, Institute of Inorganic and Analytical Chemistry, Münster
University of Frankfurt, Institute of Pharmacy, Frankfurt

Research Field	Environmental Biology/ Chemistry/Pharmacology, Food Chemistry
Keywords	Analytics, Biomarker, Metabolomics, Neurodegenerative Diseases, Nutrition
Head of Faculty	Prof. Dr. Schebb / Prof. Dr. Bornhorst
Internet	www.lebchem.uni-wuppertal.de/
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Faculty of Mathematics and Natural Sciences, Organic Functional (Macro)Molecules

Our current research interests encompass:

- Organic macromolecular chemistry, with new directions towards sustainable raw materials and biodegradability
- Polymer nanoobjects via polymerization-induced self-assembly (nanoparticles, nanofibers, micro/nanovesicles)
- Functional polyoxazolines (water-soluble, biocompatible, antifouling, antibacterial)
- Protein/enzyme conjugation and stabilization (polymer armoring via grafting or wrapping)
- Control of molar mass distribution and functionality using reversible-deactivation radical polymerizations, particularly nitroxide-mediated polymerization and RAFT polymerization, and ring-opening polymerizations
- Photochemistry (coupling, polymerization, surface functionalization)
- Surface-reactive nanostructured materials

International Collaborations

Queensland University of Technology, Brisbane, Australia
Tohoku University, Sendai, Japan
Massachusetts Institute of Technology, Cambridge, MA, USA

National Collaborations

BASF SE
University of Applied Sciences Aachen
North-West German Textile Research Institute (DTNW)

Research Field	Macromolecular Chemistry, Organic Chemistry, Materials Chemistry
Keywords	Biocatalysts, Enzymes, Polymer Synthesis, Hybrid Nanomaterials
Head of Faculty	Prof. Dr. Guillaume Delaittre
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Research Field	Environmental Science
Keywords	Atmospheric Chemistry, Atmospheric Physics, Safety Engineering, Simulation Experiments, Process Studies
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Institute of Atmospheric and Environmental Science

The Institute for Atmospheric and Environmental Research was founded in August 2014. With this institute a department-related competence centre for atmospheric and environmental research has been created that currently combines the research expertise of atmospheric chemistry, atmospheric physics, safety engineering and environmental protection at the University of Wuppertal. In addition, the promotion of young scientists is an important task of the Institute. To achieve its objectives, the Institute will conduct research in atmospheric chemistry, atmospheric physics, simulation experiments, modelling, development of new and innovative measurements techniques and evaluation algorithms.

Together with the city of Wuppertal the Institute is operating a monitoring station for air quality, which was formerly part of the German national air quality monitoring network, which would have been closed otherwise. In addition to air quality monitoring the Institute uses the station also for the practical training of its students.

International Collaborations

York University, Toronto, Canada
Université Paris-Est Creteil
Peking University, Beijing, PR China

National Collaborations

Universities of Bremen, Cologne,
MPI for Chemistry, Mainz
Research Centre Jülich
DLR
Leibniz Institute for Tropospheric Research, Leipzig
The National Metrology Institute of Germany (PTB)

UNIVERSITÄT BIELEFELD

KEYWORDS
Biocatalysts, Fermentation, Genomics, Synthetic Biology, Bioinformatics

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Internet	www.uni-bielefeld.de
Founded (year)	1969
Number of employees	scientific 3,495 administrative 1,236
Funding	Federal Government (Germany) 100%

www.uni-bielefeld.de


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Bielefeld University

Humanities, Natural and Social Sciences, Technology – Transcending Boundaries

As a university internationally regarded for its top-level research and innovative teaching concepts, Bielefeld University makes a significant contribution to a progressive and participatory knowledge society. It is an attractive, family-friendly place to work and study and is characterised by an open communication culture, lived interdisciplinarity, diversity and freedom for personal development.

Bielefeld University was founded in 1969 with an explicit research assignment and a mission to provide high-quality research-oriented teaching. With around 25,000 students, the University currently encompasses 14 faculties. As a 'Volluniversitat' (full university), it offers a differentiated range of disciplines in the humanities, natural sciences, technology as well as in medicine.
Committed to its strong research focus, Bielefeld University ranks among the top quarter of universities in Germany and is internationally renowned. Its research profile stems from four strategic research areas which are connected by three cross-cutting topics. These research areas are interdisciplinary by nature, each involving various faculties and central academic institutes. Here, top-class interdisciplinary research is carried out at the highest international level, in particular within the framework of targeted third-party funded projects. The strategic research areas focus on cutting-edge basic research. They provide valuable points of orientation for possible applications in and questions arising from business and society, in accordance with the Bielefeld principle of 'Transcending Boundaries'.

Faculty of Biology

Individuality & Interaction: We investigate individuality that describes the unique properties of a single cell, an organism or a whole system. Change and adaptation occurs over the lifetime and in response to the environment. In addition, individual entities also interact and even cooperate at higher functional levels (tissue, population, ecosystem).

Sustainability & Resource Efficiency: Sustainability and resource efficiency are of vital and global importance in our changing society. We characterize highly resource-efficient strategies of nature from healthy food, intact ecosystems, changing commodities to clean, renewable energy and finally implement them in technical solutions.

Networks: from genes over metabolism to diversity: Molecular, cellular and organismic networks with their emergent properties are a hallmark of the complexity of biological systems. We investigate which types of interactions characterise networks, how networks change over time and how they react to changes in the environment.

International Collaborations

ERA projects INDIE, C1Pro and MERIT

National Collaborations

CLIB Kompetenzentrum Biochnologie,
CLIB – Cluster Industrielle Biotechnologie e.V.

Research Field	Various Biological Fields of Research
Keywords	Genomics, Metabolomics, Proteomics, Stem Cell Research, Behavioural Biology
Head of Faculty	Prof. Dr. rer. nat. Jacob Engelmann
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Faculty of Chemistry

Several groups are interested in the application of enzymes as valuable and environmental friendly catalysts in organic synthetic transformations. By means of interdisciplinary research projects achievements have been made in the development of synthetic processes which fulfill the criteria of high efficiency, sustainability as well as scalability. Focuses are on (1) the development of efficient biocatalytic reactions (biotransformations) and their technical applications, (2) the combination of biocatalysis with chemocatalysis in one-pot multi-step syntheses in water and (3) target driven synthesis based on the use of biocatalysts in synthetic key steps (in particular for the synthesis of pharmaceuticals). Directed enzyme evolution is applied to expand the range of catalytic reactions. Enzymatic halogenation, enzyme immoblilization, peptides as drugs and peptidomimetics are investigated.

International Collaborations

Toyama Prefectural University, Japan
Osaka University, Japan
University Yaoundé I, Cameroon

National Collaborations

University of Cologne
Max-Planck-Institute for Chemical Energy Conversion
Magicbullet::Reloaded

Research Field	Biotechnology, Organic Chemistry
Keywords	Biocatalysts, Enzymes, Peptide Synthesis, Recombinant Proteins, Small Molecules
Head of Faculty	Prof. Dr. Adelheid Godt
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CeBiTec
Center for Biotechnology

KEYWORDS
Genetic Engineering, Genomics, Microbial Genomics, Sequencing (Facility), Synthetic Biology

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E-Mail	lutz.wobbe@uni-bielefeld.de
Internet	www.cebitec.uni-bielefeld.de
Founded (year)	1998
Number of employees	scientific 180 administrative 2
Funding	Federal Government (Germany) 70% State Government NRW 2% EU 14% Industry 14%

www.cebitec.uni-bielefeld.de

CeBiTec – The Interdisciplinary Center for Biotechnology

The Center for Biotechnology is a faculty-spanning central academic institution of Bielefeld University. It bundles biotechnological activities and research projects at the university, to foster cross-linking of research approaches and technologies from different research fields and to develop innovative projects within its two main research areas: "Large Scale Genomics and Big Data Bioinformatics" and "Metabolic Engineering of Unicellular Systems and Bioproduction". The first research area focuses on genome research on bacteria relevant for biotechnology, agriculture and the environment, on structural and functional decoding of genomes of crop plants, animal cell cultures and microalgae, on metagenomics analysis of microbial communities as well as on elucidation of the function and interaction of genes and genomes with post-genomics and bioinformatics methods. Within the second research area microorganisms, unicellular algae, and mammalian cell lines are applied for the production of a broad spectrum of valuable products. These include the sustainable production of bioproducts with microorganisms, the production of recombinant therapeutic and diagnostic proteins in animal cell lines, studies of plant growth and development, the optimisation of the sunlight-to-biomass conversion in phototrophic microorganisms, the production of biofuels with heterotrophic and phototrophic organisms, and the protein production and secretion as well as the synthesis of hydrocarbon compounds and the biocatalytic H2 production with microalgae. To this end, the three Technology Platforms of CeBiTec, namely for Bioinformatics, for Genomics and for Fermentation & Bioenergy, which are equipped with state-of-the-art instrumental infrastructure, play an important role and their equipment and expertise are indispensable for the ambitious biotechnological research projects conducted by the CeBiTec. Furthermore, the CeBiTec organises several scientific events from workshops and scientific retreats to distinguished lectures and international research conferences.

Technology Platform Bioinformatics

The large amounts of data acquired from today's PolyOmics technologies demand intensive bioinformatics support including adequate data management, efficient data analysis algorithms, and user-friendly software applications.

The Technology Platform Bioinformatics can look back on many years of expertise in the computational processing of genomic and postgenomic datasets. It serves as a central bioinformatics research unit and cooperation partner, offering a comprehensive IT infrastructure for data storage and analysis.

Furthermore, the Technology Platform Bioinformatics provides access to a variety of bioinformatics tools and software applications ranging from functional genome analysis and metagenomics to transcriptomics, metabolomics, and proteomics.

New developments at the platform in particular target the integration of data from different levels of -omics as well as the development and provision of re-usable workflows for large-scale data processing and exploration.

National Collaborations

Justus-Liebig-Universität Giessen
ZB MED
Ruhr-Universität Bochum

Membership in local and regional Networks

Deutsches Netzwerk für Bioinformatik-Infrastruktur (de.NBI)
CLIB

Research Field	Bioinformatics
Keywords	Bioinformatics, Genomics, Postgenomics, Workflows, Data Integration
Head of Institute	Dr. Stefan Albaum
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Technology Platform Fermentation & Bioenergy

The Technology Platform Fermentation & Bioenergy combines knowledge and experience of the chairs of Cell Culture Technology, Fermentation Engineering and Algae Biotechnology & Bioenergy of Bielefeld University. The technical infrastructure has consequently been complemented and updated and currently hosts more than 30 bioreactors from different manufacturers and scales. Major topics are the cultivation of microbial and cell cultures as well as enzymatic reactions in a semi-pilot plant scale using a broad spectrum of organisms and enzymes.

The associated BioEnergieTechnikum is a technical center for bioenergy research. Build by Bielefeld University and sponsored by the Stadtwerke Bielefeld, the interdisciplinary approach and the modern technical equipment of the center offer groups and departments of Bielefeld University/CeBiTec access to setup experiments related to bioenergy research & application on a technical scale.

National Collaborations

AlgaSubst (ZIM, BMWi)

Membership in local and regional Networks

CLIB
Konsortium Bioenergie OWL
next2Enzyme
Mikroalgen-Nachhaltige Quelle hochw. Naturstoffe

Research Field	Biotechnology
Keywords	Bioenergy Research, Biomass, Enzymes, Fermentation
Head of Institute	Dr. Jan Mussgnug Dr. Joe Max Risse
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Research Field	Biotechnology
Keywords	Genomics, Metabolomics, Microbial Genomics, Microarrays, Proteomics
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Technology Platform Genomics

The Technology Platform Genomics (TPG) has four sections addressing the most important technologies in genome research: Genomics mainly comprises genome sequencing. The most recent high-throughput sequencing systems from Illumina (e.g. NextSeq2000) and Oxford Nanopore are currently installed. Transcriptomics covers all techniques used to analyze transcripts, including deep sequencing of transcriptomes. Proteomics involves gel-based and gel-free separation as well as identification and quantification of proteins by MALDI-TOF or by LC-ESI mass spectrometry. Metabolomics embraces metabolic profiling and flux analysis by gas-chromatography (GC) or liquid-chromatography (LC) coupled to mass spectrometry (MS). The TPG is running three GC-MS and two LC-ESI instruments, a quadrupole TOF and an ion-trap machine. All the Omics methods have been applied to microorganisms in the past and are currently extended also to higher organisms and to microbial communities.

International Collaborations

Universität für Bodenkultur, Vienna, Austria
Czech Academy of Sciences, Prague, Czech Republic
Chinese Academy of Sciences, Beijing, China

National Collaborations

Bayer Pharma AG
Evonik Nutrition and Care GmbH

Membership in local and regional Networks

CLIB

German Sport University Cologne

The German Sport University Cologne (GSU), founded in Cologne in 1947, combines qualified teaching and international research of the highest level. It is Germany's only, and Europe's largest, university in the field of sport and exercise science. Research and teaching at 19 academic institutes, four affiliate institutes and five academic centres cover many aspects – all pertaining to sport and exercise. This expertise concentrated in one location allows for a unique interdisciplinary approach and provides the opportunity to examine complex social topics from various perspectives of sport and exercise science. The spectrum ranges from basic science research topics concerning the fundamentals of movement, performance and health to applied research projects, for example in the field of excercise science and in health promotion, prevention and rehabilitation.

Located at the Müngersdorf Sport Park, in the heart of Cologne's green belt and within an ideal sport infrastructure, the GSU offers an unique environment for 650 employees and approximately 6,000 students from 93 countries. More than 60 university partnerships are a sign of its international focus. As an university aligned with European ideas and state-of-the-art graduate and postgraduate degree programmes, it has constantly encouraged and influenced sport and exercise science.

The spectrum of studies at the university includes five bachelor and nine master degree programmes as well as degrees in PE and seven master degrees in advanced studies. Additionally PhD Studies in German and English are offered. The variety of training options enables precise orientation which aims to facilitate future career choices and prepares students optimally for the sport and exercise as well as health job market, which is constantly growing.

The GSU consistently follows its path as a research university. Its interdisciplinary work goes beyond institute and university borders, and it encourages young academics, particularly through the establishment of postgraduate programmes.

In the most diverse disciplines, academics at the GSU research a variety of problems using basic research methods as well as greater practical orientation. In further developing research results, GSU works closely with a range of industrial partners as well as public institutions, administrations, associations and societies.

Deutsche Sporthochschule Köln
German Sport University Cologne

KEYWORDS
Ageing, Cardiovascular Research, Drug Discovery/ Drug Delivery, Neurodegenerative Diseases, Oncology

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Internet	www.dshs-koeln.de
Founded (year)	1947
Number of employees	scientific 330 (+380 PhD students) administrative 320

www.dshs-koeln.de

Research Field	Anti-Doping Research, Analytical Chemistry
Keywords	Analytics, Metabolomics, Proteomics, Small Molecules, Sports Drug Testing/Doping Controls
Head of Institute	Prof. Dr. Mario Thevis
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Institute of Biochemistry / Centre for Preventive Doping Research

The Institute of Biochemistry is a central unit of the Centre for Preventive Doping Research of the German Sport University Cologne as well as the European Monitoring Center for Emerging Doping Agents (EuMoCEDA), and as such represents one of the worldwide largest WADA- and IOC-accredited doping control laboratories. The main research focus is sports drug testing, including the development of new analytical approaches for efficient and comprehensive anti-doping tests, conducting metabolism studies (*in vitro* and *in vivo*) for improved detection windows for established as well as new drug entities, and the identification of scenarios resulting in anti-doping rule violations caused by an inadvertent exposure of athletes to prohibited substances. Moreover, new testing strategies employing alternative matrices and minimal- or non-invasive sampling methods are developed, allowing for primarily mass spectrometry-based analyses of target compounds.

International Collaborations

University of California Los Angeles (UCLA), California
Uppsala University, Sweden
Sports Medicine Research and Testing Laboratory, Salt Lake City, Utah
CER Groupe, Marloie, Belgium University of Copenhagen, Denmark

National Collaborations

University of Cologne
Humboldt-University Berlin
Heinrich Heine University Düsseldorf

Research Field	Human Biology, Physiology
Keywords	Immune Modulation, Regenerative Medicine, Stem Cell Research
Head of Institute	Prof. Dr. med. Wilhelm Bloch
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Postal Code/City	50933 Cologne
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Institute of Cardiology and Sportsmedicine - Molecular and Cellular Sports Medicine

The main research interests at the field of exercise biology/physiology are mechanical, metabolic and redox signalling and adaptation of endothelial cells, haematopoietic cells, cardiac cells, skeletal muscle as well as stem cell dependent tissue regeneration. The investigation of extra cellular matrix modulation and epigenetic modulation by physical activity is a further goal of research. The research includes the whole range from cell culture, animal models up to human research. The effect of physical activity / training is investigated in elite atheletes, recreational athletes and in patients with different diseases including diabetes, cardiovascular diseases, cancer and neurodegeneration as well as COPD.

International Collaborations

Department of Biology, Institute of Molecular Health Sciences, ETH Zurich, Zurich, Switzerland
Edith Cowan University Health and Wellness Institute, Joondalup, WA 6027, Australia
Unité Transversale de la Drépanocytose, CHU de Pointe-à-Pitre, Pointe-à-Pitre, Guadeloupe

National Collaborations

Institute of Physiology I, University of Bonn, Germany
German Aerospace Center, Institute of Aerospace Medicine and Space Physiology, Cologne
Department of Molecular Medicine, Max-Planck Institute of Biochemistry

Institute of Movement and Neurosciences

Department I focuses on the observation of main motor forms of demand: coordination, strength, speed, endurance and flexibility in athletics, swimming and gymnastics. Aspects of motor learning play an important role. Central focus of department II is the analysis of the effect of physical activity on the brain of active and inactive people of different ages under specific environmental conditions. Another focus is on the aspects of sport for people with disabilities. The research in Department III is focused on relationships between (in)- active leisure activities and motor development or the performance of children and adolescents.

Department IV deals with specific aspects of movement science from rehabilitation to toplevel sport, especially in Paralympic sports.

International Collaborations

European Space Agency (ESA)
University of the Sunshine Coast, Australia
European Research Group in Disability Sport (ERGiDS)

National Collaborations

German Space Agency
Functional Neuroimaging Group, Department of Radiology, University Hospital Bonn
German Research Centre for Elite Sport Cologne (momentum)

Research Field	Neurobiology, Movement and Neuroscience
Keywords	Cardiovascular Research, Metabolomics, Neurodegenerative Diseases, Neurotransmitter, Neurotrophic Factors
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Department for Exercise Physiology

The research is focused on the responses of the human body to combined challenges of physical activity and extreme environments such as weightlessness and under water. The analysis includes both, the underlying fundamental processes and their modifiability by other influences, e.g. training and aging. This also implies the development of specific methods for these special conditions. The research is mainly supported by external funding and by collaborations at the national and international level.

International Collaborations

IBMP, Moskau
ESA, Norrdwijk
Charles University, Prague

National Collaborations

University of Stuttgart
University of Mainz
University of Oldenburg

Research Field	Exercise Physiology
Keywords	Metabolic Demands, Cardiovascular Research, Space Physiology, Extreme Environments
Head of Institute	Dr. Uwe Hoffmann
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hhu Heinrich Heine Universität Düsseldorf

KEYWORDS
Cardiovascular Research, Plant Science, Membrane Biology, Molecular and Clinical Hepathology, Knowledge-Cognition

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Founded (year)	1965
Number of employees	scientific 2,731 administrative 1,415
Funding	State Government NRW 100 %

www.hhu.de

Heinrich Heine University Düsseldorf
Life, Nature, Society

Heinrich Heine University Düsseldorf (HHU) combines first class research and education with entrepreneurship in an environment that is inspired by innovation, collaboration, exchange, and diversity following our motto "Life, Nature, Society".

Pursuing a growth strategy from its foundation in 1965, HHU today comprises five faculties (Medicine, Mathematics and Natural Sciences, Arts and Humanities, Business and Economics, and Law) and six central and cross-faculty facilities. The faculties offer more than 80 courses of study and are home to 330 professors and over 3.811 academic and non-academic staff members. HHU is the alma mater for about 36.095 students. The University's departments enjoy an excellent reputation due to for example their collaborative research centres (currently two collaborative research centres are coordinated at HHU). The Cluster of Excellence on Plant Sciences (CEPLAS) which focuses internationally renowned expertise from the Universities of Düsseldorf and Cologne, the Max Planck Institute for Plant Breeding Research (MPIZ), and the Forschungszentrum Jülich is a unique research and training venture to advance plant and microbial research in an ecological context. Moreover, the state capital Düsseldorf provides an attractive environment with a high quality of life.

HHU is internationally renowned for its outstanding research in life sciences and biomedicine. HHU life science and biomedical researchers closely collaborate in several collaborative research consortia and interdisciplinary university core facilities. Biotechnology is one of the key profile areas of the Faculty of Mathematics and Natural Sciences. Additionally, HHU is an active partner within the Bioeconomy Science Center (BioSC) and has close collaborations with non-university research institutions such as the Forschungszentrum Jülich and the local industry. Outstanding education and training of doctoral researchers are central to the mission of HHU which is also reflected in the high number of research training groups and graduate schools coordinated at HHU. HHU has a long-standing tradition of entrepreneurship and was selected in 2011 as one of 10 universities for funding within the EXIST IV programme of the Federal Ministry for Economics and Technology. In 2019, the university successfully applied for funding as a companion project under the Startup Excellence Center initiative of the Ministry of Economics and Innovation NRW.

Institute of Biochemical Plant Physiology

The Institute of Biochemical Plant Physiology has expertise and equipment for the expression, purification, crystallization, and structure analysis of bacterial and plant proteins. Major tools employed in the lab are X-ray diffraction, fluorescence spectroscopy and a range of state-of-the-art biophysical techniques for quantification of biomolecular interactions such as Microscale Thermophoresis (MST), Isothermal Titration Calorimetry (ITC) or Biolayer Interferometry (BLI). Our research focusses on molecular bioenergetics and protein-protein interactions (PPI) in plant hormone signaling. In these engagements, the lab has established cloning, expression and purification of several key components of the ethylene plant hormone signaling pathway. In these projects we have unique peptides as valuable substances that target PPIs in the ethylene network and thereby control important agronomical traits such as ripening, aging, and senescence.

International Collaborations

University of Maryland, USA
Tokyo Institute of Technology, Japan
CAS Center for Excellence in Molecular Plant Sciences, Shanghai, China

National Collaborations

HHU Düsseldorf
ZMBP, University of Tübingen
Biotec, RWTH Aachen University

Membership in local and regional Networks

Bioeconomy Science Center (BioSC), CEPLAS

Research Field	Bioeconomy, Plant Biology/Plant Physiology, Structural Biology
Keywords	Agricultural Biotechnology, Bioeconomy, Enzymes, Recombinant Proteins, Signal Transduction
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Institute of Biochemistry I

Our laboratory uses state-of-the-art molecular biology in yeast and bacteria for high level protein production and isolation, protein characterization as well as structural biology to study transport processes across and information processing at biological membranes. Currently we focus on membrane proteins of the ABC transporter family that are involved in bacterial protein secretion systems (type 1 secretion), bacterial, fungal and human drug resistance (multidrug resistance), maturation and secretion of peptide-based antibiotics (lantibiotics) as well as in human diseases of the liver. To understand the mechanistic principles of such transport processes, we employ a wide variety of biochemical / biophysical techniques) to study protein-ligand and protein-protein interactions in vitro. These set-ups are completed by various *in vivo* approaches.

International Collaborations

Department of Biochemistry, University of Cambridge, UK
Catholic University of America, Washington DC, USA
CNRS, Lyon, France

National Collaborations

Institute of Microbiology, Philipps-University Marburg
Jacobs Univeristy Bremen

Membership in local and regional Networks

CLIB
Bioeconomy Science Center (BioSC)
Sonderforscungsbereich 1208 (SFB 1208)

Research Field	Biochemistry, Microbiology, Structural Biology
Keywords	Biocatalysts, Biomaterials, Enzymes, Structural Biology, Synthetic Biology
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Research Field	Biochemistry, Biocatalysis, Protein Engineering
Keywords	Biocatalysts, Bioeconomy, Enzymes, Synthetic Biology
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Institute of Biochemistry II

Our research focuses on the application and optimization of enzymes for biocatalysis. Applications of enzymes in biocatalysis require high expression levels, fast substrate conversion, high enzyme selectivity as well as robust reaction systems in order to achieve high product yields.

Our research projects involve identification, cloning and high-level production of target enzymes in recombinant microorganisms, elucidation of molecular mechanisms that mediate enzyme activity and selectivity, and improvement of activity, selectivity and stability of enzymes by protein engineering. The enzyme optimization strategies target diverse areas such as the extension of substrate spectra, enzyme specificity, but also cofactor recycling and enhancement of thermal and process stability that inter alia can be achieved by immobilization or fusion of enzymes.

International Collaborations

TU Delft, The Netherlands
University of Washington, USA
Research Centre for Natural Sciences, Budapest, Hungary

National Collaborations

RWTH Aachen
Forschungszentrum Jülich
Universität des Saarlandes

Membership in local and regional Networks

CLIB
Bioeconomy Science Center (BioSC)

Research Field	Biotechnology, Organic Chemistry
Keywords	Biocatalysts, Bioeconomy, Drug Discovery/Drug Delivery, Enzymes, Small Molecules
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Institute of Bioorganic Chemistry

Scientists at IBOC focus on the development of new synthetic methods and their application in target oriented organic synthesis. Of particular interest are catalytic, enantioselective methods: New, optimised, as well as commercially available enzymes – from oxidoreductases, hydrolases, lyases and transferases to ligases – as well as organocatalysts are utilised in chemoenzymatic syntheses. More recently, flow chemistry approaches utilizing immobilized catalysts are implemented in (enzymatic) reaction cascades. The methods are applied in natural product and active agent synthesis, with the target compounds ranging from polyketides, glycolipids to alkaloids and many more. The compound libraries obtained are of interest for agricultural (plant protectives) as well as pharmacological studies (antibiotics, antitumor, neurodegenerative).

International Collaborations

University of Osaka, Japan
University of Basel, Switzerland
University of Babes-Bolyai, Cluj-Napoca, Romania

National Collaborations

RWTH Aachen
University of Bonn
TU Dortmund

Membership in local and regional Networks

CLIB
Bioeconomy Science Center (BioSC)
BioRiver

Institute of Cell and Interaction Biology

Plants cannot run away, but they are masters in acclimating to changing environmental conditions. The Institute of Cell and Interaction Biology (ICIB) combines molecular biology, quantitative live imaging and bioinformatics to understand the mechanisms that enable plant roots to regulate growth and give rise to specialized cell shapes. To facilitate the visualization of interactions at the root-soil interface, research at the ICIB involves fluorescent reporters that shed light on the dynamics of small signaling molecules, genetic tools that enable manipulation of the growth machinery, and custom-designed microdevices for precision control of the root microenvironment. Ultimately, a comprehensive understanding of the molecular machineries that integrate environmental cues and drive cell and organ growth, enables novel plant engineering and advanced cultivation strategies to improve the resistance of crop plants to biotic and abiotic stress.

International Collaborations

Imperial College, London, UK
ENS Lyon, France

National Collaborations

University of Heidelberg
Technical University Munich
University of Bochum

Membership in local and regional Networks

Center of Excellence on Plant Sciences (CEPLAS)
Sonderforschungsbereich 1208 (SFB 1208)

Research Field	Cell Biology, Plant Biology/ Physiology
Keywords	Organ Function & Development, Cell Morphogenesis, Cell-to-Cell Communication, Plant-Environment Interactions, Quantitative Imaging
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Institute of Cell Biology

Our group studies the signaling mechanisms of Adhesion G protein-coupled receptors (aGPCRs) and their physiological relevance. Adhesion GPCRs are functionally and structurally unusual GPCRs. Despite their essential functions in health and disease and their unique architecture facilitating cell and matrix interactions, aGPCRs are by far the most poorly understood receptor class.

We aim to understand the molecular mechanisms underlying Adhesion GPCR activation and activity and how these are translated into physiological functions in development as well as metabolic processes. In both processes, Adhesion GPCRs play so far unappreciated roles. We are interested in answering the following questions: How do aGPCRs function in a physiological context? Which molecular mechanisms are required?

We use in vivo models supported by various cell culture models and a broad range of cell biological, biochemical, and pharmacological methodologies to address these questions and to link physiological functions with molecular mechanisms.

International Collaborations

Vrije Universiteit Amsterdam, The Netherlands
Institute of Biochemistry, University of Oxford, UK
Katholieke Universiteit Leuven, Belgium

National Collaborations

Leipzig University
Institute of Genetics, Technical University Braunschweig
Charité Berlin

Research Field	Cell Biology, Signal Transduction
Keywords	Animal Models, GPCRs, Signal Transduction
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Research Field	Cell Biology, Microbiology
Keywords	Enzymes, Infectious Diseases, Microbial Genomics, Signal Transduction, Small Molecules
Head of Institute	Prof. Dr. Ursula Fleig
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Eukaryotic Microbiology

Small molecule secondary messengers are crucial elements in cellular decision-making processes. Our focus is on inositol pyrophosphate (IPPs) messengers, a highly phosphorylated subgroup within the class of soluble inositol phosphates. IPPs are exclusively eukaryotic molecules that adapt numerous biological processes to changing environments via protein modification. IPPs controlled processes in fungi encompass genome stability, phosphate homeostasis and morphogenesis. IPPs are generated by two highly conserved enzyme families and our work with the yeast Schizosaccharomyces pombe PPIP5K/Vip1 has defined these proteins as bifunctional enzymes controlling the intracellular concentration of a specific IPP class. Using mitosis as a tool to understand how IPPs control biological processes, we found that IPPs alter the architecture of the two mitotic machines, the kinetochore and the spindle apparatus, in a dose dependent manner. How this is achieved on the protein modification level, will be our challenge for the next years.

International Collaborations

University College London, UK
Virginia Tech, USA,
University of Copenhagen, Denmark

National Collaborations

Leibniz-FMP, Berlin
Heinrich Heine University, Düsseldorf

Research Field	Microbiology, Infection Biology
Keywords	Anti-infective Research, Infectious Diseases, Recombinant Proteins, Vaccines
Head of Institute	Prof. Dr. Johannes H. Hegemann
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Institute of Functional Microbial Genomics

Research at FUGE focusses on the characterization of the pathogenicity mechanisms of the obligate intracellular human pathogenic bacteria *Chlamydia trachomatis* and *Chlamydia pneumoniae*. Infections with both pathogens occur worldwide and infection rates are increasing. We are studying the chlamydial entry process into host cells by identifying the bacterial cell surface proteins, the adhesins, and their host cell receptors, by employing a wide variety of biochemical, cell biological and microscopical techniques. Moreover, we identify chlamydial effector proteins, which are secreted into host cells during infection to manipulate host cell processes to the benefit of the pathogen. Because Chlamydiae are approximately 700 million years old, they have developed effector proteins with unique biochemical activities, which we characterize and currently translate into medically relevant tools. Finally, in collaboration with immunologists, we develop a multi-subunit vaccine against Chlamydiae, which is not yet available.

International Collaborations

College of Veterinary Medicine, China Agricultural University, Beijing, China
Medical Sciences I, University of California, Irvine, USA

National Collaborations

Institute for Medical Microbiology and Hospital Hygiene, Düsseldorf, Germany
Institute for Medical Microbiology and Hospital Hygiene, Hannover, Germany

Membership in local and regional Networks

Speaker of the Manchot Graduate School ´Molecules of Infection` Düsseldorf

Institute for Microbiology

The causative agent of corn smut, *Ustilago maydis*, has matured as an excellent model system throughout the last decade. Currently, it belongs to the best 10 fungal pathogens in molecular plant pathology. Using this model pathogen, the Institute for Microbiology is focusing on three different aspects: cell biology, pathogenicity and biotechnology. In the cell biology section, we apply *in vivo* approaches to study different aspects of RNA biology, such as the role of endosomes, in *U. maydis*. With respect to pathogenicity, we investigate various aspects of the infection process in *U. maydis* and *Thecaphora*, i.e. to establish a Brassicaceae-smut infection system. In the applied sciences, we are applying *U. maydis* as novel protein expression system. As a unique feature we use unconventional secretion for the export of functional proteins, such as single-chain antibodies, nanobodies and CaZYmes.

International Collaborations

Michigan State University, East Lansing, USA
UNAM, Mexico City, Mexico

National Collaborations

Ludwig Maximillians University Munich, RWTH Aachen
Max Planck Institute for Plant Breeding Research, Cologne

Membership in local and regional Networks

CLIB (CKB)
Bioeconomy Science Center (BioSC)

Research Field	Microbiology
Keywords	Bioeconomy, Biologicals/ Biopharmaceuticals, Genetic Engineering, mRNA, Synthetic Biology
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Institute for Molecular Ecophysiology of Plants

Plants have to cope with changing environmental conditions throughout their lifetime. To successfully grow and develop, they must adequately respond to a variety of biotic and abiotic factors. For instance, plants are equipped with an intricate defence network to counteract attempted invasion by bacterial, fungal, or viral plant pathogens. Our research group is interested in the molecular responses that plants activate after having recognized such microbial invaders. In particular, we are seeking to better understand systemic acquired resistance, a plant response that provides broad-spectrum resistance to the whole foliage to pathogen infection. This is achieved by the combinatory use of interdisciplinary approaches such as physiological, molecular genetic, biochemical, analytical-chemical and metabolite profiling analyses.

International Collaborations

University of Lausanne
University of Edinburgh

National Collaborations

Max Planck Institute for Plant Breeding Research, Cologne
Helmholtz-Zentrum Munich

Research Field	Plant Biology/Physiology
Keywords	Metabolomics, Plant Produced Products, Small Molecules, Plant Immunity, Signal Transduction
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Research Field	Biotechnology, Microbiology
Keywords	Biocatalysts, Bioeconomy, Enzymes, Genetic Engineering, Synthetic Biology
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Institute of Molecular Enzyme Technology (IMET)

Scientists at IMET develop microbial expression systems and synthetic biology modules for the production of difficult-to-express enzymes, membrane proteins and secondary metabolites. In addition, mechanisms of protein folding and secretion are investigated and applications of newly discovered enzymes are examined. Another research focus is the isolation, biochemical and structural characterization of a new class of oxygen independent fluorescent proteins which can be applied as molecular reporters and sensors. State-of-the-art molecular- and optogenetic tools, microbiological, biochemical and biotechnological methods are applied. A high-throughput robotic screening facility enables the identification of novel enzymes, e. g. from metagenomes, and their subsequent optimization using directed evolution methods. The IMET harbors laboratories according to German security level S2 allowing to experimentally handle putative pathogens.

International Collaborations

School of Biological Sciences, Bangor University, Bangor, United Kingdom
Institute of Catalysis and Petrochemistry (ICP), Spanish Council for Scientific Research (CSIC), Madrid, Spain
Barcelona Supercomputing Center - Barcelona, Spain

National Collaborations

Institute of Biotechnology RWTH Aachen University
Department of Biology, Biozentrum Klein Flottbek, Hamburg University
Geomar Helmholtz Centre for Ocean Research Department of Marine Ecology, Kiel

Membership in local and regional Networks

CLIB, BioRiver, BioSC, DFG CRC 1208

Research Field	Bioinformatics, Physiology, Molecular Evolution
Keywords	Analytics, Enzymes, Genomics, Systems Biology, Comparative Genomics, Microbial Genomics
Head of Institute	Prof. Dr. William F. Martin
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Institute of Molecular Evolution

The term that best describes our work is "early evolution". In the laboratory, we mainly work on the process of early metabolic evolution. At the computer, we have helped to pioneer the use of networks, instead of trees, to capture the vertical and horizontal component of genome evolution. We have made noted contributions to the understanding of the origin of life and early microbial evolution and gene transfer in evolution, both in the context of endosymbiotic organelle origins and in the context of gene transfer among free-living prokaryotes. Our work has been recognized with well over 39,000 citations (h-index 95) and a third Advanced Grant from the European Research Council (2020).

International Collaborations

University of Strasbourg, France
Ben Gurion University of the Negev, Israel
Japan Agency for Marine-Earth Science and Technology

National Collaborations

MPI für Kohlenforschung, Mülheim an der Ruhr
Universität Greifswald

Membership in local and regional Networks

North Rhine-Westphalian Academy of Sciences, Humanities and the Arts

Institute of Molecular Physiology

We study the intercellular and inter-organ exchange of nutrients in plants, in particular via plasma membrane transporters and plasmodesmata. We identified the key transport proteins and found that some are hijacked by pathogenic bacteria. We are using advanced breeding technologies to obtain braod-spectrum resistance against plant diseases. We explore options to increase yield. We engineer genetically encoded biosensors and monitor metabolic, signaling and transport processes with these minimally invasive tools in bacteria, fungi, plants and animals.

International Collaborations

ITbM, Nagoya University, Japan
ICAR, New Dehli, India
IRRI, The Philippines

National Collaborations

ERC Sympore, U. Hohenheim & MPI Biochemistry, Martinsried
Eberhard Karls University of Tübingen
IPK, Gatersleben

Membership in local and regional Networks

CEPLAS
CRC1208

Research Field	Plant Biology/Physiology, Pathogen Resistance
Keywords	Agricultural Biotechnology, Diagnostic Systems, Pathology, Plant Breeding, Biosensors
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Institute of Organic Chemistry and Macromolecular Chemistry

The research in our institute is focused on molecular and macromolecular functional compounds and materials. The scope ranges from small molecule entities with biological activity or functional chromophores to supramolecular interactions of polymer-molecule host-guest systems and polymer-biopolymer interactions.

International Collaborations

University Genova, Italy
University St. Petersburg, Russian Federation
University Kharkiv, Ukraine

National Collaborations

Henkel KGaA
BASF SE
Evonik

Membership in local and regional Networks

CLIB

Research Field	Organic Chemistry
Keywords	Anti-infective Research, Drug Discovery/Drug Delivery, Molecular Library, Enzymes, Small Molecules
Head of Institute	Prof. Dr. Thomas J.J. Müller
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Research Field	Macromolecular Chemistry
Keywords	Biomimetic Polymers, Glycopolymers, Biomaterials, Infectious Diseases, Polymers for Biorecycling
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Institute of Organic Chemistry and Macromolecular Chemistry Verbundsforschung Glyco Pathogens

Our lab works on the synthesis of sequence-controlled polymers via the so-called solid phase polymer synthesis. This allows for full control over the monomer sequence and overall chain length of the obtained oligo(amidoamine) as well as their architecture and composition. High versatility of this approach is enabled through development of a library of building blocks and use of automated synthesis. Furthermore, oligomeric structures derived by solid phase assembly can be used as building blocks in the bottom-up synthesis of high molecular weight polymers, functionalized nanoparticles or microgels and surfaces. Based on our expertise, we develop new classes of biomimetic and bioactive polymers and materials. On the one hand this helps us to gain deeper insights into the underlying structure-property correlation of both, bio- and biomimetic polymers. On the other hand, we obtain bioactive materials enabling various biotechnological and biomedical applications such as the development of antibacterial and antiviral treatments.

International Collaborations

Davidson College, USA
University of Vienna, Austria
Aarhus University, Denmark

National Collaborations

University Münster
University Lübeck
RWTH Aachen

Membership in local and regional Networks

FOR 2327
CRC 1208
BioSC, Zukunftsgruppe Glycopathogens

Research Field	Biotechnology, Microbiology, Bioactive Natural Products
Keywords	Anti-infective Research, Antibiotic, Drug Discovery/ Drug Delivery, Infectious Diseases, Microbial Genomics
Head of Institute	Prof. Dr. Rainer Kalscheuer
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Institute of Pharmaceutical Biology and Biotechnology

Research in the Institute of Pharmaceutical Biology and Biotechnology focusses on the search for new antimicrobial natural products from microorganisms and plants, in particular to combat multi-resistant bacterial, fungal and viral pathogens, as well as the subsequent elucidation of the underlying mechanisms of action and molecular targets using microbial genetics and biochemical approaches. In particular, endophytic fungi from stress-exposed habitats serve as a rich source of new antibacterial natural products. We cover the isolation and spectroscopic structure elucidation of new leads from nature as well as their production through fermentation. In addition, access to natural products is provided by an extensive cooperation network with academic partners in Africa and China. A particular focus in our preclinical antimicrobial drug development activities is on the human BSL3 pathogens Mycobacterium tuberculosis and SARS-CoV2.

International Collaborations

Albert Einstein College of Medicine
Texas A&M University
Chinese Academy of Tropical Agricultural Sciences, Hainan, P.R. China

National Collaborations

University of Duisburg-Essen
Research Center Borstel
Ruhr University Bochum

Membership in local and regional Networks

GRK 2158
MOI Graduate School

Institute of Physical Biology

Research at the Institute of Physical Biology focuses on the development and application of methods to precisely investigate three-dimensional structures and dynamics of biologically and medically relevant macromolecules at atomic resolution by nuclear magnetic resonance (NMR) spectroscopy, X-ray crystallography, cryo-electron microscopy and computational structural biology. We are particularly interested in the misfolding and subsequent aggregation of proteins in neurodegenerative diseases like Alzheimer's and Parkinson's disease. A defining characteristic of our approach to curative intervention of neurodegeneration is the combination of basic research in structural biology and applied research, which has reached clinical stage in both diagnostics and therapy (see spin-off companies attyloid and Priavoid).

International Collaborations

University of Alabama at Birmingham, USA
Tel-Aviv University, Israel
University of Melbourne, Melbourne, Australia
University of Alberta, Edmonton, Canada

National Collaborations

Heinrich Heine University Düsseldorf
Charité, Berlin
Klinikum rechts der Isar, München

Membership in local and regional Networks

Graduate Schools iGRAD, iGRASPseed, iBrain and Molecules of Infection, IHRS BioSoft, Bio-N3MR Network NRW, Bioeconomy Science Center (BioSC), BMFZ, SFB 1208

Research Field	Biochemistry
Keywords	Atomic Resolution Structural Biology, Neurodegenerative Diseases, Biomolecular NMR Spectroscopy, Protein Ligand Interactions, Autophagy
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Institute of Plant Cell Biology and Biotechnology

Our research focuses on the various polymers of the plant cell wall, a sophisticated mainly polysaccharide based material in all plants. These plant polymers represent the dominant carbon sequestration pathway in our biosphere, soaking up greenhouse gases during their biosynthesis. The resulting material, termed lignocellulosics including straw and wood can be considered a renewable, sustainable resource for the production of commodity chemicals.

The group has expertise in the detailed, comprehensive analysis of carbohydrate (polymers). Our research focus is the molecular and biochemical study of their synthesis in the plant. Identified components of the biosynthetic machinery are transferred to yeast allowing also the production of these polymers in a fermenter including the production of novel structures not found in nature.

In addition, we assist plant breeders to assess plant lignocellulosic residues, their improvements and valorization.

National Collaborations

Cluster of Excellence in Plant Sciences (CEPLAS)

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)

Research Field	Biotechnology, Plant Biology/Physiology
Keywords	Agricultural Biology, Bioeconomy, Genetic Engineering, Plant Breeding, Synthetic Biology
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Research Field	Genetics, Molecular Biology, Plant Biology/ Physiology
Keywords	Crop Research, Genomics, GMO
Head of Institute	Maria von Korff Schmising
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Institute of Plant Genetics

My long-term research interest is to unravel the genetic and molecular control of reproductive development and shoot and inflorescence architecture of barley in response to environmental variation (abiotic stresses). My research group has detected and characterised major regulators of reproductive development in response to photoperiod, temperature and drought using quantitative genetics and Next-Generation-Sequencing (NGS) based methods in natural and mutant barley populations. In particular, we have used the annual wild barley (Hordeum vulgare spontaneum), the progenitor of cultivated barley, for the identification of novel genes and alleles controlling development and stress adaptation. Further, we have started to develop genetic resources and collected phenotypic data of wild species within the Hordeum clade that differ from cultivated barley in their adaptation to abiotic stresses (salt, drought) and life history (perennial growth). We embark on a new research area to exploit interspecies variation within the Hordeum clade and explore the genetic basis of annual versus perennial growth in grasses with the ultimate aim to engineer perennial traits in the annual crop barley.

International Collaborations

University of California, Davis, USA
University of Milan, Italy
Institute of Experimental Botany of the Czech Academy of Sciences

National Collaborations

Heinrich Heine University, Germany
LMU Munich, Germany

Research Field	Plant Biology/Physiology, Biomedicine, Synthetic Biology, Optogenetics
Keywords	Agricultural Biology, Genetic Engineering, Platform Technology, Synthetic Biology, Tissue Engineering
Head of Institute	Prof Dr Matias Zurbriggen
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Institute of Synthetic Biology

We develop and apply theoretical-experimental, synthetic biology principles to the integrative research on biological signalling systems. This transdisciplinary approach at the interface between engineering and life sciences, focuses on the implementation of strategies to control and understand eukaryotic signalling and regulatory networks, in a quantitative and spatiotemporally resolved manner. This includes synthetic pathways, biosensors, chemical and optical switches and biotechnological applications in microbial, plant and animal systems. In this framework, our lab has leading expertise in eukaryotic synthetic biology and has pioneered the development of optogenetics (> 25 articles) in mammalian and plant systems. We seek to implement optogenetics for biomedical applications, e.g. tissue engineering and synthetic organoid development.

International Collaborations

ETH Zürich
University of Edinburgh
Danforth Center, US

National Collaborations

Max Planck Institute for Plant Breeding Research, Cologne
University of Freiburg
University of Heidelberg

Membership in local and regional Networks

Bioeconomy Science Center (BioSC), CEPLAS
SFB CRC 1208

Institute of Zoology and Organismic Intercations

We are fascinated by the fact, that the microbiome affects nutrition, development, immunity and even behavior of an animal. In our research, we are investigating the underlying interactions between animals and bacteria, while focusing on the communication from host-to-microbe, microbe-to-host and microbe-to-microbe. We use the cnidarian model systems Hydra and Nematostella to study fundamental principles of animal-microbe interactions at the molecular, cellular and organismal level.

International Collaborations

University of Debrecen, Hungary
UNC Charlotte, USA
Univeristy of Canberra, Australia

National Collaborations

Christian-Albrechts University of Kiel
GEOMAR - Helmholtz-Centre for Ocean Research Kiel
Westfälische Wilhelms-University Münster

Research Field	Zoology
Keywords	Animal Facility, Environmental Research, Immune Modulation, Microbial Genomics, mRNA
Head of Institute	Prof. Dr. Sebastian Fraune
Internet	www.organismicinteractions.hhu.de/
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PADERBORN UNIVERSITY

KEYWORDS
Biomarker, Nutrition, Peptide Synthesis, Small Molecules, Biointerfaces

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Contact Person	Dr. Johannes Schnurr, Press Spokesman
Fon	+49 5251 60-2548
E-Mail	presse@zv.upb.de
Internet	www.upd.de
Founded (year)	1972
Number of employees	scientific 1,822 administrative 756

www.upb.de

Paderborn University

With around 20,000 students, Paderborn University focuses on excellent, international and interdisciplinary research. The teaching and research profile encompasses a broad spectrum of subjects from cultural and social sciences, economics, natural sciences and engineering. Teacher training in all these areas plays an important role. In total, the five faculties offer 70 different courses of study.

Among other things, the university has established itself in profile areas with internationally recognized cutting-edge research. These include in particular Intelligent Technical Systems, Sustainable Materials, Processes and Products, Transformation and Education, Optoelectronics and Photonics and Digital Humanities. Paderborn University is embedded in an innovative and dynamic business environment in the region of Ostwestfalen-Lippe, which engenders numerous cross-sector collaborations with benefits for researchers and the regional economy. Besides technology transfer and networking with industry, a special focus is also on collaborating with other universities and research networks, which means excellent career opportunities for graduates.

Being a campus university, short distances between lecture halls and facilities, contemporary student accommodation directly on campus and a city centre within walking distance makes Paderborn University a particularly attractive choice for students.

Department of Exercise & Health

The Department of Exercise & Health investigates the contribution of sustainable nutrition and physical exercise to health promotion and the prevention of chronic diseases. These activities include wide-range applications of biotechnological approaches such as the use of novel biomarkers or wearables for everyday monitoring of metabolic responses. Hence, neuroscientific findings, insights on biological constructs and precision nutrition tools are combined and implemented to determine the effectiveness of everyday interventions. This allows for the development of targeted advice relevant for a range of settings, encompassing school, workplace, university, clinical and rehabilitation settings.

Research Field	Neuroscience, Sports Medicine, Public Health, Movement and Neuroscience, Biomechanics
Keywords	Biomarker, Nutrition
Head of Department	Prof. Dr. Elke Grimminger-Seidensticker
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Department of Chemistry/Department of Physics

The Departments of Chemistry and Physics focus on the development of sustainable processes in quantum optics & photonics (PhoQS and CeOPP), materials sciences (ILH, PIAF) and conversion of matter (CSSD). These activities have strong connections to biomaterials, biotechnical and biochemical applications in sensing, drug-delivery, analytics and synthesis of bioactive small molecules. Additive manufacturing of alloys is used for the design of advanced bioresorbable implant materials. Stimuli-responsive polymers as smart materials are developed for applications in tissue engineering for excellent biocompatibility or for drug-delivery systems in biological systems. Modifications of surfaces by self-assembled monolayers and DNA-based molecular lithography (DNA-origami) paired with latest technology in spectroscopy (XPS, FTIR, NMR, AFM, electron microscopy) enables deeper insights into DNA and enzyme deposition on surfaces for biomedical applications. Solution structures and binding properties are accessed by synthesis of small molecules and optical makers, e.g. for sensor for macromolecular crowding in vitro and *in vivo*. Strong groups in quantum theory within the faculty support these activities. They rely on the exceptional infrastructure for high performance computing (HPC). The "Paderborn Center for Parallel Computing" (PC2) provides resources for computational applications on federal level as a strong member of the "high performance computing network of north rhine-westphalia" (hpc.nrw).

Research Field	Organic Chemistry, Inorganic Chemistry, Analytical Chemistry, Material Sciences
Keywords	Peptide Synthesis, Small Molecules, Biointerfaces
Head of Department	Prof. Dr. Dirk Reuter / Prof. Dr. Thomas D. Kühne
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Address	Warburger Str. 100
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Research Field	Organic Chemistry, Material Sciences, Neuroscience, Sports Medicine, Public Health
Keywords	Biomarker, Nutrition, Peptide Synthesis, Small Molecules, Biointerfaces
Head of Department	Prof. Dr. Wolf Gero Schmidt
Internet	www.nw.upb.de
E-Mail	dekan-nw@upb.de
Address Postal Code/City	Warburger Str. 100 33098 Paderborn
Fon Fax	+49 5251 60-2677 +49 5251 60-3547

Faculty of Natural Sciences

The faculty consists of about 40 university professors who are teaching in three different departments: the Department of Physics, the Department of Exercise & Health and the Department of Chemistry. The high interdisciplinarity in applied and fundamental sciences across the faculty results in innovative research and success in highly competitive awards, such as the Gottfried Wilhelm Leibniz Prize and three ERC grants. Intensive collaborations on national as well as international level sustain the interdisciplinary positioning of the faculty by the exchange of knowledge and students. The three departments furthermore concentrate on sustainability as a whole for the society.

International Collaborations

Qingdao University of Science and Technology, China
University of Le Mans, France
ECPM, University of Strasbourg, France
Toronto University, Canada

National Collaborations

BASF SE
TU Dresden
Helmholtz-Zentrum Dresden-Rossendorf
Fraunhofer Institute for Cell Therapy and Immunology Leipzig
University Hospital RWTH Aachen

Membership in local and regional Networks

High performance computing network of North Rhine-Westphalia (hpc.nrw)

universitätbonn

KEYWORDS

Bioeconomy, Crop Research, Immune Modulation, Neurodegenerative Diseases, Stem Cell Research

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Internet	www.uni-bonn.de
Founded (year)	1818
Number of employees	scientific 4,479 +561 professors administrative 1,800
Funding	Others 23,6% third-party research funding

www.uni-bonn.de


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Rheinische Friedrich-Wilhelms-Universität Bonn

Traditionally modern – the University of Bonn

The University of Bonn is one of eleven German Universities of Excellence and the university with the most research Clusters of Excellence – six in total. It has produced more Nobel Prize laureats and Fields Medal winners than any other German university in recent decades. The University of Bonn stands for world-class, top-notch science and research. For 200 years, the University has been shaped by outstanding scientific personalities, research-led degree courses, the international flair of being the German city of the United Nations, a dynamic, world-wide networked scientific region and - last but not least – by the livable Rhineland in the heart of Europe.

With around 35,000 students, 6,000 doctoral students, almost 550 professorships and 6,000 employees, the University of Bonn is one of the largest traditional and research-intensive universities in Germany. The large spectrum of subjects on offer in seven faculties ranges from agricultural sciences to dentistry. Numerous subjects occupy a leading position in international competition. In addition to strong disciplines, six cross-faculty Transdisciplinary Research Areas (TRAs) provide space for exploration and innovation that addresses key scientific, technological and societal challenges.

The University of Bonn is guided by the principle that science succeeds best when research and teaching go hand in hand and excellent minds can develop freely. The Nobel laureates Wolfgang Paul (Physics, 1989) and Reinhard Selten (Economics, 1994) lead the list of excellent researchers in Bonn. No other German university has produced as many Nobel Prize winners in the past three decades. Mathematicians Gerd Faltings and Peter Scholze are the only German winners of the Fields Medal and are both active researchers at the University of Bonn.

In order to make research results available to society, the University of Bonn relies on knowledge transfer and science communication. It is thereby an engine of social and technological development. Cooperation with industry is diverse and ranges from sponsorships to the joint establishment of endowed professorships to scholarships and contract research projects.

Institute for Cellular and Molecular Botany (IZMB)

The IZMB (Institute of Cellular and Molecular Botany) at Bonn University consist of the three departments Molecular Evolution (Prof. Dr. Volker Knoop), Cell Biology (Prof. Dr. Ute Vothknecht) and Ecophysiology (Prof. Dr. Lukas Schreiber). Research at the IZMB is dealing with various aspects of functional plant biology. Scientific approaches include molecular biology, molecular evolution, cell biology, physiology and phytochemistry. Main research topics are molecular evolution of early land plants, membrane transport of nutrients, cytoskeleton and differentiation of plant cells and plant environment interactions occurring across plant interfaces made of cutin and suberin. Experimental approaches range from the molecular and cellular level to the organismic level of the intact plant.

International Collaborations

Chinese Academy of Sciences, Beijing, China
Shanghai Jiaotong University, Shanghai, China

National Collaborations

BASF SE, Limburgerhof
Max Planck Institute for Plant Breeding Reserach, Cologne
Forschungszentrum Jülich

Research Field	Plant Biology/Physiology
Keywords	Analytics, GMO, Metabolomics, Plant Produced Products Breeding
Head of Institute	Prof. Dr. Lukas Schreiber
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Fon	+49 228 73-2130

Institute for Molecular Physiology and Biotechnology of Plants

Research at the Institute for Molecular Physiology and Biotechnology of Plants (IMBIO) is concerned with the analysis of the molecular basis of primary metabolic pathways and lipid synthesis in plants and bacteria. We work primarily with model plants like Arabidopsis and Lotus, but also include crop species such as tomato, Camelina and barley, as well as photosynthetic and non-photosynthetic bacteria (e.g., Agrobacterium, cyanobacteria). The work focuses on the identification of enzymes involved in key reactions of metabolic pathways which are involved in the synthesis of economically important intermediates and end products. Pathways are being manipulated in transgenic organisms with the goal to increase the production of important products, e.g. lipids, vitamins, etc.

International Collaborations

Boyce Thompson Institute, Ithaca NY
Michigan State University, East Lansing, MI

National Collaborations

Max Planck Institute for Plant Breeding Reserach, Cologne
University of Cologne
University of Düsseldorf

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)

Research Field	Biochemistry, Plant Biology/Physiology
Keywords	Agricultural Biology, Genomics, Metabolomics, Plant Breeding, Signal Transduction
Head of Institute	Prof. Dr. Peter Dörmann
Internet	www.imbio.uni-bonn.de
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Address Postal Code/City	Karlobert-Kreiten-Str. 13 53115 Bonn
Fon Fax	+49 228 73-2830 +49 228 73-1696

Research Field	Crop Science
Keywords	Agricultural Biotechnology, Crop Research, Genomics, Pathology, Plant Breeding
Head of Institute	Prof. Dr. Claudia Knief
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E-Mail	inres@uni-bonn.de
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Institute of Crop Science and Ressource Conservation

Research at the Institute of Crop Science and Ressource Conservation (INRES) covers diverse topics with the aim to improve crop production. The work of the currently 14 professors addresses molecular aspects of crop production with research in the fields of plant breeding, plant pathology as well as plant growth and development. Likewise, the physiological and genetic basics of plant nutrition and plant stress resistance are addressed. Futhermore, research is performed in the scientific fields of crop production, agroecology, horticulture, renewable resources, soil science and soil microbioloy. Thus, work ranges from the molecuar and cellular level over the organismic level to the field and landscape scale with the aim to achieve sustainable crop production without critical yield deficits.

Experimental research is performed in biological and chemical laboratories, supported by a service platform for plant experiments. Research is likewise performed at the field stations "Campus Klein-Altendorf" and "Wiesengut".

Membership in local and regional Networks

DFG Cluster of Excellence "Phenorob", Bioeconomy Science Center (BioSC), Geoverbund ABC/J, Horticulture Competence Centre (KoGa)

Research Field	Microbiology
Keywords	Enzymes, Genetic Engineering, Microbial Genomics, Advanced Fluorescence Microscopy Methods, Single-molecule Methods and Analyses
Head of Institute	Prof. Dr. Ulrike Endesfelder
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Institute for Microbiology and Biotechnology

The Institute of Microbiology and Biotechnology covers a wide range of topics including microbial cell biology, physiology and genetics, biochemistry and applied microbiology and biotechnology. In education, we offer a MSc Microbiology. Research interests include: cellular *in vivo* biophysics and biochemistry to understand how microorgansims function on a molecular level, applications of quantitative single-molecule tracking and structural super-resolution microscopy in microbiology; biochemistry and molecular genetics of bacterial sulfur metabolism and archaeal methane production; microbial energy conversion; metalloenzymes; fermentation and anaerobic techniques, microbial synthesis of natural low-calorie sugar substitutes and prebiotics for reduction of sugar-associated diseases and promoting human health; biochemistry and interaction of human gut bacteria.

International Collaborations

Biophysics groups, CMU, Pittsburgh, PA, USA
Instituto de Tecnologia Quimica e Biologica, Universidade Nova Lisboa, Portugal
University of East Anglia, Norwich, UK

National Collaborations

Groups within the SPP 2141 (DFG priority program)
Groups within the BMBF joint projects BaPro and IMPRES
Max-Planck-Institutes for Biophysics, Frankfurt, and for Terrestrial Microbiology, Marburg

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)

Institute of Nutritional and Food Sciences

The Institute of Nutritional and Food Sciences (IEL) hosts all major disciplines related to food and nutrition research.

The Professorship ´Molecular Food Technology´ (A. Schieber) provides strong expertise in technological and analytical aspects of secondary plant metabolites, in particular polyphenols and carotenoids. Research interests include: Utilization of side streams of food processing as a source of bioactive and technologically valuable compounds; natural food ingredients; microbial conversions; effects of processing on food ingredients; authentication.

The research focus of the Professorship ´Food Science´ (U.Weisz) is on the recovery of functional ingredients from plant-based materials and by-products of food industry, with emphasis on plant proteins. Research interests include: suitable processing methods for the treatment of plant-based materials; thermal and non-thermal modification of proteins; their chemical and physicochemical analysis, application of proteins in food (meat and dairy alternatives).

International Collaborations

University of Alberta, Edmonton, AB, Canada
Universidad de Costa Rica, San José, Costa Rica
University of Food Technologies, Plovdiv, Bulgaria

National Collaborations

Fraunhofer Institute for Process Engineering and Packaging, Freising
Max Rubner-Institut, Karlsruhe

Membership in local and regional Networks

PLAIN

Research Field	Food Science and Technology
Keywords	Fermentation, Food Science, Metabolomics, Genomics, Plant Produced Products
Head of Institute	Prof. Dr. Ute Weisz, Prof. Dr. Andreas Schieber
Internet	www.lwf.uni-bonn.de/institute/iel/institut/iel/
E-Mail	schieber@uni-bonn.de; uweisz@uni-bonn.de
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Life and Medical Sciences (LIMES) Institute

The Life & Medical Sciences Institute (LIMES) is an internationally oriented center for biomedical research and higher education at the University of Bonn. The main scientific focus of the institute is to explore the regulation of lipid metabolism and the immune system in health and disease, and decipher the signaling processes that take place both within and on biomembranes.
The LIMES research groups provide major research expertise in Chemical Biology, Medicinal Chemistry, Developmental Biology, Genetics, Cell and Immune Biology, Membrane Biology and Lipid Biochemistry.
The LIMES Institute is involved in several national and international research networks. Furthermore, the LIMES groups have set up various teaching programs including the undergraduate study program "Molecular Biomedicine" and the graduate study programs "Biochemistry" and "Immunobiology: from molecules to integrative systems".

International Collaborations

Waseda University Tokyo, Japan
University of Melbourne, Australia
Tokyo University of Agriculture and Technology, Japan
University of Osaka, Japan

National Collaborations

Caesar and DZNE, Bonn
Universities of Heidelberg, Dresden, Cologne

Membership in local and regional Networks

DFG Cluster of Excellence "ImmunoSensation2", IRTG 2168 (Bonn/Melbourne), Neurotech EU, ERA-CVD, TCR 83, TCR 261, SFB 1454, SFB 1089, FOR 2705 et al.

Research Field	Molecular Biomedicine
Keywords	Flow Cytometry, Genomics, Immune Modulation, Infectious Diseases, Synthetic Biology
Head of Institute	Prof. Dr. Waldemar Kolanus
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Address Postal Code/City	Carl-Troll-Straße 31 53115 Bonn
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RUHR UNIVERSITÄT BOCHUM RUB

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Address Postal Code/City	Universitätsstr. 150 44801 Bochum
Contact Person	Jens Wylkop, Corporate Communications, Press Office
Fon	+49 234 32-28355
E-Mail	jens.wylkop@uv.rub.de
Internet	www.rub.de
Founded (year)	1961; opened 1965
Number of employees	scientific 3,670 administrative 2,491
Funding	Others 41% Ferderal Government 23% State Government (NRW) 10% DFG

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Ruhr-Universität Bochum
Creating Knowledge Networks

Located in the midst of the dynamic, hospitable metropolitan Ruhr area, in the heart of Europe, Ruhr-Universität Bochum (RUB) is a place for innovative research and learning for life. Creating Knowledge Networks is its guiding principle. RUB is committed to identifying scientific solutions to global challenges of our time. The university helps its students and early career researchers become active and dedicated participants in an international knowledge society and a globalised labour market. It assumes international responsibility by championing sustainable development and social equality.

RUB is involved in global scientific collaboration networks. Research, learning and teaching, promotion of early career researchers, transfer and social engagement transcend national borders. They are an integral part of global co-operations based upon international best practice models.

Science is driven by individual curiosity and requires open exchange among researchers on all levels and across borders. Therefore, RUB breaks the boundaries between subjects, transcends physical distance and works across generations. With 21 faculties and 42,600 students in some 190 courses of study, RUB is one of the ten largest universities in Germany. As a comprehensive university, it unites the arts, humanities, social sciences, natural sciences, engineering and medicine. Interfaculty and interdisciplinary research departments, which are mutually, nationally and internationally networked, sharpen its profile – especially the two Clusters of Excellence RESOLV (Ruhr Explores Solvation) co-hosted by RUB and TU University Dortmund and CASA (Cyber Security in the Age of Large-Scale Adversaries).

As the first new university founded in the Federal Republic of Germany, RUB rang in a new age of knowledge in 1965. Its architectural design reflected its mission: it placed education in a new context and laid the foundation for Bochum's development into a leading city of education and science.

Center for System-based Antibiotic Research (CESAR)

The Center for System-based Antibiotic Research is an NRW Research Infrastructure. It addresses the need to identify new natural products that can serve as starting points for antibacterial drug discovery. It houses the infrastructure for metabolomics-driven discovery as well as proteomics infrastructure that supports target identification and mechanism of action elucidation.

National Collaborations

Lead Discovery Center GmbH, Dortmund (LDC)

Research Field	Microbiology
Keywords	Antibiotic, Drug Discovery/Drug Delivery, Metabolomics, Systems Biology
Head of Center	Prof. Dr. Julia Bandow
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Chair Biochemistry of Plants

Plants harness solar energy and convert it into biomass by photosynthetic redox reactions in chloroplasts, i.e. plant cell organelles of cyanobacterial origin. Heterotrophic organisms such as mammals depend on chloroplast-derived products making these organelles essential for sustaining human existence. We aim at understanding the biogenesis of chloroplasts and the regulation of their functions by posttranslational protein modifications. To this end, we employ functional genomics tools with a special emphasis on mass spectrometry-based proteomics. Since proteins are essential for virtually all cellular functions, information about their abundance, turnover and state of modification provides unique insights into the functioning of plant cells.

International Collaborations

University of Neuchatel, Switzerland
CAS Photobiology, Beijing, China
University of Birmingham, UK

National Collaborations

University of Hannover
University of Kaiserslautern
MPI Potsdam

Membership in local and regional Networks

UNIC

Research Field	Biochemistry, Plant Biochemistry
Keywords	Crop Research, Proteomics, Photosynthesis, Organelle Biogenesis
Head of Chair	Prof. S. Baginsky
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Research Field	Molecular Neuroscience
Keywords	Neurodegenerative Diseases, Neurotransmitter Receptors, Neuroscience, Molecular Neurobiology, Signal Transduction
Head of Department	Prof. Dr. Michael Hollmann
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Postal Code/City	44801 Bochum
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Fax	+49 234 32-14244

Department Biochemistry I – Receptor Biochemistry

We investigate the structure, assembly, intracellular transport, function, regulation, and modulation of ionotropic glutamate receptors (GluRs). We employ molecular biological and electrophysiological methods combined with confocal microscopy and protein biochemistry. We analyze functional properties of members of GluRs in heterologous expression systems such as *Xenopus* oocytes and HEK293 cells. In our studies, we include vertebrate glutamate receptors as well as invertebrate and plant GluRs. Current projects include the modulation of GluRs by interacting membrane proteins, the cloning and functional analysis of plant GluR homologs from *Arabidopsis thaliana*, the expression of GluRs in differentiating stem cells, the function of the orphan receptors of the delta subfamily and the antigenic properties of glutamate receptors that elict autoimmune responses to glutamate receptors in normal people as well as in patients with various neurological diseases.

International Collaborations

Inst. Bioorg. Chem., Moskow, Russia
Ben-Gurion Univ. Beer Sheva, Israel

National Collaborations

MPI of Experimental Medicine, Göttingen
Abteilung Myozelluläre Elektrophysiol., Universitätsklinikum Münster

Membership in local and regional Networks

Kompetenznetzwerke Neurowiss. (Neuro-NRW) & Stem Cell Network.NRW

Research Field	Biochemistry, Membrane Biology
Keywords	Membrane Transporter, Flippases, Model Membranes, Lipids
Head of Department	Prof. Dr. Thomas Günther-Pomorski
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Department Biochemistry II – Membrane Biology

Our laboratory is interested in elucidating the organization, functioning and dynamics of membrane transporters at the molecular level. These proteins are nano-machines that perform a wide range of essential cellular functions by transporting ions, lipids and metabolites between the cell and environment or between cellular compartments. Our methodological approaches include the purification and reconstitution of membrane complexes and their components into model membranes, thereby enabling their molecular analysis at different levels of complexity in defined lipid environments through advanced fluorescence microscopy and spectroscopy. Further, we develop and apply methods in chemical biology including the synthesis of novel probes for characterizing membrane properties, protein-membrane interactions and lipid trafficking. These set-ups are completed by various *in vivo* approaches in parasites, fungi and mammalian cells as model organisms.

International Collaborations

Luxembourg Institute of Health, Luxembourg
Tytgat Institute for Liver and Intestinal Research, Netherlands
University of Copenhagen, Denmark
University of Paris-Sud, France
Weill Cornell Medical College, New York, USA

National Collaborations

University Leipzig

Department of Biophysics

At the Department of Biophysics, we investigate the dynamics of proteins across scales, orchestrating a broad range of biochemical and molecular biological methods with molecular-resolving biophysical methods; in particular newly developed methods of label-free time-resolved infrared difference spectroscopy on recombinant proteins. The experimental results are evaluated with biomolecular simulations. This approach provides molecular reaction mechanisms of proteins with highest spatial and temporal resolution. With this approach the molecular reaction mechanism of bacteriorhodopsin and the Ras protein have been elucidated.

Understanding protein dynamics is not only of purely academic interest, but also has great potential for application in medicine. Disturbances in protein dynamics can trigger serious diseases. The work at the Department of Biophysics is therefore complemented by the work in the Biospectroscopy competence area at the Centre for Protein Diagnostics (PRODI).

International Collaborations

CAS-MPG Partner Institute for Computational Biology, Shanghai, China
Northeastern University, Boston, USA
University of California, Irvine, USA

National Collaborations

MPI of Molecular Physiology, Dortmund
University Medical Center Göttingen
Humboldt University Berlin

Membership in local and regional Networks

PURE, SPP 1926 (DFG), Research Training Group 2341 (DFG)

Research Field	Biophysics, Imaging
Keywords	Biomarker, Recombinant Proteins, Small Molecules, Structural Biology, Biomolecular Simulations
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Department of General Zoology and Neurobiology

The overall goal of my research is to understand how G-proteins modulate ion channels and intracellular signaling pathways and how this modulation in turn determines neuronal network function and behavior.

Not easily addressed in the reduced preparations where G-protein signaling is for the most part studied is the most basic question: Why are neuronal systems modulated by G-proteins? We therefore developed a non-invasive approach to induce G-protein modulation into channels and neuronal networks by light using vertebrate rhodopsin. These light activated GPCRs are currently be used to gain an understanding of the role of this signaling pathway for emotional and motor behavior as well as their underlying physiological response in animal models of disease, i.e. anxiety, aggression, ataxia and absence epilepsy.

International Collaborations

Baylor College of Medicine, Houston, USA
Rotterdam, NL
Case Western Reserve University, Cleveland, USA

National Collaborations

University of Heidelberg

Research Field	Cell Biology, Neurobiology, Optogenetics
Keywords	Animal Models, Genetic Engineering, Neurodegenerative Diseases, Signal Transduction
Head of Department	Prof. Dr. Stefan Herlitze
Internet	www.ruhr-uni-bochum.de/neurobiol/index.html.en
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Address	Universitätsstraße 150 ND 7/32
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Research Field	Environmental Biology/ Chemistry
Keywords	Biodiversity, Chemical Ecology, Evolution, Molecular Biology, Population Genetics
Head of Institute	Prof. Dr. Ralph Tollrian
Internet	www.rub.de/ecoevo
E-Mail	simone.jannett@ruhr-uni-bochum.de tollrian@rub.de
Address	Universitätsstraße 150 NDEF 5/754
Postal Code/City	44780 Bochum
Fon	+49 234 32-24998
Fax	+49 234 32-14114

Institute of Animal Ecology, Evolution and Biodiversity

Research in the fields of biodiversity, ecology and evolution with a geographic range from polar regions (Antarctic, deep sea) to the tropics (coral reef research, rainforests). Special emphasis on local and regional projects (climate change and anthropogenic effects on freshwater systems, chemical ecology of polinator systems), collaboration with LANUV and nature conservation agencies, fundamental research on phenotypic plasticity (metabolic pathways, genomics, ecosystem effects), phylogenetics and DNA barcoding (cryptic species, species identification, species description) and many population genetic projects (genetic diversity, population connectivity), evolution of sex.

International Collaborations

The University of Iowa, USA
University of Otago, Dunedin, NZ
Britisch Antarctic Survey, Cambridge, UK
University of Birmingham, UK

National Collaborations

University of Bayreuth
University of Würzburg
Alfred Wegener Institute, Bremerhaven
TU Darmstadt

Research Field	Biotechnology, Microbiology
Keywords	Antibiotic, Biocatalysts, Drug Discovery/Drug Delivery, Metabolomics, Proteomics
Head of Institute	Prof. Dr. Julia Bandow
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Institute of Applied Microbiology

Three research areas are pursued in the Department:

1. Searching for novel natural products of microbial origin using metabolomics;

2. Investigating antibiotic mechanisms of action by applying global methods such as proteomics in addition to classical techniques;

3. Developing applications of cold atmospheric pressure plasma in biotechnology and characterizing effects of plasma on microbes.

Institute of Cell Morphology and Molecular Neurobiology

The Department of Cell Morphology and Molecular Neurobiology aims at the elucidation of the molecular and cellular bases that regulate the generation of the central nervous system. Thematic groups focus i) on the biology of radial glia stem cells, motoneurons, glial progenitors and their microenvironment, the stem cell niche during development and under pathological conditions; ii) on neuron-glia interactions and their regulatory influence on axon growth and guidance, as well as synaptogenesis and synaptic plasticity; iii) on retinal stem cells and their integration into neural networks and the possible application to visual system lesions and degeneration. On the molecular level, glycoproteins, chondroitin-sulfate proteoglycans and their receptors, tyrosine phosphatases and downstream GTPases of the RhoA-family and GEFs (e.g. Vav-proteins) are studied using molecular and cell biological tools, and genetically modified animal models.

International Collaborations

The University of Edinburgh, UK
Hokkaido University, Sapporo, Japan
University of Cambridge, UK

National Collaborations

Ludwig Maximilians University München
Otto von Guericke University Magdeburg
Ruhr University Bochum

Membership in local and regional Networks

Stem Cell Network NRW

Research Field	Cell Biology, Neurobiology, Stem Cell Biology
Keywords	Animal Models, Antibody, Regenerative Medicine, Stem Cell Research, Tissue Engineering
Head of Institute	Prof. Dr. Andreas Faissner
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Institute of General and Molecular Botany

The major goal of the Department of General and Molecular Botany is to understand basic biological processes at the molecular level. Major research topics are the functional investigations of developmental processes in filamentous fungi as well as the analysis of regulators controlling the biosynthesis of secondary metabolites, such as antibiotics. We use for our genetic studies diverse fungi from the genera Sordaria, Penicillium and Neurospora. To address these research questions a wide range of methods and techniques are applied including genetic engineering of eukaryotic microbes, functional genomics (genome sequencing, RNA-seq, ChIP-seq), protein biochemistry (recombinant protein technology, affinity chromatography), high resolution microscopy and bioinformatics.

International Collaborations

University of California, Berkeley
University of Nottingham
Duke University, NC, USA

National Collaborations

Georg-August-Universität Göttingen
Leibniz-Institut für Analytische Wissenschaften (ISAS)
TU Braunschweig

Research Field	Genetics, Molecular Biology
Keywords	Antibiotic, Microbial Genomics, Genetic Engineering, Microscopy, Signal Transduction
Head of Institute	Prof. Dr. Ulrich Kück
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Research Field	Microbiology, Genetics, Molecular Biology
Keywords	Regulatory RNAs, Microbial Enzymes, Signal Transduction
Head of Institute	Prof. Dr. Franz Narberhaus
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Institute of Microbial Biology

We work in three major research areas: (i) Sensory and regulator RNAs in pathogenic bacteria: We are interested in the structure, function and transcriptome-wide analysis of temperature-sensitive RNA structures (RNA thermometers) and small regulatory RNAs that are involved in virulence responses. (ii) Membrane lipid biosynthesis: We study the mechanistic details of bacterial enzymes catalyzing novel phospholipid biosynthesis pathways. (iii) Control of lipopolysaccharide biosynthesis in Escherichia coli: We elucidate the molecular control of LPS biosynthesis by the signaling nucleotide ppGpp, and examine the effect of LPS biosynthesis inhibitors.

International Collaborations

Ohio University, USA
Stanford University, USA

National Collaborations

University Münster

Membership in local and regional Networks

RTG Microbial Substrate Conversion
MiCon (DFG)
SPP 2002 (DFG)
SPP 1879 (DFG)

Research Field	Allergology, Immunology, Toxicology, Molecular Medicine, Public Health
Keywords	Analytics, Biomarker, Environmental Research, Occupational Research
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Institute for Prevention and Occupational Medicine of the German Social Accident Insurance (IPA)

IPA carries out research in the field of occupational medicine, allergology and immunology, toxicology, molecular medicine and epidemiology and with a particular focus on work-related diseases, e.g.,the respiratory and urological system and the skin. Special interests include health effects of carcinogenic, mutagenic and reproductive chemicals, biomarkers for cancer diagnostics, biological monitoring of exposure, pathomechanisms of work-related diseases, health effects of shift works, and respiratory and skin allergens and irritants. Molecular and epidemiological studies are either carried out at the workplace (field studies) or, after ethical approval, in environmentally-controlled exposure laboratories. Research on humans is complemented by experimental studies *in vitro* (cell culture). Overall, sound-scientific research results are used for health preventive measures at the workplace and for the compensation of work-related diseases.

International Collaborations

University of Colorado
Langone Medical Center, New York
WHO/Int. Union of Immunological Societies
HBM4U

National Collaborations

Ruhr-Universität Bochum
Universitätsklinikum Hamburg-Eppendorf (UKE)

Membership in local and regional Networks

DFG (MAK-Kommission)

Microbial Biotechnology

The MBT Team is interdisciplinary working to describe novel biocatalysts: from gene to product. It combines versatile methods from disciplines as microbiology, molecular biology, bio-/chemistry and biocatalysis. We typically employ (meta)genomics and screening of strains or clone libraries to uncover novel activities. Respective genes are expressed and if needed modified by various mutagenic strategies. Along we employ phylogenetics and homology modelling. Sophisticated analytics allow to describe reactions and intermediates to study biochemical properties or biocatalytic processes. The developed biocatalysts are employed in cell-free enzyme reactors or whole-cell biotransformation in order to produce novel valuable compounds such as aroma, fine chemicals, pharmacophores among others.

International Collaborations
TU Delft
University Groningen
Wageningen University

National Collaborations
TU Dresden
Ruhr-Universität Bochum

Membership in local and regional Networks
DECHEMA
VAAM
SolarBioproducts Ruhr
DBU

Research Field	Biotechnology
Keywords	Biocatalysis, Enzymology, Biotransformation
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Protein Research Department

The Protein Research Department (PRD) is an interdisciplinary research network who realize research co-operations in the field of protein research. Topics such as protein structure and mechanism, macromolecular assemblies, functions of membrane protein complexes and cellular behavior are investigated from a molecular perspective using state-of-the-art methods from structural biology, biophysics, biochemistry and cell biology.

A main objective of the PRD is the investigation of basic scientific questions. Exemplary are the DFG Research Training Group "Microbial Substrate Conversion" (MiCon), which deals with mechanistic principles of microbial metabolic processes on a molecular level, and the DFG Research Unit "Structure and Function of the Peroxisomal Translocon" (PerTrans), which works on the elucidation of the import of folded proteins across the peroxisomal membrane.

The PRD is closely associated with the Center for Protein Diagnostics (PRODI).

International Collaborations
Shanghai Institutes for Biological Sciences (SIBS)
The Rockefeller University
Weizmann Institute of Science

National Collaborations
Hans-Knöll-Institute / Leibniz-Institute
MPI of Molecular Physiology
The Institute for Prevention and Occupational Medicine of the German Social Accident Insurance

Membership in local and regional Networks
Colon register study

Research Field	Protein Research
Keywords	Anti-infective Research, Biomarker, Drug Discovery/Drug Delivery, Neurodegenerative Diseases, Proteomics
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Research Field	Neurobiology, Neurophysiology
Keywords	Ageing, Animal Models, Neurodegenerative Diseases, Signal Transduction, Systems Biology
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Research Department of Neuroscience

The Research Department of Neuroscience (RDN) is a trans-faculty structure that promotes neuroscience research. Our mission is to achieve an understanding of the functional architecture of the brain by focusing on the neural system as a whole. The RDN therefore provides an integrative research platform for molecular, cellular, systems, cognitive, theoretical and clinical neuroscience. Projects in these areas are highly collaborative and interdisciplinary, as demonstrated by the two ongoing Collaborative Research Centers SFB 874 and SFB 1280. The RDN promotes excellence in research by providing state-of-the-art research infrastructure, fosters early-career scientists and facilitates collaborations between working groups, especially through its Neuroimaging Centre. A major strength of neuroscience at Ruhr-University Bochum is the focus on systems neuroscience in alliance with cognitive science, resulting in the Centre for Theoretical and Integrative Neuroscience and Cognitive Science, which is currently under construction.

International Collaborations

University Otago, New Zealand
University of Canberra, Australia

National Collaborations

Forschungszentrum Jülich
Research Consortia NeuroMind
Erwin-Hahn-Institute, Essen

Membership in local and regional Networks

SFB 874 (DFG), SFB 1280 (DFG), FOR 2812 (DFG)
International Graduate School of Neuroscience IGSN, NFDI Neuroscience

RWTH AACHEN UNIVERSITY

KEYWORDS
Biomaterials, Biomass, Pathology, Systems Biology

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Internet	www.rwth-aachen.de
Founded (year)	1870
Number of employees	scientific 6,680 administrative 2,939
Funding	State Government NRW 54%, Third-party funding 38%, Special funds 8%

www.rwth-aachen.de


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RWTH Aachen University
Thinking the Future

RWTH Aachen University exploits strong research networks and the intellectual curiosity of its staff to address bold scientific questions, transfer forefront knowledge and drive innovative discoveries that impact global challenges. The Excellence Initiative of the German federal and state governments provided RWTH with a unique opportunity to boost its research profile by strengthening the natural sciences and fostering interdisciplinary research. These were the first steps in RWTH's steady transformation into an Integrated Interdisciplinary University of Technology and also towards convergence.

Topics include sustainable synthetic fuels, data mining, computational science, production technology, high-performance materials, health, renewable resources and mobility. The successful implementation of the institutional strategy is reflected in the reputation of RWTH's graduates, the exceptional position of the University regarding acquisition of peer-reviewed third party funds and the RWTH Aachen Campus.

The RWTH Aachen Campus visibly highlights the research prowess of the University. The entrepreneurial mindset and collaboration with industry partners fostered on the Campus benefit both students and employees of RWTH. The many stimulating ideas are already having an impact in Aachen and the entire tri-border region of Germany, Belgium and the Netherlands. An innovative knowledge community is evolving that is closely networked with some of the world's leading research and industry partners. The University's innovative capacity is reflected in the high number of business start-ups. Furthermore, RWTH Aachen is the largest employer and education provider in the region. RWTH will continue to play a decisive role as a driving force influencing and shaping this high-tech region.

RWTH Aachen University offers competence-, research- and practice-oriented training with the goal of developing highly qualified and responsible graduates for leading positions in science, society and business. The University educates over 47,000 students enrolled in 150 courses. This includes more than 12,477 international students from over 138 countries.

Institute of Biology I – Botany/Molecular Genetics

We study different aspects in the area of molecular plant sciences by performing both basic and applied research. A particular focus on our work is devoted to the analysis of plant responses to biotic and abiotic stresses. We analyze plant-microbe interactions and examine the consequences of oxygen stress in plants caused by flooding. We further investigate plant secondary metabolism and cell wall biosynthesis. Our work relies on the combination of genetic, genomic, biochemical and cellular methods.

International Collaborations

Imperial College London, U.K.
NTNU Trondheim, Norway
University of Pisa, Italy

National Collaborations

Max-Planck Institute for Plant Breeding Research, Cologne
Max-Planck Institute for Moleular Plant Physiology, Golm
Forschungszentrum Jülich (IBG-2, IBG-4)

Research Field	Plant Cell Biology, Plant-Microbe Interactions, Molecular Plant Ecology, Plant Stress Biology
Keywords	Plant Pathology, Plant Stress, Plant Cell Wall, Secondary Metabolism
Internet	www.biologie.rwth-aachen.de/cms/Biologie/Fachgruppe/Institute-und-Lehrstuehle/~pti/Institut-fuer-Biologie-I-Botanik-Molekul/?lidx=1
E-Mail	barth@bio1.rwth-aachen.de
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Institute of Biology III – Plant Physiology

We use molecular biology, biochemistry, metabolomics, and physiology to understand how plants withstand disease and abiotic stress. Our primary foci are on epigenetics, transcriptional gene regulation, metabolic analysis, mathematical modelling, priming and other cellular defense mechanisms, and fungal virulence and transformation. We also address agrobiotechnology and bioeconomy by translating concepts discovered in basic research with model organisms and crops to sustainable and eco-friendly agriculture.

International Collaborations

University of Wisconsin-Madison, USA
University of California Irvine, USA
National Center for Genetic Engineering and Biotechnology, Thailand
Bayer CropScience S.A.S., France
Syngenta Crop Protection AG, Switzerland

National Collaborations

Bonn University
TU Kaiserslautern University
TU Munich University
LMU Munich University
Julius Kühn Institute
BASF Plant Science
Südzucker AG

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)

Research Field	Plant Biochemistry, Plant Physiology, Plant Pathology
Keywords	Agricultural Biotechnology, Bioeconomy, Biomathematics, Crop Protection, Plant Metabolomics
Head of Institute	Prof. Alan Slusarenko Ph.D.
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Research Field	Biotechnology, Microbiology, Metabolic Engineering
Keywords	Bioeconomy, Biomaterials, Fermentation, Applied Microbiology, Synthetic Biology
Head of Institute	Prof. Dr.-Ing. Dipl. Bio. Lars M. Blank
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Institute of Biology IV – Applied Microbiology – iAMB

At the Institute of Applied Microbiology (iAMB) of the RWTH Aachen University scientists work on various contributions to a circular bioeconomy. These contributions are to be seen in the context of the RWTH Aachen University goals "Meeting global challenges". Here, the focus lies on the sustainable production of valuable substances from biobased carbon feedstocks, carbon dioxide or plastic polymers. The design of microbial cell factories (bacteria, yeasts, fungi) and bioprocesses are based on systems analysis of the underlying metabolic pathways, metabolic engineering and lab scale process optimization.

International Collaborations

The Novo Nordisk Foundation Center for Biosustainability, DTU, Denmark
National Center of Biotechnology, CIB-CSIC, Madrid, Spain
University College Dublin, BioOrbic Bioeconomy SFI Research Centre, Ireland

National Collaborations

TU Dortmund, Department 6 - Biochemical and Chemical Engineering
University Greifswald, Dep. Biotechnology and Enzyme Catalysis
Research Center Jülich, Institute for Bio- and Geosciences

Membership in local and regional Networks

CLIB, Bioeconomy Science Center (BioSC), Excellence Cluster - The Fuel Science Center (FSC), Center for Circular Economy (CCE), Applikationszentrum für Angewandte Biotechnik (APZ)

Research Field	Environmental Biology/ Chemistry
Keywords	Environmental Research, Renewable Energy and Resources
Head of Institute	Prof. Dr. Andreas Schäffer
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Institute for Biology V – Environmental Research

We study the metabolism, bioavailability, binding of environmental pollutants and the formation of non-extractable residues in soil, water-sediment, and plants. In addition we develop remediation technologies of polluted sites, e.g. by phytoremediation.

We are developing test systems in order to assess acute, chronic and mechanism-specific toxicity caused by such pollutants by in vitro methods, various test species, populations and communities in lab- and field-based systems. The observed effects are used for the extrapolation of environmental risks.

Simulation models are able to depict and predict concentration-dependent effects and their extent on individuals, populations and communities. In individual-based simulation we use process-based models based on the life-cycle of individuals, in statistic modelling approaches the model structure is developed in a data-based inductive way.

International Collaborations

University of Saskatchewan (Canada), FHNW/Basel (Switzerland), Universities Shanghai (Tongji), Nanjing, and Chongqing

National Collaborations

Many cooperation partners from universities, Helmholtz Centers and Fraunhofer institutes

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)
The Fuel Science Center – Adaptive Conversion Systems for Renewable Energy and Carbon Sources

Institute for Biology VI – Department of Biotechnology

We are experts in biocatalyst engineering with a focus on directed protein evolution. We are developing novel random mutagenesis methods (SeSaM: Sequence Saturation Method), high throughput screening systems and computational programs to manage the complexity of protein sequence space. Based on our core competencies in directed protein evolution we founded a company (SeSaM-Biotech) and collaborate with leading companies in the field of industrial biotechnology. To facilitate the translation of our research into industry, we founded Aachen Proteineers GmbH in 2018, which provides an opportunity for interested start-up teams to test and scale their ideas. With our expertise we aim to understand structure-function relationships of biocatalysts and functional biomaterials in order to solve significant problems in industrial biocatalysis.

International Collaborations

Tianjin Institute of Industrial Biotechnology (TIB), China
Osaka University, Japan
EU ITNs

National Collaborations

Bioeconomy Science Center (BioSC)
SFB 985 Functional Microgels and Microgel Systems

Membership in local and regional Networks

CLIB, JARA-HPC, EFB – European Federation of Biotechnology, Co-Chair Division

Research Field	Biotechnology, Biointeractive Materials
Keywords	Protein Engineering, Directed Evolution, Hybrid-Catalysts, Biological Transformation
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Institute of Biology VII – Molecular Biotechnology

The Institute of Molecular Biotechnology, in cooperation with the Fraunhofer Institute for Molecular Biology and Applied Ecology (IME), is involved in the development of plants that are genetically optimized for the production of active proteins and industrially utilizable raw materials. Biosynthetic pathways of plants can be genetically optimized to enrich defined secondary metabolites or to reduce their concentration. In addition, synthesis in other organisms may contribute to the production of important herbal ingredients, thus the institute uses metabolic engineering in different production organisms. In the field of plant virology, the institute develops viruses as expression vectors for recombinant proteins from plant bioreactors and designs virus particles for use in biomaterials and as carriers for pharmaceutically active substances.

International Collaborations

University of California San Diego (UCSD),
University of St. Andrews,

National Collaborations

University of Münster,
Heinrich Heine University Düsseldorf,
Forschungszentrum Jülich, UK Aachen

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)

Research Field	Biotechnology
Keywords	Biocatalysts, Recombinant Proteins, Plant Virus Nanoparticles, Biomaterials
Internet	www.molbiotech.rwth-aachen.de
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Research Field	Medical Devices
Keywords	Chip Technology, Diagnostic Systems, Environmental Research, Biosensors, Medical Wearables
Head of Institute	Univ.-Prof. Dr. rer. nat. Sven Ingebrandt
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Institute of Materials in Electrical Engineering 1

The institute´s activities are focused on the development of micro- and nanosystems for biomedicine and life sciences as well as for environmental sensing and industry 4.0 applications. There is a strong aspect of developing and using silicon, 2D materials, heterostructures, composite materials, and conductive polymers as thin films and as nanostructured, optoelectronic active elements in micro- and nanosystems. The team also focusses on fundamental science aspects with particular emphasize on material combinations in novel sensors. Main activities lie on the coupling of biological systems (such as living cells, cellular compartments like membranes, proteins, antibodies, and DNA) to the technical systems, development of "intelligent" implants, prostheses, and medical wearable devices as well as microfluidic systems for biotechnology and biomedical diagnostics.

International Collaborations

Tokyo Institute of Technology, School of Chemical Engineering, Tokyo, Japan
University of Maastricht, Faculty of Science and Engineering, The Netherlands
Council of Scientific and Industrial Research - Central Scientific Instruments Organisation, Chandigarh, India

National Collaborations

Forschungszentrum Jülich GmbH
Fraunhofer IMS, Duisburg und Universität Duisburg-Essen
Justus-Liebig Universität Giessen, Exzellenzcluster Kardio-Pulmonales System

Membership in local and regional Networks

Landescluster NanoMikroWerkstoffePhotonik.NRW, JARA-Brain, VDE Regio Aachen e.V., DGBMT

Research Field	Biotechnology, Process Development
Keywords	Bioeconomy, Biomass, Bio-processing, Fermentation, Pilot Plant
Head of Institute	Prof. Dr.-Ing. Jochen Büchs
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Aachener Verfahrenstechnik – Biochemical Engineering (AVT.BioVT)

The chair has three main research areas: characterization of shaken culture systems, fermentation technology and development of new online measurements techniques at all (bioreactor) scales.The chair has contributed significantly to an increased understanding of the cultivation conditions in microtiter plates and shake flasks. The development and commercialization of several online monitoring tools for shake flasks and microtiter plates are main achievements. These include RAMOS (Respiration Activity MOnitoring System) and BioLector devices. In addition, techniques for fed-batch operations for small-scale cultures (e.g. FeedBeads and FeedPlates) have been developed. Furthermore, the chair operates four overpressure bioreactors, with which a scale-up to the pilot plant scale is possible (150 L). All techniques are applied in cultivation of organisms such as bacteria, fungi, yeast and mammalian cell cultures.

International Collaborations

iConsensus
BioconcO_2

National Collaborations

Bioeconomy Science Centre (BioSC)
Industrial partners

Membership in local and regional Networks

CLIB
DECHEMA

Aachener Verfahrenstechnik – Fluid Process Engineering – (AVT.FVT)

The research of the chair of fluid process engineering AVT.FVT is focused on the low-energy separation techniques extraction, crystallization, adsorption and chromatography, in particular for biotechnological applications. The aim of our research is to extend the understanding of separation processes by targeted investigations of the fundamental phenomena. For this purpose, we use a combination of experimental and model-based methods. From this, we are able to apply model-based design methods to develop optimal and robust processes as well as investigate options for process intensification. Currently, one focus lies on the development of holistic biorefinery concepts for the production of bio-based platform chemicals. By combining innovative process concepts such as *in-situ* product separation or electrochemically induced separation with techno-economic analyses, promising process concepts are being developed. To provide comprehensive feasibility studies, the processes are scaled-up to technical scale in the modular biorefinery of AVT.

National Collaborations

Bioeonomy Science Centre (BioSC)
BioökonomieREVIER
Cluster of Excellence "Fuel Science Centre" (DFG)

Membership in local and regional Networks

CLIB
DECHEMA / ProcessNet
VDI

Research Field	Downstream Processing, Biorefinery Concepts
Keywords	Separation of bio-based Product Mixtures, Model-based Process Design
Head of Institute	Prof. Dr.-Ing. Andreas Jupke
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Aachener Verfahrenstechnik – Soft Matter Process Engineering

The focus of research is on the development of new functional materials that are produced from biomaterials such as proteins and polysaccharides with the aim of preserving their structure and, as far as possible, their functional properties. To prepare the functional materials, we modify the solubility properties or the intermolecular interactions of the biopolymers or use various methods for concentration such as membrane separation processes and drying. A number of high-resolution spectroscopic and imaging techniques are used to monitor the structure formation processes. In detail, we investigate structure-process relationships in 1. fiber formation from micellar casein; 2. biomass digestion; 3. production and functionalization of microparticles and 4. production of gels and particles based on renewable raw materials.

International Collaborations

European Synchrotron Radiation Facility

National Collaborations

Heinrich-Heine-University of Düsseldorf

Membership in local and regional Networks

Bioeonomy Science Centre (BioSC)
ProcessNet-Fachgruppe Lebensmittelverfahrenstechnik
Vereinigung zur Förderung der Milchwissenschaftlichen Forschung

Research Field	Biotechnology
Keywords	Biomaterials, Biomass, Bio-processing, Food Science, Structural Biology
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Research Field	Biotechnology, Process Development
Keywords	Analytics, Bio-materials/ -mass/-processing/ -refinery, Bioenergy Research, Process Design/ Optimization
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Aachener Verfahrenstechnik – Process Systems Engineering (AVT.SMP)

The chair for Process Systems Engineering (SVT) was founded in 2012 and is directed by Prof. Alexander Mitsos, PhD, who moved to RWTH from MIT. It deals with computer-based methods for Process Engineering, i.e. Modeling, Simulation and Optimization. Our particular goals are process synthesis and process optimization. Our focus is on optimal design and operation of new chemical processes and energy systems based on existing and new methods. In particular we are aiming in optimal use of renewable energy and material sources for sustainable processes. In parallel we develop methods and algorithms.

International Collaborations

Imperial College London (ICL)
University of Cambridge (UCAM)
Massachusetts Institute of Technology (MIT)

National Collaborations

Cluster of Excellence Tailor Made Fuels from Biomass
Bioeconomy Science Centre (BioSC)
DFG, SFB985, Functional Microgels and Microgel Systems

Membership in local and regional Networks

DECHEMA
VDI

Technische Universität Dortmund TU Dortmund University

TU Dortmund University is a dynamic research-oriented university with 17 faculties in the natural and engineering sciences as well as social sciences and cultural studies. Around 6,500 employees make a daily contribution here to solving pressing questions of the present and the future. The international campus offers excellent learning conditions for over 33,000 students. The Ruhr metropolitan region guarantees short distances to diverse partners from science and industry.

The research strength of TU Dortmund University is particularly distinguished in its four profile areas, in which the University has achieved outstanding international success beyond disciplinary boundaries: (1) Materials, Production Technology and Logistics, (2) Chemical Biology, Drug Research and Process Engineering,(3) Data Analysis, Modeling and Simulation, (4) Education, Schooling and Inclusion.

Focus on Drug Research and Process Engineering

The second profile area, Chemical Biology, Drug Research and Process Engineering, brings together strong partners: Here, Europe's largest Faculty of Biochemical and Chemical Engineering, Dortmund's Max Planck Institute of Molecular Physiology, and the Faculty of Chemistry and Chemical Biology cooperate with other research institutions. Colleagues from the faculties of statistics, mathematics and computer science help to push research on modeling and big data analysis forward. In 2014, an interdisciplinary team founded the Dortmund Drug Discovery Hub (DDDH). Students can choose from courses in biochemical engineering, chemical biology, medicinal physics or statistics with a focus on biometrics.

TU Dortmund University has played a crucial role in transforming the city into a high-tech and service hub. Since the TechnologieZentrumDortmund was founded in 1985, Europe's largest technology park has been growing in direct vicinity to the campus. Several entrepreneurs found a home for their startup in the BioMedizinZentrum next door.

technische universität dortmund

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Fon	+49 231 755-6026
E-Mail	forschungsfoerderung@tu-dortmund.de
Internet	www.tu-dortmund.de
Founded (year)	1968
Number of employees	total 6,500

www.tu-dortmund.de/en

Research Field	Biotechnology, Natural Products, Bioprocess Engineering
Keywords	Biocatalysts, Bioprocessing, Fermentation, Genetic Engineering, Synthetic Biotechnology
Head of Studies	Prof. Dr. S. Lütz Prof. Dr. M. Nett Prof. Dr. O. Kayser
Internet	www.bio.bci.tu-dortmund.de
E-Mail	bio.sek@bci.tu-dortmund.de
Address	Emil-Figge-Str. 66 Building 1, Room 6.11
Postal Code/City	44227 Dortmund
Fon	+49 231 755-7489
Fax	+49 231 755-7488

Biocenter

The Biocenter at the Department of Biochemical and Chemical Engineering is committed to the discovery of natural products from microorganisms and plants with the goal to develop efficient and green bioprocesses. The laboratories of Bioprocess Engineering (Lütz lab), Technical Biochemistry (Kayser lab) and Technical Biology (Nett lab) offer an integrated research line, starting from the identification of bioactive compounds and biocatalysts to the development of pilot scale bioprocesses. The natural synthesis is rebuilt in sustainable and environmentally compatible bioprocesses, using natural and genetically modified microbial chassis as well as isolated enzymes. To do this, the Biocenter is equipped with cutting-edge instruments, among them sensitive mass spectrometers, compatible cultivation systems from the micro to liter scale, located in our state-of-the-art laboratories.

International Collaborations

Lodz University of Technology, Lodz, Poland
Plant and Food, Auckland, New Zealand
Royal Holloway University, London, UK

National Collaborations

Universität Bielefeld/CeBiTec
Leibniz Institute for Natural Product Research and Infection Biology, Hans- Knöll-Institute (HKI), Jena
Institute for Plant Biochemistry (IPB), Halle

Membership in local and regional Networks

CLIB-Kompetenzzentrum Biotechnologie

Research Field	Biomathematics
Keywords	Biomaterials, Modeling, Mathematical Analysis and Simulation, Signal Transduction, Systems Biology
Head of Group	Prof. Dr. Matthias Röger
Internet	www.mathematik.uni-dortmund.de/lsxi/roeger/index.html
E-Mail	matthias.roeger@tu-dortmund.de
Address	Vogelpothsweg 87
Postal Code/City	44227 Dortmund
Fon	+49 231 755-3462
Fax	+49 231 755-5942

Biomathematics Group

The biomathematics group is part of the Faculty of Mathematics at TU Dortmund University. The group is concerned with mathematical modeling, analysis, and numerical simulation of biological processes. We are in particular interested in processes in cells and on cell membranes, possibly coupled with mechanical remodeling of cell shape. We have investigated symmetry breaking in signaling networks, transport processes in cells, and self-organization and elasticity properties of artificial membranes. A proper description of such complex systems is challenging as it needs to account for spatial and temporal variations, a proper coupling between cytosolic and membrane-bound processes and a description of evolving cell shape. The group aims at developing mathematical analysis approaches and numerical simulation techniques that allow to treat the specific challenges presented by biological systems.

Laboratory of Fluid Mechanics

Industrially manufactured products, whether in the food or biochemical sectors, usually consist of several macromolecular components that are brought together during production and processed by targeted deformation, pressure and temperature effects. Prof. Germann's Laboratory of Fluid Mechanics focuses on experimental materials characterization, particularly the study of the microstructural dynamics of materials under stress and the resulting mechanical properties. We also develop material models and use them to make predictions for engineering flow applications. Systematic investigations on a laboratory scale up to pilot plant tests provide valuable information for product development and manufacturing.

International Collaborations

ETH Zurich, Switzerland
University of Delaware, USA
IRET-CNR, Italy

National Collaborations

FAU

Research Field	Rheology (Non-Newtonian Fluid Mechanics)
Keywords	Biomaterials, Food Science, Bio-processing
Head of Laboratory	Prof. Dr. Natalie Germann
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E-Mail	natalie.germann@tu-dortmund.de
Address	Emil-Figge-Str. 68 Building G3
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Fon	+49 231 755-5955
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Laboratory of Thermodynamics

Research in the group covers several areas: Measuring and predicting physical properties of bio(macro)molecule solutions, aiding liquid-phase design in biocatalysis, downstream processing in biocatalysis, and (bio) pharmaceutical formulations.

Molecules of interest include active pharmaceutical ingredients, biomacromolecules (enzymes, antibodies), electrolytes, peptides, and amino acids. Physicochemical properties, stability, phase and reaction equilibria (including kinetics) are investigated both, experimentally and theoretically. Special emphasis is placed on the sophisticated design of superior liquid phases, investigating the influence of several parameters (e.g. salts, buffer, pH, cofactors, enzymes) on phase equilibria and reactions.

Based on these investigations, tailor-made liquid phases are proposed for a variety of applications, including enzymatic catalysis, downstream processing in biotechnology, and (bio)pharmaceutical formulations (both, in liquid and solid form).

International Collaborations

Janssen Pharma
Georgia Institute of Technology Atlanta, GA
PUC Santiago de Chile

National Collaborations

KIT
Universität Rostock
AbbVie

Membership in local and regional Networks

CLIB CKB
RESOLV Excellence Cluster
INVITE, DDIC

Research Field	Process and Product Development
Keywords	Antibody, Biocatalysts, Biologicals/ Biopharmaceuticals, Downstream Processing, Enzymes
Head of Laboratory	Prof. Dr. Gabriele Sadowski
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UNIVERSITÄT DUISBURG ESSEN

Open-Minded

Name	University of Duisburg-Essen
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Contact Person	Prof. Dr. Ulrich Radtke (Rector)
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E-Mail	rektor@uni-due.de
Internet	www.uni-due.de
Founded (year)	2003
Number of employees	scientific 4,324 administrative 1,557
Funding	German Research Foundation (DFG), Federal Ministry of Education and Research (BMBF)/ Federal Funds, EU, Foundations

www.uni-due.de

University of Duisburg-Essen
Open-Minded

Located in the heart of the Ruhr metropolis, the University of Duisburg-Essen (UDE) is one of the youngest and largest universities in Germany. It's also wellknown in the international scientific community. The Times Higher Education ranked UDE 18th among the best young universities worldwide in 2021. The slogan "open-minded" stands for innovative teaching and research as well as the lived diversity and genuine educational equality practiced at the UDE. At the UDE close to 43,000 students from more than 130 countries are enrolled in a total of over 250 courses of study ranging from the humanities and social sciences over economics and business studies all the way to the engineering sciences and natural sciences (including medicine). An important objective of the UDE's diversity management program is to offer equal opportunities to young people from non-academic backgrounds.

The research carried out at UDE covers a broad spectrum including five inter-departmental research priorities: nanosciences, biomedical sciences, urban systems, transformation of contemporary societies and water research. The steady increase in the total influx of research money to the UDE – now well over 140 million euros annually when the third party funding of the Faculty of Medicine is taken into account – reflects the success of these research efforts. As a global academic player, UDE works in partnership with more than 100 universities all over the world. It is a member of the University Alliance Ruhr (UA Ruhr), a strategic coalition formed by the three universities in the Ruhr area. The UA Ruhr operates liaison offices in North America and Russia.

Center of Medical Biotechnology

The Center of Medical Biotechnology (ZMB) provides the framework for interdisciplinary biomedical research at UDE, integrating 80 groups at UDE campus and the University Hospital. It´s mission is to elucidate molecular mechanisms of disease and to turn this knowledge into medical progress.

The interdisciplinary approach that covers basic scientific research and application oriented medical research is reflected in three research areas: i) oncology, ii) immunology, infectious diseases and transplantation and iii) molecular and chemical cell biology.

The dynamic, stimulating and collaborative research environment crosses traditional boundaries and involves joint projects with the biotechnical and pharmaceutical industry, nanotechnology, physics and engineering.

With state-of-the-art facillities, BSc and MSc schemes in Medical and Molecular Biology and structured (inter)national doctoral programs, the ZMB provides excellent training for a scientific career in the biomedical field.

National Collaborations

Max Planck Institute for Molecular Physiology, Dortmund
German Consortium for Translational Cancer Research

Membership in local and regional Networks

University Alliance Ruhr

Research Field	Biotechnology, Life Sciences
Keywords	Infectious Diseases, Oncology, Immunology, Molecular and Chemical Cell Biology
Head of Centre	Prof. Dr. Michael Ehrmann
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Center for Water and Environmental Research

The Centre for Water and Environmental Research (ZWU) was funded in 2003 with the goal to advance modern environmental research which links global social changes and challenges (such as population growth, urbanisation and megacities, climate change, water availably and sustainable energy supply) with environmental concerns and integrates their effects on human life. This kind of research is primarily interdisciplinary and ranges from natural and engineering sciences to medical and social sciences, and economics. Main focus of the ZWU activities is on water research with a wide spectrum of expertise in the field water ecology, drinking water treatment and supply (contamination, evaluation, and purification), environmental toxicology and chemistry, urban water management, hydrology, hydraulic engineering, and water governance including competencies in water economy and law. Since 2020, "Water Research" is one of UDE's five main research areas.

International Collaborations

Radboud University Nijmegen, NL
Fayoum University, Egypt
Nort-West University Potchefstroom, SA

National Collaborations

Ruhr-University Bochum
Hochschule Ruhr-West, Mülheim
IWW Zentrum Wasser

Membership in local and regional Networks

Water Science Alliance
Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.
Deutsche Gesellschaft für Membrantechnik e.V.

Research Field	Integrated Water and Environmental Research
Keywords	Water Quality Monitoring, Molecular Environmental Diagnostics, Photocatalysis, Biodiversity, Algae Research
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Research Field	Biotechnology, Microbiology
Keywords	Archaea, Hyperthermophiles, Extremophiles, Metabolism, Extremozymes
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Center for Molecular Enzyme Technology and Biochemistry (MEB)

The Molecular Enzyme Technology and Biochemistry is part of the Environmental Microbiology and Biotechnology unit (Faculty of Chemistry) at the University of Duisburg-Essen. For many years, we are researching the decoding of the complexity and the regulation of metabolism in (hyper) thermophilic archaea. A combination of classic methods of biochemistry, enzymatics and molecular biology with new high-throughput technologies (poly-omics) and modeling is used to achieve the most holistic understanding possible. Based on this basic research, the application of archaeal enzymes or enzyme cascades and the development of *Sulfolobus acidocaldarius* (growth 80 °C, pH 2-3) as a new archaeal platform organism for biotechnology are in the foreground of our work.

Bettina Siebers has been the coordinator of various applied (inter) national joint projects (SulfoSYS, SulfoSYSBIOTEC, HotSysAPP, HotSolute, HotAcidFACTORY) since 2007.

International Collaborations

Stellenbosch University (South Africa)
University of Exeter (UK)
Wageningen University (NL)

National Collaborations

University of Freiburg
University of Bielefeld
University of Braunschweig

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Internet	www.uni-koeln.de
Founded (year)	1388
Number of employees	scientific 5,226 administrative 3,342

www.uni-koeln.de


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University of Cologne
Good ideas – since 1388

The University of Cologne (UoC) is one of Germany's leading research universities. It is home to more than 50.000 students who can choose from over 300 degree courses. UoC promotes research-based teaching methods and places particular emphasis on supporting young talent with a view to professional and academic careers. To find solutions to the most pressing issues of our time, UoC has established six major, internationally competitive research areas: age-associated diseases, behavioral economic engineering and social cognition, quantum matter and materials, socio-economic, cultural and political change in the Global South, plant sciences and skills and structures in language and cognition.

The Faculty of Medicine and the Faculty of Mathematics and Natural Sciences host UoC's life and natural sciences including biology, chemistry, geography, geosciences, mathematics and physics. Three out of UoC's four Clusters of Excellence are based here providing an ideal environment for cutting-edge interdisciplinary and internationally oriented research:

- the Cluster of Excellence on Cellular Stress Responses in Aging-Associated Diseases (CECAD) aiming at developing new therapies for the entire spectrum of aging-associated diseases, including cancer, diabetes, stroke, renal failure and neurodegenerative disorders,
- the Cluster of Excellence on Plant Sciences (CEPLAS) which contributes new paradigms to the solution of urgent problems in plant performance and production through the exploitation of natural variation and biodiversity and, finally,
- the Cluster of Excellence on Matter and Light for Quantum Computing (ML4Q) aiming at developing new computing and networking architectures using the principles of quantum mechanics.

In addition, UoC has established the Cologne Center for Ethics, Rights, Economics, and Social Sciences of Health (ceres), a cross-departmental center for interdisciplinary research, education and advanced training in the area of health, which advises high caliber policy makers and administrators on health related matters.

Center for Molecular Medicine Cologne

The Center for Molecular Medicine Cologne – founded in 1994 – is a multi-disciplinary center within the Faculty of Medicine and the Faculty of Mathematics and Natural Sciences at the University of Cologne. It provides a forum that brings together clinicians with research scientists who can perform top-quality competitive research due to the outstanding constellation of faculty and facilities including state-of-the-art technologies and access to unique disease models and patient material. The CMMC's mission – based on its highly collaborative approach – is to advance the understanding of the underlying molecular and cellular mechanisms of human diseases as a prelude to improving prevention, diagnosis and treatment of many common health problems. Currently, the CMMC comprises 60 research groups investigating on the molecular level the pathogenetic mechanisms of cardiovascular disorders, cancer, inflammatory and infectious diseases as well as neurological disorders.

International Collaborations
National Collaborations
Membership in local and regional Networks
Detailed information:
www.cmmc-uni-koeln.de/about-us/scientific-environment

Research Field	Biomedical Research
Keywords	Cardiovascular Research, Infectious Diseases, Neurodegenerative Diseases, Oncology
Head of Center	Prof. Dr. Thomas Benzing, Chair Dr. Debora Grosskopf-Kroiher, Scientific Coordinator
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Address	Robert-Koch-Str. 21 CMMC-Research Building
Postal Code/City	50931 Köln
Fon	+49 221 478-89536
Fax	+49 221 478-4833

Institute for Genetics

The Institute for Genetics, founded in 1962 by Max Delbrück, currently includes 16 professorships and several independent young investigators groups that promote excellence in research and teaching. Research at the Institute for Genetics covers a broad spectrum of topics ranging from molecular, cell to computational biology. Molecular mechanisms at all levels are studied in model organisms, cell cultures and in silico. The Institute provides access to shared infrastructure and central service units, which allows young researchers to work within an excellent international research environment at its two locations, the Biocenter and the CECAD research center on ageing-associated diseases.

Research Field	Genetics, Molecular Biology
Keywords	Ageing, Inflammation, -Omics, RNA/RNAi, Systems Biology
Head of Institute	Prof. Dr. Thomas Wiehe
Internet	https://genetik.uni-koeln.de
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Universität Siegen

KEYWORDS

Biomaterials and Sensing, Micro- and Nanochemistry, Neurobiology, Life Sciences, Biochemistry / Biotechnology

Name	University of Siegen
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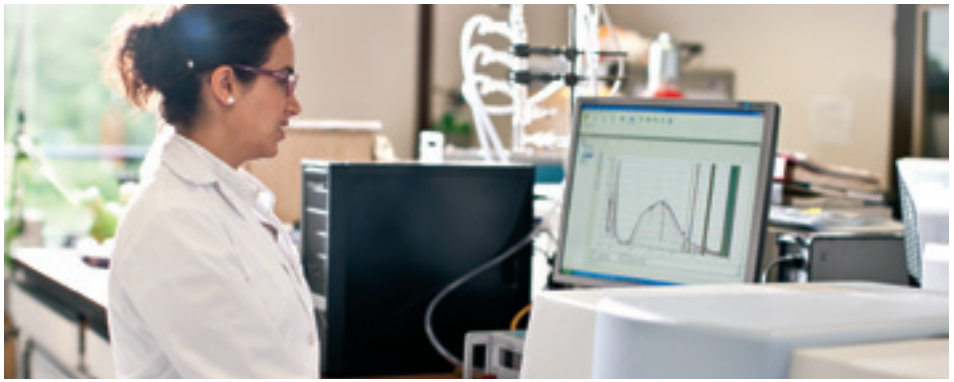
Contact Person	André Zeppenfeld
Fon	+49 271 740-0
E-Mail	presse@uni-siegen.de
Internet	www.uni-siegen.de
Founded (year)	1972
Number of employees	scientific 1,424 administrative 854
Funding	State Government NRW 80% 20% third-party funding

www.uni-siegen.de



University of Siegen

Shaping a Humane Future

The University of Siegen is a young, dynamic, and innovative University. The University is firmly rooted in the region of South Westphalia and is extensively networked on both a national and an international level. It is natural for the way the University views itself to link responsibility for education, training, and general societal issues on the regional level with common international demands on teaching, study, research, and the transfer of knowledge, as well as to perceive the further development of these areas as an ongoing task. The overriding goal of the University of Siegen is to contribute to a humane future and to assume responsibility for people and society. This is expressed in the guiding principle of the University of Siegen: shaping a humane future.

Around 19,000 young people study here today, and more than 2,200 academic and non-academic employees ensure that the course of administration, research, and teaching is set for the future.

Several research focuses have emerged from five interdisciplinary faculties: excellent cultural and media research has been a tradition at the University of Siegen for many years. At the University of Siegen, the German Research Foundation (DFG) established the Collaborative Research Center "Media of Cooperation" in 2016, the transregional Collaborative Research Center "Particle Physics Phenomenology after the Higgs Discovery" in 2019, and the Collaborative Research Center "Transformation of the Popular" in 2020. Another long-term focus is the area "Sensors and Nanoscience". In research, there are currently more projects in progress at one time than ever before, totaling even more than in the first 30 years of the University's existence.

Research and teaching enjoy equal priority at the University of Siegen. Teaching is itself understood as a research-based process, which benefits the students. The University of Siegen offers students a diverse range of courses with individual support and many opportunities to become actively involved.

The University of Siegen cooperates with more than 200 universities worldwide and consistently emphasizes international orientation in all areas: be it through global research associations and english-language degree programs, or by supporting the international mobility of students and employees.

Department of Chemistry – Biology

The Department with its focus on micro- and nanochemistry as well as (bio)technology has numerous connections with the life sciences. The research activities span all the way from sensor materials synthesis, functional materials and advanced microscopic characterization to biological and biomedical applications. The different research groups are involved e.g. in the platform development focused at the creation of complex multifunctional nanostructures, the design, synthesis and characterization of new molecules as versatile DNA/RNA-binding ligands and fluorescent probes, also biologically relevant analytes, polymer-based biomaterials for bacterial detection and controlled release in wound dressings; polymeric hydrogel based materials for biointerfaces, sensing and protein-RNA interactions in the scope of neurodegenerative diseases.

International Collaborations

Laboratorio di Oncoematologia, Università di Padova, Italy
UMR INSERM/ UBO, Brest, France
Department of Chemistry, University of Bath, UK

National Collaborations

University of Bonn / DZNE e.V. , Bonn
Center for Molecular and Cellular Bioengineering, Technical University Dresden
Biomedical Technology Center (BMTC) of the Medical Faculty of Münster

Membership in local and regional Networks

"Research Center for Micro- and Nanochemistry and Engineering" University of Siegen

Research Field	Functional Materials, Micro- and Nanochemistry, Nano-technology, Biomedical Technology
Keywords	Biomaterials, DNA/RNA, Drug Discovery/Drug Delivery, Microscopy, Bioorganic Chemistry
Head of Department	Prof. Dr. Carsten Engelhard
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Human Biology and Neurobiology / Department of Chemistry – Biology

Neurodegenerative diseases are characterized by progressive cell loss in the central nervous system. One cause of genetic neurodegeneration is the expansion of repetitive sequences like CAG trinucleotide repeats. The so-called CAG repeat diseases are characterized by symptoms such as the progressive loss of cognitive abilities and progressive movement disorders. Structurally, mutant CAG repeat RNA differs from the physiological RNA: the expanded CAG repeats fold into characteristic hairpin structures. These hairpin structures aberrantly recruit RNA-binding proteins leading to both: a loss of physiological function of the RNA-binding proteins and a gain of function of these proteins in conjunction with the mutant RNA. The goal of our studies is to investigate such aberrant RNA-protein interactions and thereby identify molecular targets for innovative treatment strategies. For our investigations we are using a broad panel of molecular and cell biological methods.

International Collaborations

University of Innsbruck, Austria
University of Perugia, Italy
Leiden University Medical Center, The Netherlands

National Collaborations

MDC Berlin
University of Bonn / DZNE e.V. Bonn
German Research School for Simulation Sciences, Forschungszentrum Jülich

Membership in local and regional Networks

Member of the Research Center for Micro- and Nanochemistry and Bio(Technology) (Cμ)

Research Field	Neurobiology
Keywords	mRNA, Neurodegenerative Diseases, RNA/RNAi/ antisense RNA, Signal Transduction, Therapeutics
Head of Sectiot	Prof. Dr. Sybille Krauß
Internet	https://biologie-uni-siegen.de/?page_id=344
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Postal Code/City	57076 Siegen
Fon	+49 271 740-2273

Research Field	Behavioral Biology & Ecology
Keywords	Animal Models, Behavioral Biology, Conservation Biology, Ecotoxicology, Ecology
Head of Section	Prof. Dr. Klaudia Witte
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Integrative Biology / Department of Chemistry – Biology

My research projects cover several topics in the fields of Behavioral Biology, Ecology and Ecotoxicology. We investigate proximate and ultimate factors in sexual selection in fish and birds and focus on the role of social information in mate choice in fish by using interactive computer animations developed and designed in close cooperation with computer scientists. Additionally, we investigate the role of social learning in fish and frogs. To understand life history strategies long lived and long-distance migratory birds, we monitor breeding success in common swifts and record their migration behavior outside their breeding period. To discover possible biogenic effects of silver and titanium-dioxid nanoparticles we study the fate and effect of wastewater-borne manufactured nanoparticles in Daphnia and Danio rerio together with several partners. Together with several partners we develop a real-time detection system of the varroa mite in brood cells of honey bee combs.

International Collaborations

Section of Integrative Biology, University of Austin, USA,
Department of Biology, Centre for Animal Movement Research at the Lund University

National Collaborations

Fraunhofer Institute for Molecular Biology and Applied Ecology IME, Schmallenberg
Center for Sensorsystems (ZESS) University of Siegen

Research Field	Molecular Physiology
Keywords	Animal Models, Molecular Physiology, Chitin Biology, Gastrointestinal Immunity, Membrane Proteins
Head of Section	Prof. Dr. Hans Merzendorfer
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Section of Molecular Biology / Department of Chemistry – Biology

Our research focuses on the properties of chitin-containing matrices in the intestine of invertebrates, and the modes of chitin biosynthesis, modification and degradation. We examine these processes mainly in the pest model beetle Tribolium castaneum, which is amenable to systemic RNA interference allowing the functional analysis of various genes including immunity-related genes. Additionally, we use the genetic model system Saccharomyces cerevisiae, which allows us to examine intracellular maturation and trafficking of proteins involved in chitin biosynthesis. Several classes of commercially applied insecticides and miticites act as chitin synthesis inhibitors. Their modes of action as well as resistance mechanisms against them are matters of particular interest to us. In this context, we study the roles of ABC transporters.

International Collaborations

Dept. of Biochemistry and Molecular Biophysics, Kansas-State University, USA
Institute for Plant Protection, Chinese Academy of Agricultural Sciences, Beijing, China
Dept. of Entomology, North Carolina State University, USA

National Collaborations

Department of Genetics, University of Tübingen
Dept. of Biological Materials, Center for Molecular and Cellular Bioengineering, TU Dresden

Membership in local and regional Networks

Member of the Research Center for Micro- and Nanochemistry and Bio(Technology) (Cμ), University of Siegen

Organic Chemistry / Department of Chemistry – Biology (Ihmels)

With the long-term goal to establish annelated quinolizinium derivatives as versatile platform for the design of DNA-binding ligands and fluorescent probes, we study the synthetic approaches to this class of compounds and investigate in detail their chemical, photophysical and DNA-binding properties. Along with the perspective of discovering novel DNA-targeting drugs, our main research interest lies in the understanding of structural parameters that govern the DNA-binding properties of cationic hetarenes, in particular towards special DNA forms such as triplex- and quadruplex DNA, and DNA with abasic sites.

In another project we aim at the development of fluorescent probes based on the water-soluble benzo[b]quinolizinium fluorophore that enable the fluorimetric detection of biologically relevant analytes.

International Collaborations

Department of Women's and Child's health, Oncohematology laboratory,University of Padova, Italy
Prof. Dr. Olga Fedorova, A. N. Nesmeyanov Institute of Organoelement compounds, Russian Academy of Sciences, Moscow, Russian Federation

National Collaborations

Department of Chemistry, Universität Bielefeld,
Physical Chemistry, University of Siegen
Institute of Organic Chemistry, University of Würzburg

Membership in local and regional Networks

Member of the Research Center for Micro- and Nanochemistry and Bio(Technology) (Cμ), University of Siegen

Research Field	Organic Chemistry
Keywords	Small Molecules, Bioorganic Chemistry, DNA-Ligands, Fluorescent Dyes and Probes
Head of Section	Prof. Dr. Heiko Ihmels
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Address Postal Code/City	Adolf-Reichwein-Str. 2 57076 Siegen
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Organic Chemistry / Department of Chemistry – Biology (Berdnikova)

Our research aims at the development of RNA-targeting organic molecules with particular focus on governing the RNA–ligand interactions by light. We are working on three main projects:

i) Design, synthesis and investigation of photoswitchable binders for natural therapeutically relevant RNAs, such as HIV RNA, human telomeric TERRA RNA and other RNA species. Identification of novel organic photoswitches for bioapplications.

ii) Development of RNA-targeting antibiotics with light-controllable activity and identification of novel therapeutically relevant RNA targets.

iii) Development of the NMR spectroscopy with in situ irradiation and real-time NMR monitoring of photochemical reactions and photoinduced RNA dynamics (in cooperation with Dr. Thomas Paululat, Universität Siegen).

International Collaborations

Laboratoire Ondes et Matière d'Aquitaine – UMR CNRS 5798, Bordeaux University, Talence, France
Nesmeyanov Institute of Organoelement compounds, Russian Academy of Sciences, Moscow, Russian Federation
Czech Advanced Technology and Research Institute, Palacký University, Olomouc, Czech Republic

National Collaborations

Forschungszentrum Jülich, Germany

Membership in local and regional Networks

Member of the Research Center for Micro- and Nanochemistry and Bio(Technology) (Cμ), University of Siegen

Research Field	Organic Chemistry
Keywords	Antibiotic, Drug Discovery/Drug Delivery, Photochemistry, RNA/RNAi/Antisense RNA
Head of Section	Dr. Daria Berdnikova
Internet	www.chemie-biologie.uni-siegen.de/oc/oc2/mitarbeiter/berdnikova.html?lang=de
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Address Postal Code/City	Adolf-Reichwein-Str. 2 57076 Siegen
Fon Fax	+49 271 740-2057 +49 271 740-4052

Research Field	Physical Chemistry
Keywords	Anti-infective Research, Cell Separation, Diagnostic Systems, Personalized Medicine
Head of Section	Prof. Dr. Holger Schönherr
Internet	www.chemie-biologie.uni-siegen.de/pc/hs/
E-Mail	schoenherr@chemie.uni-siegen.de
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Physical Chemistry I / Department of Chemistry – Biology (Schönherr)

Our research revolves around the physics and chemistry of polymeric materials with a focus on micro- and in particular nanostructures, self-organized systems and functional biointerfaces. We cover the complete breadth of physicochemically and biomaterial science oriented multidisciplinary research from synthesis to characterization using state-of-the art surface analytics and microscopy. Specific research efforts focus on the autonomous detection of pathogenic bacteria, in which the detection, identification and treatment of bacteria via reactions triggered e.g by bacterial enzymes are targeted. In separate project we combine nano- and microstructuring with defined surface functionalization with polymer brushes to obtain novel 2D and 3D cell microenvironments, including the development of selective cell release surfaces and intelligent antimicrobially active implant coating.

International Collaborations

Department of Chemistry, Univ. of Bath, UK
UMR INSERM/ UBO, Brest, France
Monash University, Melbourne, Australia

National Collaborations

Organic Chemistry, University of Siegen
Macromolecular Chemistry, University of Siegen, Siegen
Biomedical Technology Center (BMTC) of the Medical Faculty of Münster

Membership in local and regional Networks

Member of the Research Center for Micro- and Nanochemistry and Bio(Technology) (Cμ), University of Siegen, Member of the CVD.NRW

Research Field	Microbiology
Keywords	Biomaterials, Diagnostic Systems, Infectious Diseases, Personalized Medicine, Quorum Sensing
Head of Section	Dr. Mareike Müller
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Physical Chemistry I / Department of Chemistry – Biology (Müller)

The group's research is focused on the development, detection and confinement of bacterial biofilms both from a basic and applied research point of view. Specifically we investigate the impact of bacterial signaling molecules (e.g. Quorum Sensing molecules) but also signaling molecules derived from infected hosts (e.g. hormones) on the development of medically relevant biofilms, such as *Pseudomonas aeruginosa* biofilms in cystic fibrosis. Our research methods range from standard methods in microbiology and molecular biology to various microscopy techniques, including fluorescence and scanning electron microscopy. Moreover we use bacterial signaling molecules and enzymes as potential targets for point of care detection approaches for bacterial pathogens and test new biomaterials in interdisciplinary collaborations for their functionality and performance in biological systems.

International Collaborations

UMR INSERM/ UBO, Brest, France
Medical Microbiology, UMC, Amsterdam, NL
Chemical Engineering , DeKUT, Nyeri, Kenya

National Collaborations

Organic Chemistry, University of Siegen
Macromolecular Chemistry, University of Siegen, Siegen
Molecular Bacteriology HZI / TWINCORE, Hannover

Membership in local and regional Networks

Member of the Research Center for Micro- and Nanochemistry and Bio(Technology) (Cμ), University of Siegen, Member of the Forschungsgemeinschaft Mukoviszidose (FGM), Mukoviszidose e.V.

School of Life Sciences

The School of Life Sciences specializes in digital healthcare and combines disciplines such as biotechnology, medical informatics, epidemiology, psychology, and digital public health. Research focusses on mobile diagnostics/healthcare at home, XR technologies, patient-centered digital monitoring, and health services research for rural areas. Multi-morbidity of older patients is a common topic.

International Collaborations
Erasmus Medical Center Rotterdam

National Collaborations
University of Bonn
DZNE Bonn

Membership in local and regional Networks
Digital Health Germany

Research Field	Health, Digital Healthcare
Keywords	Ageing, Diagnostic Systems, Neurodegenerative Diseases, Personalized Medicine
Head of Section	Prof. Dr. Christoph Strünck
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School of Life Sciences – Biochemistry

Viruses affect basically all organisms on earth. Some are detrimental to human development, whereas those targeting pathogenic bacteria or crop pathogens can be beneficial for us. We investigate structural changes in protein complexes of human pathogenic viruses throughout the viral lifecycle. Transition states or intermediates, for which structural information is scarce, of dynamic processes are of special interest for rational drug design. To monitor and structurally characterize such transition states, the group mainly employs mass spectrometry (MS) and develops new approaches in combination with X-rays in order to achieve single molecule like analysis with high spatial and temporal resolution. Using structural MS, we look at the formation of coronaviral replication/transcription complexes as well as structural changes and assembly of norovirus capsids, which are proteinaceous shells protecting the viral genome.

International Collaborations
MS SPIDOC Project
Viruscan, Madrid

National Collaborations
European XFEL, Leibniz Institute for Experimental Virology (HPI)
Centre for Structural Systems Biology (CSSB)
German Electron Synchrotron (DESY)

Membership in local and regional Networks
www.virocarb.de

Research Field	Physical Chemistry
Keywords	Virology, Coronavirus, Norovirus, Structural Mass Spectroscopy, X-ray Free Electron Laser
Head of Section	Prof. Dr. Charlotte Uetrecht
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Address Postal Code/City	Am Eichenhang 50 57076 Siegen
Fon	+49 40 48051-261

Research Field	Biotechnology
Keywords	Cardiovascular Research, Hemostasis, Thrombosis, Mechanobiology, Microfluidics
Head of Section	Prof. Dr. Maria Brehm
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School of Life Sciences – Biotechnology

Blood flow leads to physical forces continuously acting on the inner layer of blood vessels (endothelial cells), blood cells and plasma proteins. Alterations in these forces are sensed by the cells and converted into biochemical signaling cascades. Pathophysiological changes of this mechanotransduction can lead to disturbed hemostasis or thromboembolic events resulting in bleeding symptoms or vessel occlusion (thrombosis, myocardial infarction (MI), stroke), respectively. Our research focusses on the biochemical and mechanobiological mechanisms underlying these diseases and the identification of novel treatment options. One research focus is laid on the mechanosensitive plasma glycoprotein, von Willebrand Factor (VWF), which is essential to primary hemostasis by recruiting platelets to the site of vascular injury. Using cell culture techniques, microfluidics, platelet function tests as well as biophysical methods, we are investigating genetic variants either leading to the most common hereditary bleeding disorder, von Willebrand disease, or an increased risk of prothrombotic events such as MI.

International Collaborations

Albert Einstein College of Medicine, Bronx, NY, USA.
Center on Bleeding Disorders and Thrombosis, Mayo Clinic, Rochester, MN, USA.

National Collaborations

Department of Dermatology, University Medical Center Hamburg-Eppendorf,
Group of Molecular Biomechanics, Heidelberg
Structural and Computational Biology, EMBL, Heidelberg, Germany

Westfälische Wilhelms-Universität Münster

WWU Münster – living.knowledge

Excellent research

The University of Münster is one of the largest universities in Germany with a rich and time-honoured tradition. It enjoys an outstanding reputation in the region and far beyond. Fifteen faculties with 120 degree programmes and some 30 research centres comprise the institutional backbone of the University. Some 45,700 students and 5,300 academics appreciate the University's excellent research opportunities, high-quality teaching, promotion of junior researchers, and the advantages of living in the city of Münster. Our slogan sums it up best: "living. knowledge".

As a research-oriented university, the University of Münster oversees pioneering research in the fields of the humanities, social sciences, natural sciences, life sciences, business and economics, and law. Some 600 professors and 4,700 academic staff members teach and conduct research in 15 faculties. Two clusters of excellence, 19 collaborative research centres (SFBs), several research training groups and independent junior research groups, 26 interdisciplinary research centres and numerous research projects provide the foundation for inter- and transdisciplinary collaborations and excellent individual research at the disciplinary level. The University supports cross-disciplinary research partnerships especially in its profile areas. These include battery research, cell dynamics and imaging, nanosciences, and the clusters of excellence "Religion and Politics" and "Mathematics Münster. Dynamics – Geometry – Structure". The fields of evolutionary research and neural systems hold great potential for excellence in the coming years.

Cooperations

- Max Planck Institute for Molecular Biomedicine
- Helmholtz Institute Münster (HI MS)
- Fraunhofer Institute of Molecular Biology and Applied Ecology (IME)
- University of Twente
- Bielefeld University

WWU MÜNSTER

KEYWORDS

Biomarker, Biomaterials, Sequencing, Stem Cell Research, Microbial Genomics

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Internet	www.uni-muenster.de/en/
Founded (year)	1780
Number of employees	scientific 5,318 administrative 1,940

www.uni-muenster.de

Research Field	Structural Cell Biology
Keywords	Ageing, Recombinant Proteins, Structural Biology
Head of Institute	Univ. Prof. Dr. Christos Gatsogiannis, Prof. Dr. Bart Jan Ravoo
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Center for Soft Nanoscience (SoN)

Our group aims to understand fundamental cellular processes at atomic level of detail. To this end, cryo electron microscopy is one of our key methods. High-end cryo microscopes allow the direct observation of biological specimens, purified or even in their functional cellular environments. We recently moved to the WWU to establish a cutting-edge cryoEM infrastructure at the Center for Soft Nanoscience (SoN). In addition, we started-up a modern biochemistry and cell culture laboratory at SoN for recombinant expression of target proteins and purification of organelles for cryoEM studies. Our research concentrates on the molecular understanding of peroxisomal biogenesis. Peroxisomes are dynamic small organelles carrying crucial metabolic functions in our cells. Peroxisomal dysfunction and impaired enzyme import result in devastating inborn metabolic disorders. Our research aims to provide mechanistic insights into such cellular pathways associated with disease and develop a strong foundation for novel therapeutic treatments.

International Collaborations

Prof. George Diallinas, University of Athens, Greece
Prof. Yoshikazu Tanaka, Tohoku University, Japan

National Collaborations

Prof. Ralf Erdmann, Ruhr University Bochum
Prof. Stefan Westermann, University Duisburg Essen
Prof. Hemmo Meyer, University Duisburg Essen

Research Field	Health, Medical Devices, Translational Imaging
Keywords	Cardiovascular Research, Diagnostic Systems, Oncology, Molecular Imaging, Small Molecules
Head of Institute	Univ.-Prof. Dr. med. Michael Schäfers
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Fon	+49 251 83-49300

European Institute for Molecular Imaging (EIMI)

Our interdisciplinary team develops imaging methods allowing to visualize molecular processes inside organisms, tissues and cells. With the help of imaging we study vascular, inflammatory, infectious and neurodegenerative diseases, and cancer but also the development of blood and lymphatic vessels. The most important applications comprise imaging studies in model systems, which can be directly translated into clinical application to serve imaging-guided patient-tailored diagnosis and treatment. Beside research efforts we foster teaching and training of young researchers. Faculties involved comprise Medicine, Chemistry and Pharmacy, Mathematics and Computer Science, and Physics.

International Collaborations

University of Groningen
University of Twente

National Collaborations

University of Tübingen

Membership in local and regional Networks

DFG CRC 1450 “inSight – Multiscale imaging of organ-specific inflammation” (coordination), Cells in Motion Interfaculty Centre, University of Münster

Institute of Moelcular Microbiology and Biotechnology (IMMB)

The IMMB has a long tradition of research in applied microbiology and biotechnology, and currently harbours 4 groups (Prof. Fetzner, Prof. Berg, Prof. Philipp, Prof. Schmid). All of them investigate basic and applied aspects of microbiology and enzymology. Many projects are related to biotechnological processes. Targeted molecules are biopolymers such as polysaccharides, polyesters and lipids. Other compounds, such as steroids, heteroaromatic molecules and aromatic flavors are produced by fermentation, enzymatic reaction cascades or biotransformation. New pathways e.g., for CO2-fixation are analysed in the context of bioeconomy research. Metabolic and enzyme as well as strain engineering are the main strengths of the institute. The bioreactor laboratory allows process optimization (parallel fermentations) and scale-up (500-L), so that novel compounds can be produced at the kilogram scale.

International Collaborations

Norwegian University of Science and Technology, Norway
ETH Zürich, Switzerland
Rensselaer Polytechnic Institute, USA

National Collaborations

Max Plank Institute for Terrestrial Microbiology, Marburg
University of Göttingen
Technical University of Munich

Research Field	Biotechnology, Microbiology
Keywords	Bioeconomy, Biomaterials, Biologicals, Enzymes, Pilot Plant
Head of Institute	Prof. Dr.-Ing. Jochen Schmid
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Address Postal Code/City	Corrensstrasse 3 48149 Münster
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Institute for Neuro- and Behavioural Biology

Work within the institute is devoted to an understanding of the development and function of the nervous system as well as causes and consequences of behaviour. We combine behavioral and neuroendocrine analyses, imaging, biochemistry and molecular genetics to decipher how neural networks control specific aspects of behavior. Current research topics include analysis of cytoskeletal dynamics, glial development and glial cell migration in Drosophila, function of the blood-brain barrier, development and dynamics of cell junctions, molecular mechanisms underlying the differentiation of wrapping glial cells, cell-cell adhesion, developmental pruning of dendrites, larval locomotion, evolution and development of social behavior, gene-environment interaction in emotion, cognition, aggressive and anxiety-like behaviour as well as animal welfare. Members of the institute strongly participate in teaching biology students at all levels in all biological BSc and MSc study programs. The institute is well-known for high end imaging techniques and houses one of the largest Drosophila facilities in Germany.

International Collaborations

University of California San Francisco, USA
Salpêtrière, ParisSYNPOL (EU-Project)
University of Texas, Southwestern Medical Center, USA

National Collaborations

University of Bielefeld; University of Bonn; University of Leipzig

Membership in local and regional Networks

SFB 1009, SFB 1348, SFB-TRR212

Research Field	Genetics, Behavioural, Biology, Molecular Biology, Neurobiology
Keywords	Animal Models, CINCHRON, DNA, Genetic Engineering, Signal Transduction
Head of Institute	Prof. Dr. Christian Klämbt
Internet	www.uni-muenster.de/Biologie.NeuroVer/en/
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Address Postal Code/City	Badestrasse 9/13 48149 Münster
Fon	+49 251 83-21122

Research Field	Natural Product Chemistry, Pharmaceutical Biology and Phytochemistry
Keywords	Bioeconomy, Drug Discovery/Drug Delivery, Infectious Diseases, Nutrition, Plant Produced Products
Head of Institute	Prof. Dr. Andreas Hensel
Internet	www.uni-muenster.de/Chemie.pb
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Institute of Pharmaceutical Biology and Phytochemistry

Natural Product Chemistry

Glycobiology (Oligo-, Polysaccharides, Glycoproteins): Structural aspects and pharmacological activity

Antiadhesive natural products against pathogens

Skin-active natural products and biochemical pathways to improved wound healing

Ethnopharmacology: New pharmacological activities of traditional medicinal plants

Neglected diseases

Computational lead discovery

Stability of plant-derived secondary products and herbal materials

Analytical development and standardization of herbal drug material.

International Collaborations

Several Partners in Brazil: Sao Paulo, Maringa etc.
Several Partners in Europe: UK, Spain, Italy, Austria, Switzerland, Hungary etc.; several partners in Africa: Ghana, Cameroon, Sudan
Several Partners in Asia: India, Vietnam, Thailand

Membership in local and regional Networks

National Research Platform for Zoonoses

Research Field	Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Bioenergy Research, Plant Produced Products, ‘Omics Techniques, Signal Transduction
Head of Institute	Prof. Dr. Antje von Schaewen, SP7; Prof. Dr. Bruno Moerschbacher, SP8
Internet	www.uni-muenster.de/biologie.ibbp/index.shtml
E-Mail	ibbp@uni-muenster.de
Address	Schlosspl. 7, 48149 Münster
Postal Code/City	Schlosspl. 8, 48143 Münster
Fon	+49 251 832-4795
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Institute of Plant Biology and Biotechnology

The eight major groups and three junior groups use a broad range of organisms (bacteria, fungi, algae, plants) and methods (genetic engineering, protein engineering, enzymatic modification, mass spectrometry, bio-assays, transgenic plants, confocal microscopy) to address a wide range of fundamental and applied topics, including the production of hydrogen, rubber, secondary metabolites for applications in agriculture, the design of plants for biomass production, stress and pathogen resistance, the development of alternative strategies for pathogen control, various aspects of nano(bio)technology and structure-function relationships of functional polysaccharides.

International Collaborations

Numerous cooperations with partners in Europe and beyond, e.g. the Americas (Argentina, Brazil, Canada, USA), Asia (China, India, Japan), and Australia.

National Collaborations

Botanical groups University of Düsseldorf
Biotechnology groups University of Bielefeld and Göttingen


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Witten/Herdecke University – Witten works. In academia and society. And in the world.

Engaging in society

Witten/Herdecke University (UW/H) was founded in 1982 as Germany's first private university. At that time, physicians and lecturers were dissatisfied with the fact that medical training was lacking practical relevance and therefore founded a medical faculty. To date, UW/H has perceived engaging in dialogue with society equally as important as practice-oriented programmes and innovative research findings.

UW/H is a private university in non-profit ownership and therefore derives most of its budget from earned revenue as well as private, research and third-party funding. Education at UW/H focuses on health, economics and culture in an interdisciplinary way.

From the very beginning, UW/H has provided important impetus for research and teaching in Germany. Its fundamental studies ("Studium fundamentale") are an integral part of all programmes, representing the University's interdisciplinary core and facilitating learning processes beyond subject-related expertise. As a model university, Witten/Herdecke University has developed and introduced further educational innovations, such as problem-oriented learning (POL), a model curriculum for medical studies, nursing as an academic discipline, individual admission procedures, and a socially fair concept of income-related tuition fee payment after graduating.

In the meantime, the number of students has increased from initially 27 to more than 2,800 students in the Faculties of "Health" and of "Management, Economics and Society". Today, UW/H is one of the region's most important economic factors and largest employers.

universität Witten/Herdecke

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E-Mail	malte.langer@uni-wh.de
Internet	www.uni-wh.de
Founded (year)	1982
Number of employees	scientific 988 administrative 678
Funding	In 2019: 51 Mio. Euro, 23% students tuition

www.uni-wh.de

Research Field	Genetics/Molecular Biology
Keywords	Gen Therapy, Infectious Diseases, Oncology, RNA/ RNAi/ Antisense RNA, Vaccines
Head of Chair	Prof. Dr. Florian Kreppel
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Chair of Biochemistry and Molecular Medicine

Our research is focussed on the development of gene transfer vectors for gene therapy, oncolysis/virotherapy and genetic vaccination. We analyze early vector-host interactions and develop shiedling technologies to enable systemic delivery of virus-based vectors. In addition, we are exploring miRNAs as novel diagnostic biomarkers and we use our vectors to express miRNAs in cell culture and animal models. In basic research we have a strong background in lipid biochemistry and ageing using yeast and drosophila as models.

International Collaborations

Baylor College of Medicine (TX, USA)
University of Vienna (A)
University of Basel (CH)

National Collaborations

LMU Munich
TU Munich
MHH Hannover

Research Field	Genetics/Molecular Biology
Keywords	Genomics, Infectious Diseases, Nutrition, RNA/ RNAi/ antisense RNA, Epigenetics
Head of Group	Univ.-Prof. Dr. rer. nat. Jan Postberg
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Group of Clinical Molecular Genetics and Epigenetics

Main research topics of the Clinical Molecular Genetics and Epigenetics group focus on genomics and epigenomics. We apply modern deep-sequencing technologies. Jan Postberg's team organizes interdisciplinary research in the experimental laboratories of the Center for Research in Clinical Medicine (ZFKM) at Helios University Hospital Wuppertal. We are interested in the dynamic regulatory mechanisms of the epigenome in cell differentiation processes, which may contribute to the development of complex diseases: We want to learn how environmental influences (including diet and lifestyle, but also viral infections) lead to altered interpretation of the genome and which changes can lead to disease. Therefore, we are investigating the mechanisms of histone variant incorporation into chromatin and the roles of small non-coding RNAs in controlling these processes. Our research moreover focuses on how parental epigenetic information might be transgenerationally inherited.

International Collaborations

Université Paris Saclay
University of Copenhagen
University of Cambridge

National Collaborations

Bergische Universität Wuppertal
Witten/Herdecke University
Klinikum Kassel

Chair of Physiology, Pathophysiology & Toxicology

The focus of research is the physiology, pathophysiology and metal toxicology of epithelia. Molecular and cellular aspects of normal function of epithelial layers are studied, in order to determine their importance for the including their role in the pathogenesis and treatment of diseases of these tissues. The projects are carried out at the molecular and cellular level using state-of-the-art molecular biological, biochemical, biophysical and microscopy techniques at the molecular and cellular level. These methods are complemented by investigations on isolated tissue and whole organisms.

International Collaborations

Department of Biomedicine, Aarhus University, Denmark
Jacobs School of Medicine & Biomedical Sciences, SUNY Buffalo, USA
University of Nijmegen, The Netherlands

National Collaborations

University of Bielefeld
University of Freiburg

Research Field	Health/Physiology
Keywords	Cell Lines/Cell Banks, Oncology, Signal Transduction, Toxicology of Cadmium and Iron
Head of Chair	Prof. Dr. med. Frank Thévenod, Ph.D.
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Universities of Applied Sciences

Universities of Applied Sciences

Universities of Applied Sciences (UAS) are institutions of higher education that combine education and research with a focus on products, markets and the demands of specific job profiles. UAS in NRW offer studies in engineering, life sciences, social sciences, business, law as well as technical subjects and design, music and arts. UAS students are awarded a bachelor degree (after seven to nine semesters) or a master degree (after completing a bachelor and up to three additional semesters). In the history of German UAS, three periods can be distinguished. After the Second World War and up until 1969, the concept of new institution of higher education apart from and separate to universities has been developed. In 1968, the federal state governments decided that UAS should become independent institutions – in contrast to the Universities, which are supported and maintained by the states. In the second period up until 1999, the concept and the organizational structures of UAS have been optimized and extended with about one third of the UAS that are present today being founded in the 1990s. A central modification of the UAS concept has been the "Hochschulrahmengesetz" from 1976: this national law gave UAS the same educational status (tertiary level) as universities. This law also ensured freedom of education and research for the institutions as well as their independent academic administration. In the third period from 2000 on and as an outcome of the "Bologna Process", the academic degrees that can be obtained at UAS have been modified to bachelor and master. The most important consequence of this restructuring process is the equality of the academic degrees from UAS with those attained at Universities. Therefore, students that acquired a master degree at a UAS are eligible to enter PhD programs at Universities for example. Today, 16 UAS *,[1] are located in NRW, the majority of them either in the Rhineland or the Ruhr Valley. 11 ** of these are active in life science research and education. Approximately 248,000 students performed their studies at a UAS in 2020, which corresponds to about 32 % of all the students in the state. [2]

* Without Schools- of Administration, Arts and private Universities of Applied Sciences (UAS).

** Classification by BIO.NRW

[1] https://www.mkw.nrw/hochschule-und-forschung/studium-und-lehre/ueberblick-hochschulen-nrw
Accessed 10.08.2021

[2] https://www.it.nrw/statistik/eckdaten/studierende-nach-hochschularten-1067
Accessed 10.08.2021

Hochschule Bonn-Rhein-Sieg
University of Applied Sciences

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E-Mail	udo.scheuer@h-brs.de
Internet	www.h-brs.de
Founded (year)	1995
Number of employees	scientific 549 administrative 283

www.h-brs.de

Bonn-Rhein-Sieg University of Applied Sciences

excellent – international – innovative

The Bonn-Rhein-Sieg University of Applied Sciences (H-BRS) was founded in 1995. It is a dynamic and research-driven university with more than 9,000 students, approximately 150 professors, 400 research associates and 124 PhD Students. They are supported by many highly qualified lecturers from the fields of academia, business and industry. There are also roughly 280 employees working for the administration, the library and the Language Centre.

At the H-BRS you can currently choose from 21 Bachelor and 17 Master degree courses. All of these courses are practice-oriented and based on the newest research findings, and some of the courses are taught in English. The University's professors have professional experience in both business and academia. Our excellent infrastructure and our well-equipped laboratories are just as integral to our offer as our numerous PC workstations, our WiFi, our modern library and the active campus life. The three campuses are located in Hennef, Rheinbach and Sankt Augustin. In Bonn, the H-BRS runs the Bonn-Aachen International Center for Information Technology (B-IT) jointly with Bonn University and Aachen Technical University (RWTH).

We attach a lot of importance to training highly qualified specialists and executive staff for the international and national job market. The Alumni Union links alumni and current students within a continuously growing network so as to enable them to jointly and actively shape their future.

Furthermore, we help students and employees to combine their studies, academia and family commitments by offering family-friendly facilities to students and employees alike.

A number of excellent rankings and achievement awards, above all the feedback we receive from satisfied students and alumni, prove that the H-BRS is one of the top universities in many respects.

Additionally, our International Office supports international students and academics in order to shape studying or working at the H-BRS in a comfortable and easy manner.

Institute for Functional Gene Analysis (IFGA)

The information stored in the DNA sequence of the genome is the basis of the proper functioning of physiological processes. Certain variants, inherited or acquired, of the DNA sequence alter this information and thus are associated with malfunctions, often leading to disease. Identification of such DNA variants therefore is pivotal for a better understanding of human disease. The Institute for Functional Gene Analysis (IFGA) uses modern high-throughput sequencing technology (Next Generation Sequencing, NGS) to achieve this aim. Our mission is to identify novel DNA sequence variants within genes relevant to various biomedical questions and to elucidate their functional consequences on a molecular level.

National Collaborations

University of Bonn
UKL Bonn
UKL Köln

Research Field	Genetics, Molecular Biology, Bioinformatics
Keywords	Antibody, Genomics, Microbial Genomics, Sequencing (Facility)
Head of Institute	Prof. Dr. Harald Illges
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Institute of Technology, Resource and Energy-Efficient Engineering (TREE)

Within the TREE Institute, research and development activities are based on the principle of sustainability. Each TREE member (roughly 50 professors and senior scientists) contributes knowledge from his or her specific field, and the institute strives to transfer sustainability by incorporating social, ecological and economic innovation. In addition, the institute provides a platform for interdisciplinary and cooperative research. This includes sustainable technology development with a focus on sustainability criteria as well as technological development for sustainable development. At our institute, we encourage continuous reflexion and discourse as well as peer exchange and interaction with the society. The interdisciplinary approach of research at the TREE Institute allows us to integrate a variety of approaches to achieve improved sustainability.

International Collaborations

Tomas Bata University in Zlín
Chalmers University of Technology

National Collaborations

Dr. Reinold Hagen Stiftung
BioFed
Fraunhofer Institutes

Membership in local and regional Networks

NRW Graduate Institute

Research Field	Renewable Energy and Resources
Keywords	Analytics, Biomaterials, Nutrition, Small Molecules, Tissue Engineering
Head of Institute	Prof. Dr. Steffen Witzleben
Internet	www.h-brs.de/en/tree
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FH AACHEN
UNIVERSITY OF APPLIED SCIENCES

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Founded (year)	1971
Number of employees	1,150

www.fh-aachen.de


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FH Aachen University of Applied Sciences

With more than 15,000 students, almost 2,000 graduates a year, ten faculties, more than 100 degree programmes, twelve in-house and five affiliated institutes as well as four competence platforms, the FH Aachen University of Applied Sciences, with its Aachen and Jülich locations, is one of the biggest and most important universities of applied sciences in Germany. Around 240 professors as well as approximately 900 employees work here, in teaching, in research and in administration.

The FH Aachen offers its students a first-rate course of study in modern and trendsetting professions. Apart from the traditional MINT-subjects, such as mathematics, informatics, natural sciences, and technology, the range of courses offered by the university also includes business studies and design. In line with market requirements, more than 100 Bachelor's and Master's degree programmes aren't just offered as full-time courses of study, there is also an ever increasing number of dual study programmes.

FH Aachen aims to be one of the strongest research universities of applied sciences in Germany. Its competences are mainly in the future fields of energy, mobility and life sciences as well as digitalisation and industrial production. Current research results are directly incorporated into teaching.

Through the close cooperation with regional small and medium-sized businesses (SMEs), the university and business enterprises collaborate on the development of products and methods which provide added value directly in the region.

The expansion of regional, national and international networking in teaching and research is an essential part of the FH Aachen's plans for the future, especially with regard to the euroregional location of the campuses in Aachen and Jülich, in immediate proximity to Belgium and the Netherlands.

Institute for Bioengineering (IfB)

The institute of bioengineering (IfB) consists of seven laboratories with 15-25 years of research experience. The IfB focuses on solving medical and biological problems from cell physiological and microbiological questions up to the level of full organs and organism. The international team of scientists develops and applies biophysical methods (bioengineering) in addition to conventional approaches of engineering and natural science. The scientific background comprises biology, biochemistry, materials sicence, medicine, biophysics, space exploration, mechanical and biomedical engineering. The IfB is able to perform successful research on microbial, plant, animal and human cells and cell cultures, including mathematical modelling, cell physiology and cell mechanics. Many successful projects on interdisciplinary medical research show the huge potential of IfB on all levels - from the theoretical modeling through design up to software and hardware products and technologies.

International Collaborations

Al-Farabi Kazakh National University
Dokuz Eylül University, Izmir, Turkey
Hanoi University of Science and Technology

National Collaborations

Forschungszentrum Jülich GmbH
RWTH Aachen University
InnoVitro GmbH

Membership in local and regional Networks

MedLife e.V., EPICERT-Gesellschaft für Epidemieprävention, Young Researchers Academy MedTech, Promotionskolleg für angewandte Forschung in NRW

Research Field	Biotechnology, Nanotechnology, Bioengineering
Keywords	Astrobiology, Biomaterials, Biomechanics, Biomedical Engineering, Environmental Research
Head of Institute	Prof. Dr. Ilya Digel
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Institute for Nano- and Biotechnologies (INB)

‘Biology meets microelectronics’ - a phrase often quoted in recent times, and one which underlines the increasing importance of inter- and trans-disciplinary research activities. Basic scientific disciplines such as physics, electrical engineering, chemistry, biology and materials science are increasingly seen to overlap common boundaries, so defining the interface of an exciting research environment with a high potential for innovation. In this context, the INB (Institute of Nano and Biotechnologies) at the Aachen University of Applied Sciences aims to combine synergistically its existing expertise in the fields of silicon-based chemical sensors and biosensors, optical micro- and nanosystems, DNA sensing and nanostructures, synthesis of tailor-made nanoparticles for sensing application along with biocatalysis, industrial microbiology, bioprocess technology and mammalian cell cultures and applied immunology. The research laboratories will focus their research activities on the pioneering spectrum of nano- and biotechnologies, a broad contemporary research area, fostering new ideas and the design of new products which may change our daily life.

International Collaborations

Clarkson University, Potsdam, NY, USA
Tohoku University, Sendai, Japan
KU Leuven, Belgium

National Collaborations

Forschungszentrum Jülich GmbH
Philipps-Universität Marburg
University of Stuttgart

Membership in local and regional Networks

MedLife e.V., IVAM

Research Field	Biotechnology, Nanotechnology
Keywords	Diagnostic Systems, Enzymes, Fermentation, Food Science, Platform Technology
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FH Bielefeld
University of
Applied Sciences

KEYWORDS
Biocatalysts, Biomass, Biomaterials, Environmental Research, RNAi

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Founded (year)	1971
Number of employees	scientific 564 administrative 276
Funding	State Government NRW 100%

www.fh-bielefeld.de

Fachhochschule Bielefeld University of Applied Sciences

Since its foundation in 1971, Bielefeld University of Applied Sciences (Fachhochschule) is a recognized centre for innovative education and research in East Westphalia-Lippe. Currently, 272 professors and teachers for special tasks and 568 further staff in research, teaching and administration ensure a modern, scientific, and pratice oriented education for more than 11,000 students.

Bielefeld University of Applied Sciences works closely together with partner universities worldwide and businesses, local authorities and the non-profit sector in the region. The spectrum of studies covers the fields of design, engineering and IT, biotechnology, renewable energies, social sciences, business, architecture as well as care and health.

The research profile of Bielefeld University of Applied Sciences is oriented towards the global social challenges of the future, paying particular attention to such urgent issues as climate, energy, health, mobility and communication. Research activities are clustered in the following institutes and networks:

Institute for educational and health-care research in the health sector (InBVG), Bielefelder Institute for Applied Material Research (BifAM), Institute for System Dynamics and Mechatronics (IsyM), Institute for the Intelligent Building (InfinteG), Institute for Technical Energy Systems (ITES) and CareTech OWL – Center for Health, Social Welfare and Technology at Bielefeld University of Applied Sciences.

Department of Engineering and Mathematics – Nanomaterials

The Junior Research Group "Nanomaterials" focuses on the investigation of sustainable fungal mycelium-based materials that have the potential to replace petroleum-based products such as plastics. Mycelium-based hybrid composites are formed by the growth of fungal filaments on organic materials such as agricultural waste and form, for example, a composite with nanofiber mats or textiles for diverse applications such as air and water filtration, sensors, electronics and tissue engineering.

The research interests of our team include needle-free electrospinning technique, fabrication of nanofibers from biobased and synthetic polymers, carbon nanofibers fabrication, manufacturing and oxidative stabilization and carbonization of magnetic nanofibers and biocomposites from fungal mycelia of Pleurotus ostreatus, and additive manufacturing.

International Collaborations

University of Málaga, Department of Chemical Engineering, Faculty of Science, Terma group (Waste and environmental technology, TEP-184), Spain
Southern Federal University, Department of Information Security of Telecommunication Systems, Research laboratory "Quantum cryptography", Institute of Computer Technologies and Information Security, Russia

Research Field	Chemical Engineering, Nanotechnology
Keywords	Biomaterials, Biomass, Bio-processing, Environmental Research, Tissue Engineering
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Department of Engineering and Mathematics – Fermentation and Formulation of Biologicals and Chemicals

Formulation denotes the transfer of an active ingredient into an applicable form such as capsules, layers or sprays. A suitable production of the active ingredient by fermentation and its formulation improves the characteristics of the final product e.g. increased stability and shelf life or increased efficacy by slow or controlled release depending on the material properties and the physicochemical or biochemical environment. Our team looks into novel materials, methods and technology that are needed to fill the gap between production of this active ingredient and its application.

Here we are interested to understand and make use of the relationship between formulation components chemical structure, supramolecular structure and resulting physicochemical and biochemical properties, e.g. mechanical and chemical stability or porosity of a capsule and related diffusion phenomena. Furthermore, the beneficial interaction of the formulation materials with the often sensitive active ingredient is of interest as well as the control of the communication with the environment and release.

International Collaborations

University of Copenhagen
University of Helsinki
University of Strasbourg

National Collaborations

BIOCARE GmbH, Einbeck
Fraunhofer-Institut IME Gießen
Feldsaaten Freudenberger

Membership in local and regional Networks

Promotionskolleg NRW (GI), BIfAM, DPG AK Biological Plant Protection

Research Field	Biotechnology, Microbiology, Formulation
Keywords	Agricultural Biotechnology, Biomaterials, Environmental Research, RNA/RNAi/Antisense RNA
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FH MÜNSTER
University of Applied Sciences

KEYWORDS
Anti-infective Research, Biomaterials, Biomass, Food Science, Regenerative Medicine

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Internet	www.fh-muenster.de
Founded (year)	1971
Number of employees	1,230
Funding	State Government NRW 86% 14% (EU, federal government, third party funds, foundations)

www.fh-muenster.de


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Fachhochschule Münster University of Applied Sciences

Advantage through Quality

15,408 students, 101 degree programs, 280 professors – today, FH Münster is one of Germany's largest and most successful Universities of Applied Sciences (UAS). Its trademark: a practical approach, an international outlook and interdisciplinarity, not only with regard to research but also to teaching. The range of degree programs comprises engineering, design and artistic subject areas, social and service-oriented disciplines, as well as business subjects.

FH Münster is a much valued, innovative partner – not only in the region and throughout Germany, but also at the international level. Backed by a network of strategic partners, it is continually consolidating its leading position by committing itself to providing education, knowledge and research transfer on a long-term basis.

Selected research areas are anchored in 8 internal research institutes and firmly embedded within the structures of the university on an interdepartmental basis. Among the topics addressed are numerous key research areas and platforms of excellence promoted by the Federal State of North Rhine-Westphalia – such as health, sustainability, nutrition, materials, energy or ressources.

FH Münster was awarded as one of the top 5 German universities for university-industry knowledge exchange (Federal Ministry of Education and Research), officially declared "Entrepreneurial University" (Federal Ministry of Economic Affairs) and "Innovative University" (Federal Ministry of Education and Research) – taking a leading position among all German UAS in terms of third party acquisition. Furthermore, FH Münster was the first UAS in Germany to receive system accreditation.

Department of Chemical Engineering

The Department of Chemical Engineering is conducting a broad variety of research in the working field. For example: Environmental behavior and ecotoxicity of industrial bulk chemicals; distribution, abiotic and biotic degradation; synthesis of stable isotopes and analysis of metabolites in the environment; false positive and false negative results in nitrification inhibition testing with certain substances; element/material cycles in the environment; recovery of ressources from environmental media; plant debris as raw material for organic substances.

Furthermore, the department is closely connected to the Institute for Optical Technologies – one of the universities` internal research institutes that is working on new methods for the generation, application and manipulation of light. Professors from different departments (Chemical Engineering, Engineering Physics and Electrical Engineering & Computer Science) jointly develop light-emitting materials for LEDs and lasers. Important examples for the application of light are photovoltaics or the use of light for biomedical purposes.

International Collaborations

Universiteit Twente
University of Tartu
International Isocyanate Institute

Membership in local and regional Networks

Gesellschaft Deutscher Chemiker
Fachgruppe Umweltchemie und Ökotoxikologie
Gesellschaft für Toxikologie

Research Field	Biochemistry, Environmental Chemistry, Ecotoxicology
Keywords	Regulatory Toxicology, Ecotoxicology, Risk Assessment, Life Cycle Assessment, Environmental Chemistry
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Department of Energy – Building – Environment

The department of Energy · Building · Environment tackles the challenges of our time: renewable energies, clean air, perfect drinking water and efficient heating systems. For example, the department is researching the anaerobic degradation of dairy wastewater, phosphorus recycling and the treatment and use of sewage sludge as fertilizer. At the Saerbeck Bioenergy Park, researchers are working on biogas digesters and the production of green hydrogen. The latest project is the construction of a megawatt-class AEM electrolyzer.

International Collaborations

University of Minnesota
Saxion University of Applied Sciences
Bioenergiecluster Oost-Nederland, Stichting Biomassa

National Collaborations

Landwirtschaftskammer Nordrhein-Westfalen
Enapter AG
Landwirtschaftskammer Niedersachsen,
REW Regenerative Energie Wirtschaftssysteme GmbH

Research Field	Biochemistry, Environmental Chemistry, Ecotoxicology
Keywords	Biogas, Manure and Digestate Utilization, Green Hydrogen
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Research Field	Biomechanics, Medical Biotechnology, Photonics, Optical Technologies
Keywords	Diagnostic Systems, Microscopy, Oncology, Platform Technology, Recombinant Proteins
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Department of Engineering Physics

The Department of Engineering Physics covers a wide range of work fields from life science and medical technology products, optical technologies and laser technology or at the intersection of technical and business issues in management. In terms of research, the department established laboratories and institutes on Biomechanics, Medical Biotechnology, Photonics and Optical Technologies – one of which is the EUREGIO Biomedtech Center, led by Prof. Dr. Karin Mittmann.

Focusing on Nanobiotechnology and solutions in medical imaging, an extensive range of biophysical, biochemical and biomedical methods, e.g. cellular MTP assays or FACS assays, is available for the development and production of recombinant proteins up to the preparation of functional nanoparticle conjugates. In cooperation with partners, preclinical toxicity studies of nanomaterials including the histological detection of non-fluorescent nanomaterials in tissues by confocal laser scanning microscopy can be performed. Furthermore, 3D models and tissue phantoms of different tumor cell lines are available for the testing of nanomaterials.

International Collaborations

University Twente, Enschede, NL
Kantonsspital Bern, CH
Life Technologies (Thermo Fisher)

National Collaborations

Quantum Analysis, Bauerfeind AG, Jüke Systemtechnik GmbH, Karl Storz GmbH & Co KG

Membership in local and regional Networks

Arbeitskreis Nanobioanalytik Münster, Deutsche Plattform für NanoBioMedizin

Research Field	Food Chemistry, Food Development
Keywords	Membrane-based Storage Options for Food, Antimicrobial Surfaces
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Department of Food – Nutrition – Facilities

The Department of Food · Nutrition · Facilities (FNF) educates degree holders, who will find jobs in the food industry, in a medical context regarding nutritional aspects, in hospitality management and associated services and in the various fields of facility management. Research at the Institute of Sustainable Nutrition (iSun), which is closely associated with the department FNF, is dedicated to the development of concepts, products and services for sustainable nutrition, which includes e.g. the development of innovative antimicrobial surfaces and membrane-based storage options for food in private households, allowing for features like moisture control during food storage.

International Collaborations

Universiteit Twente
Smart Material Printing B.V.
Parthian Technology B.V.
Aquamarijn Micro Filtration B.V.

National Collaborations

Emsa GmbH, nanoAnalytics GmbH
Wedi GmbH
Westfälische Wilhelms-Universität (WWU) Münster, Institut für Molekulare Mikrobiologie und Biotechnologie
Mikrobiologisches Labor Dr. Michael Lohmeyer GmbH

EUREGIO BioMedtech Center

Laparoscopy, surgical robots and 3D navigation, fluorescence detection and AI-based diagnostics: We solve novel challenges in medical imaging on an interdisciplinary basis in cooperative projects together with national and international medical technology companies and renowned hospitals. We effectively contribute our expertise to the development of novel medical products for medical imaging. Fluorescent markers are generated with precision and extensively investigated. Standardised documentation processes are implemented in our team. We get involved as early as the definition of the medical requirement, through the experimental planning, implementation and generation of initial test substances and biological safety investigations, to the conceptualisation of preclinical studies. The EUREGIO BioMedtech Center has specific equipment for the comprehensive biochemical and biophysical investigation of both particulate and fluorescent solutions. We build on cutting-edge experience such as sterilisation of material medical devices to proof of concept studies using the latest generation of clinical fluorescence laparoscopes. This enables us to successfully contribute to the development of innovative medical devices for fluorescence-assisted surgery.

International Collaborations
ScreenPointMedical B.V., Nijmegen, NL
University Twente, NL

National Collaborations
Erbe Medizintechnik GmbH, Tübingen
Universitätsklinikum Münster

Membership in local and regional Networks
International society of fluorescent guided surgery

Research Field	Fluorescent Medical Devices
Keywords	Medical Imaging, Fluorescence Guided Surgery, Laparoscopy and Endoscopy
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Fachhochschule Südwestfalen
University of Applied Sciences

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Internet	www.fh-swf.de
Founded (year)	2002
Number of employees	scientific 569 administrative 269
Funding	State Government NRW 104,2 Mio. Euro Drittmittelvolumen (2015): 9,9 Mio. Euro

www.fh-swf.de

Fachhochschule Südwestfalen University of Applied Sciences

The South Westphalia University of Applied Sciences has sites in Hagen, Iserlohn, Lüdenscheid, Meschede and Soest. With around 14.000 students, we are one of the largest Universities of Applied Sciences in North Rhine-Westphalia. But there is still a family atmosphere among students at the individual sites. The secrets of our success are small classes und personal support. Excellent resources and modern, future-oriented study and research focuses make this the perfect place to start a successful professional career. We produce qualified experts and managers in the fields of agricultural science, business management, early years education, engineering, information technology and natural sciences. Our range of courses, some of which are also international, is tailored to cater for both full-time students and those in employment and can also accommodate those wishing to combine vocational training with studies. Our research and development work is consistently practical and application-oriented. We use a close network of cooperation partners in business, associations and institutions.

At the site of Iserlohn we offer the full-time course of Biotechnology and Nanotechnology (B.Sc) and the full time course Life Science Analytics. The Bachelor in Biotechnology and Nanotechnology combines both technologies in one interdisciplinary, scientific approach. Our LSA students learn to test and improve food, cosmetics, medical devices and other everyday products. The effect on biological systems in general and the human body in particular is in the foreground in this course. The effect of various substances such as microplastics on ecosystems is also part of the Life Science Analytics course. It encourages students to work independently and allows them, for example, to research biomedical substances or biocatalytic handling of chemicals.

Areas of research are for example tissue engineering, biomaterials, cell biology, biotechnology and nanotechnology, corrosion and surface treatment.

Institute of Agriculture

At the University of Applied Sciences South Westphalia, Department of Agriculture, projects to improve disease prevention in different livestock species have been carried out for several years under the direction of Prof. Dr. Marc Boelhauve. The aim of these studies and projects is to record the effects of improved hygiene measures or their improved application on the animals housed, in order to generate a monetary incentive for implementation, so that livestock in NRW can be protected against the introduction and spread of animal diseases by their own active action. Furthermore, implementation obstacles that can block the permanent implementation of optimal hygiene measures are identified and subsequently removed. In the projects, cooperation is maintained with farmers, practical veterinarians, slaughterhouses, animal transport companies, pest controllers, veterinary offices, agricultural production consultants and agricultural associations.

National Collaborations

Robert Koch Institute
BfR
UKM

Membership in local and regional Networks

KONN NRW, DVG

Research Field	Health, Microbiology
Keywords	Agricultural Biotechnology, Antibiotic, Environmental Research, Infectious Diseases, Microbial Genomics
Head of Institute	Prof. Dr. Marc Boelhauve
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HOCHSCHULE
HAMM-LIPPSTADT

KEYWORDS
Bioeconomy, Diagnostic Systems, Fermentation, Neurodegenerative Diseases, Tissue Engineering

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Internet	www.hshl.de
Founded (year)	2009
Number of employees	scientific 252 administrative 164
Funding	State Government NRW 100%

www.hshl.de

Hochschule Hamm-Lippstadt University of Applied Sciences

A new university in Hamm and Lippstadt with plenty of design potential. Modern campus life, 19 market- and practice-oriented study courses, openness, tolerance, team spirit, and high demands from the start. The newly constructed and barrier-free campuses in Hamm and Lippstadt provide ideal conditions for the future-oriented education of engineers and other experts. Study courses and research projects are e.g. in fields such as Biomedical Engineering, Environmental Monitoring and Forensic Chemistry, Material Design - Bionics and Photonics, Energy Engineering and Resource Optimization or Biomedical Management and Marketing.

A total floor area of 32,250 square metres provides laboratories with state-of-the-art equipment, such as scanning electron microscope, industrial CT scanner, 3D projection surfaces, embedded systems or crane tracks, as well as plenty of space for student work, communication, teaching, and research.

Working practice-oriented and in small groups, Hamm-Lippstadt University of Applied Sciences offers a study programme on a very high academic level with a clear orientation towards current and future market requirements. The young team of professors is practically experienced. With an interdisciplinary setup, teaching focuses on both the promotion of individual strengths and the conveyance of social competences such as teamwork.


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Hochschule Niederrhein University of Applied Sciences

Transcending Borders

The Hochschule Niederrhein primarily aims to deliver: a practice-orientated academic training, applied research and development, technology transfer and extensive international collaboration. This is exemplified by establishing innovative degree programmes, such as: Dual engineering programmes with selected companies from the region to provide vocational and academic training and qualifications; degree programmes leading to double degrees; International Marketing (with IUP Colmar/F); Health Care Management; Social Work, Social Management, Cultural Education; Bachelor's/Master's degrees in Textile and Clothing Management (taught in English).

International partnerships have been formed with some 100 universities worldwide. Under the EU's ERASMUS programme, the Hochschule Niederrhein cooperates with 65 European universities and higher education institutions.

The Hochschule Niederrhein also acts as a strong structural factor for the region with its applied research and development. Its priorities are: Environmental Protection Analysis and Monitoring, Plastics Recycling, Cleaning Technology. Students learn in small groups, which ensures that graduates can advance quickly and smoothly into their aspired career.

Courses are taught by 245 professors and specialist teachers, plus more than 520 contract lecturers from business and industry as well as 634 and more staff working in research and teaching, in the workshops, the administration, the libraries and the Computer Centre. More than half the studies are completed in the form of internships and work placements, for which more than 100 laboratories equipped with state-of-the-art facilities are available at the two university campuses in Krefeld and Mönchengladbach.

The Competence Center for Mircobiology and Biotechnology supports the production chain from agricultural production through to the consumer. Key topics include the contamination and microbial decay of foods as well as food-related infections and microbial intoxication.

Hochschule Niederrhein
University of Applied Sciences

KEYWORDS
Biocatalysts, Biomaterials, Bioeconomy, Food Science, Nutrition

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Internet	www.hs-niederrhein.de
Founded (year)	1971
Number of employees	scientific 550 administrative 336

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HOCHSCHULE RHEIN-WAAL
Rhine-Waal University of Applied Sciences

KEYWORDS
Biotechnology, Bioengineering, International, Interdisciplinary, Applied Research

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Founded (year)	2009

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Rhine-Waal University of Applied Sciences
International, Interdisciplinary and Innovative

Rhine-Waal University of Applied Sciences attracts students with its personal atmosphere, modern didactic methods, brilliant facilities and unique degree programmes on both its campuses, in Kleve and Kamp-Lintfort.

Since its founding on May 1, 2009, Rhine-Waal University of Applied Sciences has grown beyond all expectations. The resonance from students both in Germany and around the world has been overwhelming – after a mere six years of operation, the university reached and exceeded its founding objective of a minimum enrolment of 7,300 students. The best part? This is just the beginning.

International

Over 75 percent of our degree programmes are taught exclusively in English, which gives people from all over the world the opportunity to earn a quality education according to the rigorous and internationally recognised academic standards of Germany. As a result, our student body is also incredibly diverse: in fact, over one third of our students come from outside of Germany and over 120 different nationalities are represented here.

Interdisciplinary

Not only is the working environment about to change, but also the requirements demanded of entrants: one must increasingly work across disciplines. The degree programmes offered by the Rhine-Waal University of Applied Sciences are therefore scientific, application-oriented and interdisciplinary.

Innovative

Every innovation comes through conducting research - through numerous co-operations with global companies; the university offers excellent conditions for researchers. In many cases, students can bring in their ideas and make an active contribution to the development of new products. So, for example, students planned and organised a First Aid Post in the mountainous region of Chocruz in Guatemala.

Faculty of Life Sciences

Rhine-Waal University of Applied Sciences is a young, vibrant university in the Lower Rhine region of Germany which offers innovative and challenging degree programmes as well as first-rate research opportunities in the natural sciences, social sciences, economics, technology and engineering.

Currently the university offers one bachelor's degree programme in the field of biotechnology which is taught in English and began in winter semester 2012-2013 in Kleve. It has since achieved international recognition, particularly among students: over 60 countries are represented by the students currently pursuing their degree in this programme.

The study program of Bioengineering B.Sc. has a very pronounced focus in the natural sciences. The curriculum introduces a tight intermeshing of biology and chemistry with engineering and technology. Modern facilities of the faculty with its own microscopy centre and biotech as well as molecular biology and microbiology labs up to safety level 2 offer great opportunities for studies and research.

International Collaborations

Radboud University, Netherlands
SupBiotech, France
Universidad Católica de Valencia 'San Vicente Mártir', Spain

National Collaborations

University of Göttingen
University of Bonn

Membership in local and regional Networks

Deutsche Gesellschaft für Immunologie e.V., ORCA.NRW

Research Field	Biotechnology
Keywords	Agricultural Biotechnology, Bio-processing, Environmental Research, Fermentation, Genetic Engineering
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Technology Arts Sciences TH Köln

KEYWORDS

Biologicals/Biopharmaceuticals, Biomaterials, Drug Discovery/Drug Delivery, Downstream Processing, Small Molecules

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Contact Person	Sybille Fuhrmann, Head of Communications and Marketing
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E-Mail	kommunikation@th-koeln.de
Internet	www.th-koeln.de
Founded (year)	1971 as Fachhochschule Köln - Cologne University of Applied Sciences
Number of employees	total number of employees 1,700

www.th-koeln.de

TH Köln – Technology, Arts, Sciences

The TH Köln – University of Applied Sciences offers students and scientists from Germany and abroad an inspirational study, work, and research environment in the social, cultural, societal, engineering, and natural sciences. Currently there are more than 27,000 students from about 120 countries enrolled in 100 bachelor's and master's programs. Annually about 6,000 students start to study at TH Köln and around 3,000 students leave the university after graduation.

"We create social innovation" – with this claim TH Köln meet the challenges of our day. The interdisciplinary approach to thinking and acting, as well as the university's regional, national, and international activities, have made TH Köln both a valuable collaborative partner and a trailblazer in many areas. The TH Köln was founded as the Fachhochschule Köln in 1971 and is regarded as one of the most innovative universities of its kind.

Research-intensive and international

TH Köln - University of Applied Sciences is a research-intensive university actively engaging in a variety of research activities. We cooperate with universities and other research institutions on a national and international level, as state-of-the-art research thrives on the exchange of expertise transcending institutional and geographic borders. Climate change, scarce resources, safety issues and demographic change are some of the major challenges mankind will be facing in the coming decades. In their application-oriented and interdisciplinary projects, TH Köln – University of Applied Sciences' experienced researchers try to solve these 'great challenges' and actively contribute to the advancement of science, the economy and society.

As one of the first institutions in Germany, TH Köln – University of Applied Sciences received the quality seal "HR Excellence in Research" for the participation in the Human Resources Strategy for Researchers (HRS4R). "HR Excellence in Research" is bestowed by the European Commission upon institutions with fair and transparent recruitment processes, concern for intellectual property rights, and stimulating work environments that provide opportunities for advanced training. The intention of the HRS4R-initiative is to foster the development of strong research cultures at universities, to create better working conditions for researchers, and to promote academic careers.

Faculty of Applied Natural Sciences – Biotechnology & Green Chemistry Group

The research group Biotechnology & Green Chemistry develops biobased chemicals from renewable resources. A general interest is the biotechnological production of (bioactive) amphiphilic molecules and functional intermediates for application in e.g. cosmetics, detergents and polymer applications.

Research comprises biocatalytical transformations with native and recombinant enzymes, chemoenzymatic processes and microbial fermentations from ml to 10 l scale. Downstream processing and process modelling is done in collaboration with the group of Prof. Barbe.

National Collaborations

FH Aachen
Forschungszentrum Jülich
University of Cologne

Membership in local and regional Networks

CLIB
BioRiver e. V.

Research Field	Bioeconomay, Renewable Energy & Resources
Keywords	Biocatalysts, Bioeconomy, Biomaterials, Recombinant Proteins
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Faculty of Applied Natural Sciences – Institute InnovAGe

The InnovAGe research institute focuses on the discovery and development of novel therapeutics for age-related diseases with a particular focus on degenerative diseases of the CNS and the muscoloskeletal system. Medicinal chemistry, cell-based pharmacology, and pharmaceutical technology are working closely together in our institute. With our collaboration partners at the BfArM and DLR, we are investigating the extremely strong pro-neuroplastic effects of our proprietary compounds, even under altered gravity conditions.

In another project, we are investigating the strong muscle-sparing and even anabolic effects of a new class of small molecules which do not act via hormonal pathways. Thus, two of the major age-and spaceflight-related health issues may be addressed: Cognitive decline and sarcopenia.

International Collaborations

European Space Agency (ESA)

National Collaborations

Deutsches Zentrum für Luft- und Raumfahrt Köln (DLR)
Bundesinstitut für Arzneimittel und Medizinprodukte (BfArM)
University of Cologne

Research Field	Organic Chemistry, Medicinal Chemistry and Pharmacology
Keywords	Ageing, Drug Discovery/Drug Delivery, Neurodegenerative Diseases, Small Molecules, Therapeutics
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Research Field	Vaccines, Gene Therapeutics and Therapeutic Antibodies
Keywords	Biologicals/ Biopharmaceuticals, Drug Discovery/Drug Delivery, Gen Therapy, Infectious Diseases, Vaccines
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Faculty of Applied Natural Sciences – Pharmaceutical Biotechnology

The Research Group Pharmaceutical Biotechnology develops and optimizes transposon vectors, viral vectors and Virus-Like Particles (VLPs) for gene therapeutic and vaccination strategies as well as novel antibody and target antigen discovery and production platforms. Our research expends also to improving mammalian cell line development, USP and DSP - in collaboration with Prof. Dr. Stephan Barbe - to enhance the efficiency of production of biologics such as therapeutic antibodies, cytokines, vaccines and viral vectors. We collaborate with partners in academia and pharmaceutical industry.

International Collaborations

Miltenyi Biotec
Sartorius Stedim Biotech

National Collaborations

Paul-Ehrlich-Institute (PEI), Federal Institute for Vaccines and Biomedicines
Max Planck Institute (MPI) for Dynamics of Complex Technical Systems
Medizinische Hochschule Hannover (MHH)

Membership in local and regional Networks

BIO.NRW

Research Field	Biochemistry, Renewable Energy and Resources
Keywords	Biomaterials, Bio-processing, Downstream Processing, Environmental Research, Pilot Plant
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Institute of of Sustainable Technologies for Environmental and Production Processes (STEPs)

The STEPs Research Institute is particularly concerned with finding solutions to complex problems of an interdisciplinary nature. This is reflected in its four research fields and in its projects. This scientific collaboration within and between research areas is a key feature of the work of the Institute.

The research interests of the institute are Biotechnology, Data Analysis, Simulation and Optimization, Energy and Resource Management, Measurement and Control Technologies, Process Analytics, Process Simulation, Membrane Processes, Sustainalble Drug Discovery, Sustainable Materials, Water and Watermanagement. One of the Research Institute's key assignments is to provide the best possible support to junior scientists.

International Collaborations

Bayer AG
Covestro
Clariant
European Biotechnology Network
German Water Partnership

National Collaborations

University of Cologne
University of Duisburg-Essen
BMBF
BMWi
MIWF
Rheinenergie AG

Membership in local and regional Networks

:metabolon (BAV)

TECHNISCHE HOCHSCHUL OSTWESTFALEN-LIPPE UNIVERSITY OF APPLIED SCIENCES AND ARTS

KEYWORDS

Cell Culture Technology, Digital Twins/ Data Science, Bioreactor Design, Photobiotechnology, Food Bioprocessing

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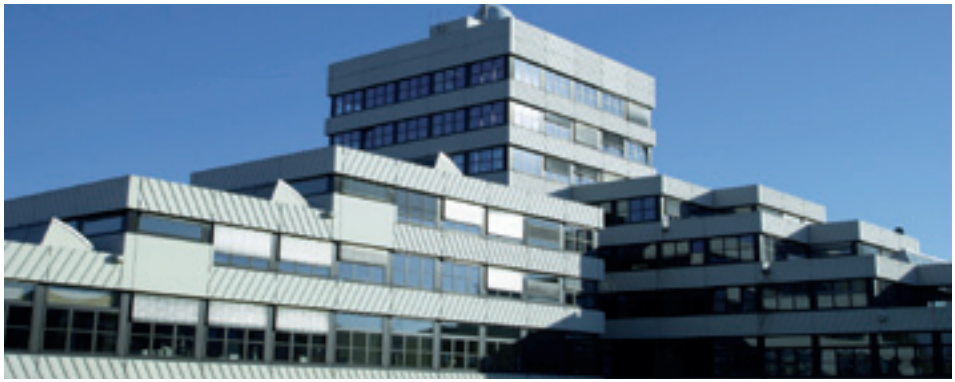
Internet	www.th-owl.de
Founded (year)	1971
Number of employees	scientific 495 administrative 257 (+ 57 apprentices)
Funding	State Government NRW 100%

www.th-owl.de



Technische Hochschule Ostwestfalen-Lippe University of Applied Sciences

The OWL University of Applied Sciences and Arts (TH OWL) is a strong research university for applied sciences, which offers around 60 bachelor's and master's degree programs as well as doctoral programs at three locations. It is firmly anchored in Ostwestfalen-Lippe, a lively and economically strong region in the northeast of North Rhine-Westphalia.

The TH OWL is creative, innovative and sustainable. It lives through the diversity of its departments, which are technically, economically, creatively and artistically oriented.

Around 6,600 students lay their foundation for a successful career and benefit from unique study programs and outstanding research.

Biotechnological research and teaching facilities at OWL University of Applied Sciences and Arts are located within the main campus in Lemgo. From the natural sciences such as microbiology and chemistry to engineering and typical biotechnological fields – the university in the heart of Ostwestfalen-Lippe covers the whole spectrum. The close vicinity on campus to the adjacent fields of Life Science Technologies such as Pharmaceutical Technology, Technology of Cosmetics & Detergents and Food Technology as well as Microbiological and Process Technological laboratories offers additional know-how and equipment.

Each campus has its own profile. Lemgo is home to the classical engineering disciplines as well as Economics, Food Technology and Wood Technology. Detmold, which focuses on disciplines involving construction and architecture, attracts attention nationwide. Interior Design and the international degree program Industrial Engineering – Construction are unique in North Rhine-Westphalia. Höxter has made a name for itself as a campus dedicated to ecological aspects in the technical sciences. This applies not only to teaching and research in Landscape Architecture but also to Environmental Engineering.

Research and innovation are fundamental for the university's success and sustainability and contribute to the quality management of its hallmark 'excellent teaching'.

Life Sciences: Industrial Biotechnology

Biotechnology research and teaching facilities cover natural sciences such as microbiology and chemistry as well as engineering skills and typical biotechnology fields from fermentation to downstream processing.

Competencies are also provided in the fields of bioprocessing, cell culture technology, bioreactor design, scale up & down, photobiotechnology, process monitoring & control, process simulation & optimization, uncertainty modeling, predictive modeling, design of experiments and customized software tools for simulation & optimization.

The biotechnology labs are equipped with fermentation capabilities from shake flask scale over small-scale parallel bioreactor systems up to 20 L bioreactor scale. Downstream processing, e.g. FPLC, high-pressure homogenizer, disc stack centrifuges, frame filter press, membrane filtration systems and lyophilisation, allows the further processing of the products. The steps are supported by corresponding analytical equipment, e.g. UPLC, Cellavista.

Furthermore, contract analyses of customer samples and products are offered.

Research Field	Industrial Biotechnology
Keywords	Bioeconomy, Biologicals/ Biopharmaceuticals, Bioprocessing, Simulation/ Process Control, Fermentation
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Westfälische Hochschule
Gelsenkirchen Bocholt Recklinghausen
University of Applied Sciences

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Internet	www.w-hs.de
Founded (year)	1992
Number of employees	scientific 568 administrative 182
Funding	State Government NRW 100%

www.w-hs.de

Westfälische Hochschule – University of Applied Sciences

Knowledge. That‘s what counts in life.

The Westfälische Hochschule was founded in 1992 under the name of its headquarter Gelsenkirchen University of Applied Sciences. As a state-managed university we consider it our responsibility to establish the necessary conditions for practical academic training at our sites in Gelsenkirchen, Bocholt and Recklinghausen in order to secure a base for qualified young talents in our region. Our study programmes are characterized by a clear technical-economic profile, which is oriented towards the needs of the economy. This also manifests itself through our close and expanding cooperation with companies in the field of dual study programmes. With further concepts, which received multiple nationwide awards, we have made it our task to promote young people and develop their various talents. As a partner for our region, we do not only set out to support the teaching and learning but also the research. We consider strong research as an essential element of contemporary teaching oriented towards the challenges of today and tomorrow. An important pillar of our research activity is the diversity of topics. We want to further cultivate this variety and simultaneously establish research focuses. Even with a clear commitment to our regional responsibility we are open to a globalised world. International university partnerships, students from other countries, as well as study and praxis stays of our students in all continents of the world contribute to the completion of our profile. We offer a wide range of future-oriented study programmes. Furthermore, we not only take account for the current structure of the economy in our region with courses in the fields of engineering, science, informatics, economics, journalism and law, but we also give a new impetus to newly developing branches and, as a result, we open various opportunities for prospective students. Accompanying support services help students to orientate and solve technical problems, especially during the introductory phase. Research creates the future. Whether it is about new energy supply concepts, a safer internet, intelligent mechatronic systems or new diagnosis and therapy systems in the health care sector, we work on tomorrow’s solutions. Application-orientation and close cooperation with the practical field shape our work.

Institute for Bioinformatics and Chemoinformatics (IBCI)

The Institute for Bioinformatics and Chemoinformatics (IBCI) bundles research and development activities in chemo- and bioinformatics. Focal points are computational neuroscience, automated fluorescence and telemicroscopy, proteomics and systems biology of platelets, genetic sequence variation of germ and tissue cells, the use of machine learning for chemical and biological modelling, molecular fragment chemoinformatics and biomolecular mesoscopic simulation. (https://www.w-hs.de/forschungsinstitute/institut-fuer-biologische-und-chemische-informatik/)

International Collaborations
European Bioinformatics Institute (EBI)

National Collaborations
Universität Duisburg-Essen
Friedrich-Schiller-Universität Jena
WWU Münster

Research Field	Bioinformatics, Cheminformatics, Machine Learning, Molecular Modelling and Simulation
Keywords	mRNA, Platform Technology, Structural Bioinformatics, Biomolecular Mesoscopic Simulation, Single Cell Data Analysis
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Institute for Biomimetics (WIB)

The WIB is research in-institute at the Bocholt campus. It performs research and development on biological structures and mechanisms creating innovative products. In parallel industrial research projects with specific challenges are addressed using structured methodology. Innovation depth is increased when sustainability aspects are added to the biomimetic approach. Existing products are improved or completely new technologies are developed using living nature as an inspiration. Biomimetics therefore, is characterised as a highly transdisciplinary approach.

The focus is on SME through all industrial sectors. Next to that, independent research prepares technologies for industrial applications. Disciplines involve structural mechanics, lightweight design, materials, sensing, control, behavior. We start with the biological model organisms and finish at advanced technical concepts, their structural and material design, manufacturing, integrated sensing and control derived from biological models.

International Collaborations
TU Delft
European Space Agency

National Collaborations
ZF Friedrichshafen
Spaleck
Dräger

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BIOKON
VDI

Research Field	Biomimetics
Keywords	Bioeconomy, Circular Economy, Environmental Research, Structural Biology, Biomimetics
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Fraunhofer-Gesellschaft

Fraunhofer-Gesellschaft

The research organization "Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V." (Fraunhofer society for the advancement of applied research) was founded in 1949, the same year as the Federal Republic of Germany. It is named after Joseph von Fraunhofer, who as a scientist, engineer, and entrepreneur is said to have superbly exemplified the goals of the society. The Fraunhofer-Gesellschaft started out as a small office with just three employees but went on to become one of the largest research organizations in Europe. Today, it has attained a size and influence that makes it a vital element in Germany's industrial and scientific landscape. [1]

Organization

The Fraunhofer-Gesellschaft promotes and conducts applied research in an international context of direct utility to private and public enterprises and to the widespread benefit of society at large. By developing technological innovations and novel system solutions for their customers, the Fraunhofer institutes help to reinforce the competitive strength of the economy in their region – throughout Germany and in Europe. Their research activities aim at promoting the economic development of our industrial society, particularly with regard to social welfare and environmental compatibility. As an employer, the Fraunhofer-Gesellschaft offers a platform that enables its employees to develop the necessary professional and personal skills that will allow them to assume positions of responsibility within their institutes, industry, and other scientific domains. [2]

More than 80 research units belong to the Fraunhofer-Gesellschaft, including 75 institutes at over 45 locations in Germany. Furthermore, the Fraunhofer-Gesellschaft is engaged in a number of international activities, mainly in Europe, North and South America, Asia, and the MENA (Middle East and Northern Africa) region. The Fraunhofer-Gesellschaft operates subsidiaries in parts of Europe (Austria, Italy, Portugal, Sweden, UK), in North and South America (USA, Chile), and also in Asia (Singapore). Additional representative offices and senior advisors in Asia and the MENA region form a bridge between the local Asian markets and the Fraunhofer institutes. Their activities are focused on marketing and business expansion. [3]

Overall, the Fraunhofer-Gesellschaft is the largest organization for applied research in Europe with 29,000 employees (the majority of whom are scientists or engineers) and a total annual research budget of around € 2.8 billion. Some basic funding is provided by the government at federal and state levels, but 85 % (€ 2.4 billion) of funding is earned through contract research, either from contracts with industry or via publicly funded research projects. [2]

Research

Fraunhofer research activities are focused on applications and results. The organization pursues the implementation of innovative research findings in industrial and social applications. Its work is based on a dynamic balance between applied basic research and innovative development projects. The research activities are decentralized. The Fraunhofer institutes use structured processes to identify areas of technology that are relevant for industry and the short-term and long-term demands of the contract research market. Their choice of research fields is based on this information. The various institutes adopt a parallel approach, leading to a wide range of creative solutions. The Fraunhofer-Gesellschaft carries out publicly funded pre-competitive research, which forms the basis of the contract research projects conducted for customers. Private-sector earnings enable the organization to finance a major proportion of its budget through its own means. [4]

Fraunhofer Venture Group

Industry and government place a high value on the institutes of the Fraunhofer-Gesellschaft in their role as a nucleus promoting the foundation or relocation of companies within their respective regions. The Fraunhofer-Gesellschaft supports this aspect of the institutes' work by actively encouraging the formation of start-up companies and supporting cooperative ventures between spin-off companies and Fraunhofer institutes in a variety of ways. There is a focus on reviewing and optimizing business plans, obtaining access to equity and risk capital, helping with the drawing-up of partnership agreements, and providing direct support to guarantee the smooth launch of its business activities. The Fraunhofer Venture Group, founded in 2001, is a private investment fund that offers professional investment management of venture capital for the launch and initial growth phase of start-up companies. In combination with its venture group, the Fraunhofer-Gesellschaft offers the ideal conditions to make the leap from applied research to an independent company. [5]

If you want to find out more about the Fraunhofer-Gesellschaft, please visit the organization's website (https://www.fraunhofer.de/en).

[1] www.fraunhofer.de/en/about-fraunhofer/profile-structure/chronicles.html, Accessed 06.08.2021 [2] Fraunhofer Jahresbericht 2020; www.fraunhofer.de/de/mediathek/publikationen/fraunhofer-jahresbericht.html, Accessed 06.08.2021 [3] https://www.fraunhofer.de/en/institutes.html, Accessed 06.08.2021 [4] www.fraunhofer.de/en/about-fraunhofer/profile-structure.html, Accessed 06.08.2021 [5] www.fraunhoferventure.de/en.html, Accessed 06.08.2021

Fraunhofer SCAI

KEYWORDS
Biopharmaceuticals, Drug Discovery, Neurodegenerative Diseases, Unstructured Information Mining

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Founded (year)	2001
Number of employees	183 Including adminstrative employees (2020)

www.scai.fraunhofer.de/bio

Fraunhofer Institute for Algorithms and Scientific Computing SCAI

Fraunhofer – We Forge the Future

The Fraunhofer Institute for Algorithms and Scientific Computing SCAI combines know-how in mathematical and computational methods, with a focus on the development of innovative algorithms and their take-up in industrial practice – bringing benefits for customers and partners.

SCAI's research fields in Computational Science include machine learning and data analysis, optimization, multiphysics, energy network evaluation, virtual material design, multiscale methods, high performance computing, and computational finance.

In the field of bioinformatics, SCAI represents the entire data-based value chain of translational biomedical research in science and industry. Here, the most important application field is the modeling of neurodegenerative diseases.

SCAI engages in the training of students of the international master's degree program "Life Science Informatics" at the Bonn-Aachen International Center for Information Technology (b-it). b-it is jointly carried by the University of Bonn, RWTH Aachen University, the University of Applied Sciences Bonn Rhein-Sieg, and the Fraunhofer-Gesellschaft. Prof. Dr. Hofmann-Apitius, head of the SCAI´s department of bioinformatics, and Prof. Dr. Holger Fröhlich, group leader "AI & Data Science" in the department of bioinformtics, also lead working groups at b-it.

The annual budget of Fraunhofer SCAI in 2020 was around 15 million euros. The networking in national and international research projects ensures the alignment of offers with leading standards.

Department of Bioinformatics

The business area Bioinformatics is a problem solver for data- and knowledge-based scientific challenges in the biotechnology and pharmaceutical industries. The value chain ranges from unstructured information mining and knowledge graph technologies to algorithms and modeling approaches that combine data and knowledge. Finally, the recently established AI & Data Science team provides actionable insights, simulations of scenarios, and decision support.

We work closely with industrial partners – from SMEs to global enterprises – to improve their competitiveness by mediating knowledge and technology transfer from academic research to industrial application. Our affiliation with the Bonn-Aachen International Centre for Information Technology (b-it) is a source of constant renewal. Teaching forces us to always stay up to date. We combine a clear focus on solving scientific problems defined by industry and an academic research profile that allows us to collaborate with leaders in AI-based biomedicine in Europe and worldwide.

International Collaborations

Harvard Medical School
University of Oxford; Dementias Platform UK
ICM (AI / Data Science), France

National Collaborations

NFDI4HEALTH
COPERIMOplus and the University Hospital, Erlangen
Key4AI-MED with Charité

Research Field	Bioinformatics
Keywords	Biomarker, Neurodegenerative Diseases, Systems Biology, Computational Biology
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Fraunhofer
FIT

KEYWORDS
Human-Centered Engineering, Digitalization, Industry 4.0, Blockchain, Data Science & AI

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Fon	+49 2241 14-3333
E-Mail	info@fit.fraunhofer.de
Internet	www.fit.fraunhofer.de
Founded (year)	1983
Number of employees	scientific 300 administrative 20
Funding	Federal Government (Germany) 31% EU 22% Contract Research 35%

www.fit.fraunhofer.de

Fraunhofer Institute for Applied Information Technology – FIT

Fraunhofer FIT is an excellent partner for the human-centric design of our digital future.

As a partner for digitization, Industry 4.0 and the Internet of Things, the Fraunhofer Institute for Applied Information Technology FIT has been developing IT solutions tailored to people and seamlessly integrated into business processes for almost 40 years. As a driving force of innovation, FIT not only provides guidance, but also shapes the digital transformation in business, the environment and society.

FIT's interdisciplinary R&D teams are drawn from our staff from computer science, social science, business administration, economics, psychology, and engineering. They bring their expertise in designing and implementing information technology systems to bear on problems and needs from different areas of life.

We strategically evolve our expertise in IT, specific application fields, and our scientific excellence with the aim to be ahead of the market for our customers from industry and administration. We focus on three application domains: Digital Energy, Digital Health, and Digital Sustainability.

Each of FIT's informatics departments is built around one of our five core competencies:

- Human-Centered Engineering & Design
- Cooperation Systems
- Data Science & Artificial Intelligence
- Microsimulation & Econometric Data Analysis
- Business & Information Systems Engineering

In addition, Fraunhofer FIT established the Fraunhofer Blockchain Lab, with offices at Sankt Augustin, Augsburg and Bayreuth. The lab helps companies in identifying innovations and potential efficiency improvements through applications of blockchain technology, and supports their implementation. In Hürth, a coordinating office for the Blockchain-Reallabor Rheinisches Revier is being set up.

Digital Health

For over 30 years now, Fraunhofer FIT has been developing information technology systems for healthcare, focusing on improving diagnostics and therapy as well as clinical and pharmacological research by bringing together molecular diagnostics, image and signal analysis, data integration and machine learning. We are involved in two fields of research:

Smart bioanalytical instruments and data analytics for reliable health data

We build and validate advanced detection techniques in combination with innovative algorithms for data analysis. We bring together image processing, machine learning, and artificial intelligence to summarize, integrate, and reliably interpret data.

Services, platforms and data ecosystems for health

Our aim is to support the digital transformation in preventive healthcare, diagnostics, chronic disease management, aftertreatment, care, and support. The Fraunhofer Medical Dataspace concept aims to lay a foundation here. We played a key role in developing it. Fraunhofer FIT is an integral part of the 4D (Diagnostics, Devices, Drugs, Data) strategy of Fraunhofer-Gesellschaft for the healthcare sector.

Research Field	Bioinformatics
Keywords	Analytics, Chip Technology, Diagnostic Systems, mRNA, Personalized Medicine
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Fraunhofer UMSICHT

KEYWORDS
Climate-neutral Energy Systems, Resource-efficient Processes, Circular Products

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Internet	www.umsicht.fraunhofer.de
Founded (year)	1990
Number of employees	scientific 218 (Oberhausen), 43 (Sulzbach-Rosenberg) administrative 69 (Oberhausen), 14 (Sulzbach-Rosenberg)
Funding	Industrial returns 25.6%, Public returns 41.2%, Other returns 8.9%, Internal programs 12,7%, Basic funding 11,6 %

www.umsicht.fraunhofer.de


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Fraunhofer Institute for Environmental, Safety, and Energy Technology – UMSICHT

Pioneer for a sustainable world - Research for the market

Fraunhofer UMSICHT is a pioneer for a sustainable world. With our research in the areas of climate-neutral energy systems, resource-efficient processes and circular products, we make concrete contributions to achieving the 17 Sustainable Development Goals (SDGs) of the United Nations.

We develop innovative, industrially feasible technologies, products and services for the circular economy and bring them to application with all our strength. The focus is on the balance of economically successful, socially equitable and sustainable developments.

The institute has sites in Oberhausen, Willich and Sulzbach-Rosenberg. In 2020, Fraunhofer UMSICHT generated a turnover of more than 53.9 million euros with a workforce of 577 employees. As one of 75 institutes and research facilities of the Fraunhofer-Gesellschaft, the leading organization for applied research in Europe, we are part of a worlwide network and promote international cooperation.

Business Unit Biomass

Technologies for the provision of of bioenergy and biogas, utilization of residues, nutrient management and recovery as well as decentralized production and marketing of bio-based conversion products (biochar, synthesis gas, and pyrolysis condensate) are among our focal points. We develop and optimize thermochemical and biological conversion and distribution processes and the corresponding plant technology. With the objective to recover nutrients from municipal and industrial process chains and the conversion processes, we develop concepts and methods for nutrient management in biomass management. In this, we take into consideration raw materials potentials as well as logistic issues and integrate the technologies developed into established or novel value added chains.

Research Field	Renewable Energy and Ressources
Keywords	Bioenergy Research, Biomass
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Business Unit Chemistry

We offer research on process engineering as well as on products and processes incl. intellectual property rights. These help to meet the increasing demands for affordable sustainability and innovation in chemistry, petrochemistry and refinery. Our know-how encompasses the areas of fine and specialty chemicals (organic acids, peptides, sugars, surfactants), polymers (monomer syntheses, polymerization, polycondensation) as well as chemical commodities like higher alcohols, naphtha and biofuels (diesel, kerosene). Biomass, synthesis gas and selected residues constitute the portfolio of raw materials from which we develop process-specific solutions. Know-how regarding the upstream and downstream processing as well as product formulation complete our expertise. We are points of contact for the whole value and logistics chains and develop sustainability assessments and strategies. We are glad to bundle internal and external competences to make them fit to projects.

Membership in local and regional Networks

CLIB
aireg
ETIP Bioenergy

Research Field	Chemical Engineering
Keywords	Bioeconomy, Bioprocessing, Downstream Processing, Pilot Plant, Catalysis
Head of Business Unit	Dr.-Ing. Axel Kraft Dr.-Ing. Hartmut Pflaum
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Research Field	Environment
Keywords	Biomaterials, Biomass
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Business Unit Environment

Our service portfolio includes consulting, applied studies, innovative technology development up to pilot plant scale as well as support of the technical implementation at industrial scale. We provide clear communication paths with a central contact person who looks across our business units for the ideal solution for the customers' demands and who supports the joint realization. We deliver basics for strategic decisions; we improve competitiveness through optimization of energy flows, raw material flows, and waste streams, through sustainability assessments and through optimization of processes and plants. We as a reliable and strong partner for our customers are willing to establish long-term business partnerships.

Research Field	Biopolymers
Keywords	Biomaterials, Circular Economy, Environmental Research, Biopolymers, Biodegradability
Head of Business Unit	Dr.-Ing. Jochen Nühlen
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Business Unit Polymer Materials

For decades, Fraunhofer UMSICHT has been a strong partner to small and medium-sized enterprises all the way up to large-scale industry in the areas of the development and processing of plastics. Our specialties include the development and customization of materials of bio-based plastics and recyclate-based plastics for a variety of applications like films, fibers, filamensts, injection molded parts, adhesives and others. We contribute our expertise to transform the today's globally still largely linear plastics economy into a circular plastics economy. We are representative of product and process developments, simulation, production scale-up and additive manufacturing of plastics. In the area of consumer products, we have proven expertise in high pressure technology and coating technology. As an application-oriented development partner, we also transfer our polymer related material, process, and product innovations to the construction and leather industries.

International Collaborations

Federal University of Campina Grande (UFCG)

National Collaborations

FKuR Kunststoff GmbH
Loick Biowertstoff GmbH
Institut für Textiltechnik RWTH Aachen Universiy (ITA)

Membership in local and regional Networks

Industrielle Biotechnologie Bayern Netzwerk GmbH
ZIM KN "Waste2Value"
ZIM KN "BioPlastik"

Institute for Microelectronic Circuits and Systems – IMS

At the Fraunhofer Institute for Microelectronic Circuits and Systems IMS we have the vision of developing the next generation of biosensor systems in order to significantly reduce the complexity and costs of current analytical methods. A major focus lies on the integration of biosensors into miniaturized systems.

Key elements of PoC systems are miniaturized biosensors which are becoming smaller, more powerful and less expensive thanks to the enormous progress in micro- and nanotechnology.

In addition to their use in PoC systems biosensors also offer great potential in diagnostics for personalized medicine, inline process and quality control of biological products in the biotechnology and pharmaceutical industry and pharmacological drug screening.

For this we have know-how in the area of CMOS-based signal processing, chip/wafer bonding technologies for integrating microfluidics, (wireless) communication interfaces as well as AI-based data analysis.

The principle structure of biosensors is composed of a biological receptor, to which the analyte specifically binds and a signal converter which converts the binding into a physical parameter.

At the Fraunhofer IMS are three main areas of focus regarding the signal converters.

One focus lies on biofunctionalized nanomaterials, in particular carbon nanotubes. These are functionalized with selective biological receptors and change their optical properties (i.e., their fluorescence in the near-infrared range (NIR)) upon binding of an analyte.

A second focus is the development of single-photon avalanche diodes (SPADs) for chemiluminescence and fluorescence applications. SPADs are optical detectors with comparable sensitivity to photomultiplier tubes (PMT) which can be fabricated in a cost-effective manner. The high sensitivity of Fraunhofer IMS SPADs is particularly outstanding for detection of lowest light intensities such as during chemiluminescence reactions. In addition, SPADs also have temporal resolution allowing to analyze fluorescence lifetime.

The third focus is on MEMS-based nanopipettes fabricated by atomic layer deposition (ALD). Applications include multi-electrode arrays (MEA) for time- and spatially-resolved measurements of electrophysiological signals and single-molecule detection based on ion conductivity measurements.

Fraunhofer IMS

KEYWORDS
Chip Technology, Diagnostic Systems, Flow Cytometry, Biosensors, Biosignal Processing

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Founded (year)	1984
Number of employees	scientific 200 administrative 20
Funding	Federal Government (Germany) 30% Fraunhofer Society 30% Others 40% Industry

www.ims.fraunhofer.de

Fraunhofer IME

KEYWORDS
Agricultural Biotechnology, Food Science, Plant Breeding, Recombinant Proteins

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Founded (year)	1959
Number of employees	scientific 430 administrative 100
Funding	Federal Government (Germany) 30,6% Fraunhofer Society 21,9% Others 17% EU 6,3% Industry 24,2%

www.ime.fraunhofer.de

Fraunhofer Institute for Molecular Biology and Applied Ecology – IME

The Fraunhofer Institute for Molecular Biology and Applied Ecology IME conducts interdisciplinary research in the field of applied life sciences. Fraunhofer IME has four facilities in Germany: the Molecular Biotechnology Division with locations in Aachen and Münster as well as its Branch for Bioresources in Giessen, and the Applied Ecology Division in Schmallenberg, each with close ties to universities (the Institute for Biology V (Environmental Research) at RWTH Aachen University; the Institute of Plant Biology and Biotechnology as well as the Institute for Evolution and Biodiversity and the Institute for Molecular Microbiology and Biotechnology at the University of Münster; and the Institute for Insect Biotechnology and the Institute for Pharmaceutical Chemistry at the University of Giessen). It collaborates with other Fraunhofer institutes in Germany to form strategic alliances such as the Fraunhofer Group for Life Sciences, the Fraunhofer Food Chain Management Alliance, the Fraunhofer Big Data Alliance and Artificial Intelligence, and the Fraunhofer High Performance Center "International Center for Networked, Adapted Production (ICNAP)". Fraunhofer IME also collaborates with multiple government departments and industry partners.

The Molecular Biotechnology Division develops tailored plants, animal cells and microbes for applications such as the production of food and renewable raw materials, the manufacture of technical and pharmaceutical proteins, and the handling of anthropogenic pollutants including greenhouse gases, which we can exploit to produce valuable substances. Another focal point is the identification of active substances from bioresources such as plants, microbes and insects, plus the development of concepts for the sustainable agricultural production of active substances from plants.

The Applied Ecology Division develops experimental and model-based methods for the assessment of risks to ecosystems posed by potentially hazardous substances as well as for the analysis of consumer exposure to such substances within the environment. It often acts as scientific mediators between commercial producers and the regulatory authorities. It is GLP-certified and has accreditations for sample preparation and all state-of-the-art detection systems.

Applied Ecology Division

The Applied Ecology division of the Fraunhofer IME is explicitly dedicated to ecological issues and thematically routed in agricultural production. The overall aim of the division is to determine, assess and finally minimize the risk of synthetic and natural substances for ecosystems, and for humans via contamination of food, feed and consumer products.

Our analytical and ecotoxicological activities focus on the characterization and assessment of the environmental safety of plant protection products, biocides, veterinary medicinal products, industrial chemicals and, e.g., nanomaterials and include project work aiming to ensure food safety and quality.

We carry out a large part of our contract research projects for clients from industry and medium sized enterprises in different chemical sectors, the food manufacturing and processing industries. With projects performed for governmental agencies, consultancy services and expert memberships in regulatory boards the institute also takes considerable influence on environmental policy.

International Collaborations

Chemical industry, plant protection producers, research Institutes and universities

National Collaborations

RLP AgroScience,
Mesocosm GmbH,
gaiac, ECT

Membership in local and regional Networks

Fraunhofer Life Science, Fraunhofer Alliance Food Chain Management, Fraunhofer Alliance Photocatalysis , SETAC, GdCh

Research Field	Environmental Biology/ Chemistry, Monitoring, Food Safety, Ecotoxicology
Keywords	E-Fate, Hazard Identification, Risk Assessment, Trace Analysis, Substance Regulation
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Bioresources Division

We use groups of organisms with great biodiversity as bioresources, including insects, bacteria and fungi. We combine innovative technologies and established platforms to isolate and characterize natural substances, and to evaluate their potential for use in medicine, plant protection and industrial biotechnology.

The development and application of insect biotechnology allows us to use insects, insect-derived molecules, cells or organs, and insect-associated microbes as products or systems for diverse applications in medicine, industrial biotechnology, and the food and feed industry.

We also exploit insect cells as protein expression systems and insect antennae as biosensors for drugs and explosives. Also, we develop insect models for toxicology studies and use biotechnology to control pest and vector insects, e.g. RNA interference and the sterile insect technique. We also use insects for the conversion of organic waste into proteins and fats for the food and feed industry.

With the world's largest industrial strain collection of microorganisms, taken over from Sanofi, we are also open to projects with other industrial partners from non-competing fields of application.

Research Field	Biotechnology, Sustainable Agricultural Production, Insect Biotechnology
Keywords	Agricultural Biotechnology, Food Science
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Research Field	Biotechnology, Process Development, Process Modelling
Keywords	Agricultural Biotechnology, Biologicals/ Biopharmaceuticals, Bioprocessing, Downstream Processing, Plant Produced Products
Division Director	Prof. Dr. Stefan Schillberg PD Dr. Dr.-Ing. Johannes Buyel
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Department of Bioprocess Engineering

Biopharmaceutical proteins like monoclonal antibodies and vaccines are a pillar of our modern healthcare systems. The establishment of production and purification processes is often a time-consuming trial-and-error approach. This can result in unpredictable delays in process and product development and ultimately slow down the market launch of the associated product.

The department of Bioprocess Engineering addresses these challenges through intensive research on model-based process development. On the one hand, the accumulation of products is predicted based on the effect of different genetic elements such as promoters and untranslated regions. On the other hand, methods are being developed to characterize the separation behavior of proteins during different unit operations and evaluate the corresponding downstream processes with regard to yield and product purity. In addition, the department deals with the integration and evaluation of the collected data as well as their utilization for the improvement of the different models.

International Collaborations

St. Georges University Hospial, London, UK
Rensselaer Polytechnic Institute, Troy, USA
Maastricht University, Maastricht, NL

National Collaborations

Forschungszentrum Jülich
Technische Universität München
MPI Magdeburg

Membership in local and regional Networks

CLIB

Research Field	Biotechnology, Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Biomass, Genetic Engineering, Plant Breeding, Plant Produced Products
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Department of Functional and Applied Genomics

The Department of Functional and Applied Genomics (DFAG) has capitalized on the rapidly accumulating catalogue of genome sequence data to fuel a discovery engine that takes us from gene to function to target to useful products. In the context of plant-based research, the major aim of the DFAG is to develop new traits that allow the sustainable production of biopolymers, which are the most abundant organic compounds in the world and the major constituent of plant cells. DFAG has active research projects underway into the biopolymers starch, natural rubber and a particular type of protein-based polymer (forisomes). In addition, DFAG further research interests are to improve plant biomass by utilization of the tobacco forever young effect.

International Collaborations

Neiker, Spain
Wageningen University, The Netherlands
Lethbridge Research Centre, Canada

National Collaborations

Continental Reifen, Hannover
Westfälische Wilhelms-Universität Münster
BioPlant, Ebstorf

Membership in local and regional Networks

CLIB

Department of Industrial Biotechnology

Many microbes and plants can synthesize complex natural products that are difficult to produce chemically. In this respect, nature has provided elaborate biochemical factories often involving biochemical reactions that are unparalleled by modern chemical synthesis methods. Humans use these complex molecules in many ways, e. g. as spices, flavors, fragrances and pharmaceuticals. However, the molecules are produced naturally in tiny amounts, often among many similar molecules, making them expensive and difficult to isolate.

These challenges can be addressed by metabolic engineering (using recombinant cells) and bioorganic synthesis (using isolated enzymes). The Industrial Biotechnology group focuses on the production of natural products and other valuable molecules using metabolically engineered microbes and isolated enzymes, helping to reduce the cost and increase the availability of useful and valuable compounds.

International Collaborations

Sekisui Chemicals, Japan

National Collaborations

Max-Planck Institut Jena
Max-Planck Institut Dortmund
Fraunhofer ICT Karlsruhe

Research Field	Biotechnology
Keywords	Bioenergy Research, Biomass, Bio-processing, Enzymes, Metabolomics, (Microbial)Genomics
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Department of Plant Biotechnology

Biotechnology can be used to modify plants to improve their agronomic performance. The same techniques can be used to modulate metabolic pathways so that specific plant metabolites are produced in large quantities and can improve the nutritional value of foods. Plants and plant cell cultures can also be used as biofactories to produce pharmaceutical and industrial proteins in large amounts. We also focus on the establishment of new strategies to increase the production and stability of recombinant proteins in plant cells through novel molecular biology approaches, improved cultivation conditions based on statistical experimental design, and the high-content screening of plant lines. In this context, we aim to determine the molecular and cellular mechanisms affecting protein production using transcriptomics, proteomics and metabolomics. Finally, the department focuses on the establishment of novel techniques to enhance plant growth and the development of plant stem cell lines for the cosmetics industry.

Membership in local and regional Networks

CLIB

Research Field	Biotechnology
Keywords	Antibody, Crop Research, Downstream Processing, Plant Produced Products, Recombinant Proteins
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Fraunhofer IPT

KEYWORDS
Bio-processing, Cell Therapy, Personalized Medicine, Platform Technology, Stem Cell Research

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Founded (year)	1980
Number of employees	scientific 485 administrative 101

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Fraunhofer Institute for Production Technology – IPT

With its broad range of skills in all fields of production technology and its many years of practical experience, the Fraunhofer IPT provides its clients and project partners with applied research and development services for a networked, adaptive production. For this purpose, we generate marketable results in the areas of process technology, production machines, production quality and metrology as well as technology management. We understand the production process not as a mere sequence of isolated events. Our work has always taken into account the many ways in which the individual elements of the process chain are interconnected and interlinked, integrating the early and advanced stages of product development with the planning and preproduction processes as well as the production itself and the subsequent assembly into a single functional whole.

We develop and optimize new and existing methods, technologies and processes to create the networked, adaptive production environment of the future. Using an integrated perspective, we analyze production technology challenges of our clients in the context of the process chains involved. This allows us to go beyond the development of individual technologies which are capable of performing highly specific tasks, designing customized system solutions for our clients' production requirements.

Our business units combine the skills and the knowledge of the individual departments, the Fraunhofer CMI and our partner institute at the RWTH Aachen University, the Laboratory for Machine Tools and Production Engineering WZL. This interdisciplinary view allows us to approach and develop solutions which require thinking beyond the narrow confines of any particular discipline.

We put great importance on our continuous contacts and exchanges with industrial corporations and the permanent updating of our equipment. This allows us to ensure that we always remain abreast of the latest technological trends and developments – and that we can provide you with that all-important competitive edge in your production technologies. Our laboratories and production facilities feature state of the art technology and cover an area of 5,000 m². The entire Fraunhofer IPT occupies an area of app. 9,000 m².

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Business Unit Life Sciences Engineering

Medical engineering, biotechnology and pharmaceuticals are characterized by a high degree of innovative strength that constantly generates new technologies and products. At the same time, industry usually places high demands on new developments in terms of safety and quality. It is therefore important for companies to make targeted use of production technologies in order to be able to deliver new products safely and cost-effectively. We are happy to support you in adapting your production strategies in order to remain competitive in the long term.

Using elaborate production planning and organization, we develop the next generation of medical technology as well as biotechnology products that can be manufactured cost-effectively and safely.

Furthermore, we have experience with production processes, metrological systems, process automation as well as technology and quality management and provide advice on the use of new and proven technologies for the manufacture of medical, biotechnological and pharmaceutical products.

Research Field	Cell Biology, Process Development
Keywords	Bio-processing, Cell Therapy, Personalized Medicine, Platform Technology, Stem Cell Research
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Helmholtz Association

Helmholtz Association

The Helmholtz Association of German Research Centres ("Helmholtz-Gemeinschaft Deutscher Forschungszentren e. V.") is Germany's largest scientific research organization with a total of more than 42,000 employees who work at 18 scientific-technical and biological-medical research centres. About 70 % of the total annual budget (more than € 4.9 billion) is raised from public funds provided by the federal government (90 %) and the federal states (10 %). The remaining 30 % of the budget is raised by the individual Helmholtz centres in the form of contract funding. [1] The association is named after German physiologist and physicist Hermann von Helmholtz. [2]

The official mission of the Helmholtz Association is to solve the major challenges facing science, society, and the economy. Its research is therefore focused on making a substantial contribution to solving these challenges. Helmholtz Association scientists perform cutting-edge research on complex systems that affect human life and the environment. For example, they aim to ensure that society remains mobile and has a reliable energy supply and that the environment is passed on to future generations intact as well as to find treatments for previously incurable diseases. The activities of the Helmholtz Association focus on securing the foundations of human life for the future and on creating the technological basis for a competitive economy. These goals are supported by the outstanding scientists working at the research centres, a high-performance infrastructure, and modern research management.

In order to achieve the aforementioned objectives, the Helmholtz Association concentrates its work into six research fields [3]:

- Aeronautics, Space and Transport
- Energy
- Earth and Environment
- Health
- Information
- Matter

Scientists develop research programmes for each of these fields and international experts review these programmes. Their evaluation forms the basis of the programme-oriented funding given to Helmholtz research. Within the six research fields, Helmholtz scientists cooperate with each other and with external partners – working across disciplinary, organizational, and national borders. Indeed, the name Helmholtz stands for concerted research in which networks form the key principle behind inquiring thought and action. As the concerted research is efficient and flexible, the Helmholtz Association creates an effective platform for shaping the future.

Research infrastructures

Scientists and researchers from the Helmholtz Association develop and operate large-scale facilities of international significance, such as particle accelerators, synchrotron beams, neutron and ion sources, research vessels, supercomputers, and aircrafts. These facilities attract the best researchers from around the world as well as young scientists. Each year, several thousand researchers from home and abroad use these large-scale facilities, some of which are the only ones of their kind. [3]

Research programmes for greater focus

No other research organization can compare to the Helmholtz Association in the way that it has engaged in reforms in recent years and, in doing so, successfully put these reforms into practice. Since the foundation of the Helmholtz Association in autumn 2001, its research has been strategically restructured. Programme-oriented funding is at the heart of these reforms. Resources are no longer invested in individual institutions but rather in centre-embracing research programmes that compete with each other for funding. In accordance with the core objectives of the "Pact for Research and Innovation", activities now focus primarily on achieving excellent results through cooperation and competition. The scientists and researchers working at the 18 Helmholtz centres [1] have developed a total of 19 research programmes, running from 2021 till 2027 [4], whose scientific excellence and strategic relevance are evaluated by internationally renowned peers once every five years. This in turn helps to ensure that the results of Helmholtz research can compete with the work of leading institutes worldwide.

If you want to find out more about the Helmholtz Association, please visit the association's website (www.helmholtz.de/en).

[1] Helmholtz Geschäftsbericht 2020, https://www.helmholtz.de/fileadmin/user_upload/03_ueber_uns/zahlen_und_fakten/Jahresbericht_2020/20_Jahresbericht_Helmholtz_Zahlen_Fakten.pdf
Accessed 06.08.2021
[2] https://www.helmholtz.de/en/about-us/the-association/history/hermann-von-helmholtz/
Accessed 17.08.2021
[3] The Strategy of the Helmholtz Association, 2018 https://www.helmholtz.de/fileadmin/user_upload/04_mediathek/perspektiven/18_Helmholtz_Strategiebroschuere_EN_Web.pdf
Accessed 17.08.2021
[4] https://www.helmholtz.de/fileadmin/user_upload/04_mediathek/epaperStratBeg/epaper-Strategische_Begutachtung/index.html#12
Accessed 06.08.2021

JÜLICH Forschungszentrum

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E-Mail	info@fz-juelich.de
Internet	www.fz-juelich.de
Founded (year)	1956
Number of employees	6,446
Funding	Federal Government (Germany) 90%
	State Government NRW 10%

www.fz-juelich.de

Forschungszentrum Jülich
Shaping Change

How will we live longer in future while remaining healthy as we age? How will we ensure our energy supply and protect the environment at the same time? How can we manage the transition from an oil-based to a sustainable bioeconomy? In order to answer these pressing questions, society needs solutions from research – solutions based on completely new ways of thinking that can only be achieved with cutting-edge research tools.

Forschungszentrum Jülich is concerned with these kinds of key technologies, whose benefits are not restricted to the specific needs of isolated disciplines, but instead open new doors for research as a whole. Jülich, one of Europe's largest interdisciplinary research centres works with the best partners in science and industry to develop and build these key technologies, to use them for their own research, and make them available to science.

Our potential for meeting the objective of "key technologies for tomorrow" lies in 6,446 employees who work together in an interdisciplinary manner, over 200 cooperation partners in Germany and abroad, a unique infrastructure, and our special expertise in physics, materials science, nanotechnology, life science, and information technology. We harness this potential to generate new solutions for the areas of health, energy and environment, and information.

Excellent researchers who cooperate across the borders of institutes, research centres and even countries are Jülich's greatest strength. In order to allow them to collaborate with the best partners throughout the world, Jülich participates in strategic alliances both in Germany and abroad. The young scientists, students, and PhD candidates make an especially vital contribution to the intellectually stimulating environment and energy at the campus. Jülich offers them a working environment with state-of-the-art instruments and global contacts, as well as the opportunity to do independent research early on in their careers.

Forschungszentrum Jülich is proud of the tools it provides for its researchers to do their work: simulation with supercomputers, research with neutrons, imaging techniques for medicine and plant science, nanotechnology tools – these modern instruments allow science to break through to new horizons of knowledge. This infrastructure, valued and used by researchers throughout the globe, characterizes Jülich the home of key technologies.

IBG-1: Institute of Bio- and Geosciences/Biotechnology

IBG-1: Biotechnology is active in the field of White Biotechnology. It contributes to the realization of a bio-based economy by developing novel sustainable biotransformation processes exploiting the biocatalytic potential of microorganisms and enzymes. To enable the conversion of biomass, organic waste, and plastics into valuable chemical and pharmaceutical products, IBG-1 combines strain and enzyme development by metabolic engineering, synthetic biology, adaptive laboratory evolution and high-throughput biosensor-based screening with bioprocess development. The infrastructure includes a comprehensive bioanalytical omics platform, single-cell analysis, microfluidics, and a broad set of cultivation devices ranging from pico- to hectoliter. A newly established biofoundry automates and digitalizes standard operations in genetic and bioprocess engineering enabling high speed and reliability. All these research areas are supported by expertise in modeling, simulation and data science.

International Collaborations

TU Delft, The Netherlands,
Institute Pasteur, France
University of Tokyo, Japan
National Renewable Energy Laboratory (NREL), USA
Novozymes, Denmark
Amgen Inc., USA

National Collaborations

Universities of Aachen, Düsseldorf, Bielefeld, Bonn, Ulm
Pfeifer & Langen, Elsdorf

Membership in local and regional Networks

CLIB, Bioeconomy Science Center (BioSC), BioökonomieREVIER

Research Field	Biotechnology
Keywords	Microbial Cell Factories, Enzymes, Metabolic Engineering, Omics Platform, Plastics Upcycling
Head of Institute	Prof. Dr. Michael Bott Prof. Dr. Wolfgang Wiechert
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IBG-2: Institute of Bio- and Geosciences/Plant Sciences

The Institute of Bio- and Geosciences, Department of Plant Sciences (IBG-2) develops integrated bioeconomy concepts for the intensification and sustainability of plant production. The objective is (i) to improve yield, (ii) adapt the quality to various uses (food, feed, raw materials, bioenergy), (iii) reduce the production footprint, and (iv) adjust processes to the future climate and production conditions.

IBG-2 has a globally leading position in plant phenotyping based on its excellent knowledge in dynamic plant-environment interaction above- and belowground combined with technology development, engineering and digitization. The scientific focus is to identify shoot and root traits that improve yield, biomass quality and resource efficiency. The technology focus is to develop and implement methods and infrastructures for deep, high-throughput and field phenotyping and combine them with state-of the-art bioinformatics.

Integration of plant sciences in bioeconomy value networks is an additional element of IBG-2 with its research in alternative biomass, cell wall and secondary metabolite biochemistry.

International Collaborations

Universities of Bologna, Gent, British Columbia
Major plant breeders: INRA, France, CSIRO, Australia, EMBRAPA, Brasilien

National Collaborations

Universities of Bonn, Düsseldorf & RWTH Aachen
Helmholtz, Fraunhofer, Max Planck

Membership in local and regional Networks

BioSC, CLIB, BioökonomieREVIER

Research Field	Plant Biology/Physiology
Keywords	Biodiversity, Biomass, Crop Research, Phenotyping, Sustainable Bioeconomy
Head of Institute	Prof. Dr. Ulrich Schurr
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Research Field	Biophysics/ Neurotechnology
Keywords	Chip Technology
Head of Institute	Prof. Andreas Offenhäusser
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IBI-3: Institute for Biological Information Processing/Bioelectronics

In our research we focus on the functional connection of biological and electronic systems where we in particular examine the molecular, cellular and electronic and electro-chemical processes at this interface. This enables the development of electronic sensors for the detection of minute amounts of biochemicals in the environment and in body fluids or even exchange signals with neurons and neuronal networks.

We operate onsite facilities for method developments, prototyping and testing bioelectronic systems, fabricating and measuring the performance of devices, and testing the interaction with biological materials. We have access to micro- and nanofabrication (1000 sqm cleanroom with state of the art micro- and nanoelectronics equipment) in the Helmholtz Nanoelectronics Facility (HNF).

International Collaborations

Shanghai Institute of Microsystem and Information Technology, China, ETRI, Daejeon, Korea, U Naples, Italy

National Collaborations

RWTH Aachen, Fraunhofer

Research Field	Biochemistry
Keywords	Alzheimer's Disease, Neurodegenerative Diseases, Structural Biology, Protein-Ligand Interactions, Autophagy
Head of Institute	Prof. Dr. Dieter Willbold
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IBI-7: Institute of Biological Information Processing/Structural Biochemistry

Research at the IBI-7: Structural Biochemistry focuses on the development and application of methods to precisely investigate three-dimensional structures and dynamics of biologically and medically relevant macromolecules at atomic resolution by nuclear magnetic resonance (NMR) spectroscopy, X-ray crystallography, cryo-electron microscopy and computational structural biology. We are particularly interested in the misfolding and subsequent aggregation of proteins in neurodegenerative diseases like Alzheimer's and Parkinson's disease. A defining characteristic of our approach to curative intervention of neurodegeneration is the combination of basic research in structural biology and applied research, which has reached clinical stage in both diagnostics and therapy (see spin-off companies attyloid and Priavoid).

International Collaborations

University of Alabama at Birmingham, USA
Tel-Aviv University, Israel
University of Melbourne, Melbourne, Australia
University of Alberta, Edmonton, Canada

National Collaborations

Heinrich Heine University Düsseldorf
Charité, Berlin
Klinikum rechts der Isar, München

Membership in local and regional Networks

Graduate Schools iGRAD, iGRASPseed, iBrain and Molecules of Infection, IHRS BioSoft, Bio-N3MR Network NRW, Bioeconomy Science Center (BioSC), BMFZ, SFB 1208

IBI-8: Institute of Biological Information Processing/Neutron Scattering and Biological Matter

The structure and internal dynamics of proteins are key to their function and interaction with their biological environment. The institutes JCNS-1/IBI-8 use neutron scattering methods to determine the structure of proteins in solution and their crystalline state. In solution, their interactions with lipid membranes, with proteins and with drugs can be investigated close to the natural state in the cell, together with the corresponding changes of their internal structure and mobility. In the crystalline state, the position of hydrogen atoms can be determined with high precision, e.g. to locate hydrogen bonds and to determine the protonation state of amino acids. Neutron and X-ray scattering techniques are applied to study the structure of native tissue, e.g. to map the local neuron orientation in brain sections.

The institutes provide access to neutron scattering experiments, as well as complementary methods including X-ray scattering and cryo-electron microscopy. We also make use of various standard methods in order to study and characterize biological and soft matter.

International Collaborations

Montreal Neurological Institute/McGill University, Canada
Neurospin CEA, Paris, France
University of California-San Diego, UCLA, USA

National Collaborations

JARA-BRAIN,
Heinrich-Heine-University, Düsseldorf
Max-Planck-Institute, Leipzig
Helmholtz Zentrum München

Research Field	Research with Neutrons
Keywords	Protein Structure, Protein Dynamics, Neutron Scattering, Small Angle Neutron Scattering (SANS), Neutron Spin Echo Spectroscopy (NSE)
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INM-1: Institute of Neuroscience and Medicine/Structural and Functional Organisation of the Brain

To achieve a deep understanding of the structural and functional organisation of the human brain requires to consider different levels of its organisation, and to take advantage of in-vivo and post-mortem structural and functional imaging as well as genetic methods. Therefore, we develop a digital twin of the brain based on a cellular ultra-high resolution 3D model of the human brain that integrates receptor architecture, connectivity, and genetics. This model represents the organising principles of the brain across different spatial scales in a multimodal approach, and enables to study its function, dysfunction, and disease. The processing and analysis of the enormously large data sets require high-performance computing, are increasingly benefiting from approaches from Artificial Intelligence (AI) and Deep Learning methods, and at the same time are helping to advance those methodologically.

International Collaborations

Human Brain Project (HBP); Helmholtz International BigBrain Analytics and Learning Laboratory (HIBALL) with Montreal Neurological Institute/McGill University, Montreal, Canada; AI, Data Analytics and Scalable Simulation (AIDAS) with Neurospin CEA, Paris, France
Hebrew University, Jerusalem, Israel

National Collaborations

Heinrich-Heine-University, Düsseldorf;
Max-Planck-Institute, Leipzig;
Helmholtz AI with Helmholtz Zentrum München

Research Field	Structural and Functional Organisation of the Brain
Keywords	Aging, Genomics, Neurodegenerative Diseases
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Research Field	Health, Cognitive Neuroscience, Neurobiology
Keywords	Neurology, Neurodegenerative Diseases, Stroke
Head of Institute	Prof. Dr. Gereon R. Fink
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INM-3: Institute of Neuroscience and Medicine/Cognitive Neuroscience

The Department of Cognitive Neuroscience (INM-3) uses behavioral, pharmacological and neuromodulatory methods to elucidate pathomechanisms of neurological, neuropsychological or psychological deficits, with the aim to develop innovative diagnostic and therapeutic strategies/procedures.

Functional imaging (PET and MRI), both systemic (neural networks) and molecular (neurotransmission) approaches and mathematical models (such as dynamic causal modeling) are combined, in order to arrive at a holistic understanding of the development of normal functions in the healthy brain (across the entire life span) as well as the diseased brain of neurological and psychiatric patients.

These aims are pursued in close collaboration with the Department of Neurology, University Hospital Cologne (stroke-induced deficits and neurorehabilitation, memory disorders in normal aging and dementias) and the Department of Psychiatry, University Hospital Cologne (disorders of social cognition in autism and schizophrenia).

International Collaborations

International CollaborationsInstitute of Cognitive Neuroscience, London, UK; Department of Psychology, University of Mebourne, Australia; Faculty of Psychology, Normal University, Guangzhou, South China

National Collaborations

University Hospital of RWTH Aachen Department of Neurology, University Hospital Tübingen; Department of Psychology, University of Cologne

Membership in local and regional Networks

SFB 1452, Virtual Times, NeuroNRW

Research Field	Health, Medical Physics
Keywords	Ageing, Alzheimer's Disease, Diabetes, Diagnostic Systems, Parkinson Disease
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INM-4: Institute of Neuroscience and Medicine/Medical Imaging Physics

The research and development activities of the Medical Imaging Physics division (INM-4) of the Institute of Neuroscience and Medicine concentrate on the development, experimental validation and the clinical implementation of novel brain imaging methods. The focal points comprise the development of novel methods in the area of ultra-high field Magnetic Resonance Imaging (MRI), Magnetoencephalography (MEG) and the development of hybrid imaging combining MRI with Positron Emission Tomography (PET). Such combinations present unique opportunities for the simultaneous acquisition of structural changes, physiological and biochemical data and provide excellent perspectives for clinical application to neurological diseases. In cooperation with our partner institutes, novel tracers for MR-PET imaging are investigated in and validated. With MEG, patterns of neuronal activities are detected with high temporal resolution. The analysis of such signals provides new insights which contribute to the basic understanding of physiological and pathophysiological activity in the human brain.

International Collaborations

Maastricht University, The Netherlands Monash University, Australia The University of Melbourne Australia, Cardiff University, UK

National Collaborations

Siemens Healthcare, RWTH Aachen University, HHU Düsseldorf, Universität zu Köln

Membership in local and regional Networks

JARA-BRAIN

INM-8: Institute of Neuroscience and Medicine/Ethics in the Neurosciences

The department "Ethics in Neuroscience (INM-8)" examines ethical, philosophical, psychological, and social issues arising from neuroscience research. The use of new neurotechnologies and their potential impact on self-consciousness raises several issues, including problems of informed consent, incidental findings, and privacy. In addition, these technologies raise questions regarding possible changes in a person's self-referential attitudes and abilities to lead a person's life. Therefore, identifying normatively relevant properties of person and personhood is an essential prerequisite for the ethical evaluation of neurotechnological systems. The use of machine learning methods in the neurosciences opens up a new field of research at the intersection of ethics and philosophy of science, in which INM-8 is now also active.

International Collaborations

Institute of Science and Ethics (IWE), University of Bonn
German reference Center for Ethics in the Life Sciences (DRZE), Bonn
Institute of Systems Neurosciences, University of Düsseldorf
Center for the Law of Life Sciences, University of Bonn
Institut für Technikfolgenabschätzung und Systemanalyse, Karlsruher Institut für Technologie (KIT)

Research Field	Ethics
Keywords	Neuroethics, Philosophy of Mind, Person, Informed Consent
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ER-C-3: Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons/Structural Biology

We use a comprehensive electron microscopy approach to study the biological structures of membrane-associated protein complexes. Our main methods of investigation are single-particle electron cryo-microscopy (cryo-EM) as well electron cryo-tomography (cryo-ET) that we are also developing to advance existing imaging technologies towards high-resolution structural biology.

Although the cryo-EM method has become very powerful in the past several years, its full potential is still to be realized. First 3D images of biological specimens at true atomic resolution have been obtained recently, but the routine resolution of cryo-EM still lags behind in detail and quality in comparison with common material science electron microscopy. Therefore, we apply new imaging hardware to biological samples and also develop novel sample preparation, data acquisition and image processing methods that we benchmark using biological test specimens. We apply these innovative cryo-EM methods to the structures of challenging biological systems.

International Collaborations

University of Tromsø, Norway
Oslo University Hospital, Norway

National Collaborations

Johannes Gutenberg University Mainz, Germany

Membership in local and regional Networks

SFB1208 Membranes (Identity and dynamics of membrane systems)

Research Field	Structural Biology
Keywords	Cryo-electron Microscopy, Cryo-electron Tomography, Multi-protein Complexes, Cryo-EM Image Analysis, Biological Membranes
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KEYWORDS

Aerospace, Space Research, Medicine, Psychology, Biology

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Founded (year)	1909
Number of employees	scientific 6,500 administrative 4,000

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German Aerospace Center, Institute of Aerospace Medicine

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its research and development work in aeronautics, space, energy, transport and security is integrated into national and international ventures. In addition, as Germany's space agency, DLR plans and implements the German space program on behalf of the federal government. DLR has over 10,000 employees at 30 locations in Germany. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C. DLR's mission comprises Earth and Solar System exploration and research for environmental protection including development of environmentally-friendly technologies for energy supply and future mobility. Moreover, DLR develops cutting-edge communication and security technologies.

The Institute of Aerospace Medicine with its research facility :envihab in Cologne and the Hamburg-based Aviation and Space Psychology division serves as interface between advanced technologies and medicine, psychology, and biology at DLR. The Institute contributes unique expertise and one-of-a-kind research facilities to research collaborations with academic institutions, agencies and industry. The Institute of Aerospace Medicine conducts interdisciplinary research with the goal to improve human health, performance, and safety in space, in aviation and on Earth. The research program focusses on mechanisms mediating environmental influences on human health, performance and living conditions. Mechanistic insight and technological innovations are translated to psychological and biomedical applications. The Institute of Aerospace Medicine develops long-term solutions aimed at increasing the effectiveness, safety and sustainability of human, machine and environment interactions. The Institute has a leadership role in aerospace medicine and psychology and contributes to prevention, individualization and remote medical care on Earth.

Department of Cardiovascular Medicine

The Department for Cardiovascular Aerospace Medicine investigates gene-environmental influences on the human cardiovascular system. We focus on real and simulated weightlessness, atmosphere conditions, nutrition, and exercise. The major aim is to elucidate mechanisms of cardiovascular structural and functional adaptation and how these responses are integrated by the autonomic nervous system. Human space experiments are flanked by highly controlled terrestrial studies in healthy persons and in patients in close collaboration with leading university medical faculties. Combination of physiological or pharmacological challenges with high-fidelity human phenotyping and biomedical engineering is our particular strength. Moreover, we translate observations in patients with rare cardiovascular conditions and defined genetic variants to astronauts confronting spaceflight and vice versa. The ultimate goal is to improve diagnostics, cardiovascular countermeasures, and treatments in space, in aeronautics, and on Earth.

International Collaborations

UTSW Dallas, Texas USA
Vanderbilt University, Nashville, TN, USA
Free University Brussels, Belgium

National Collaborations

University of Cologne
University Bonn
University-Medicine, Charité Berlin

Research Field	Health
Keywords	Ageing, Cardiovascular Research, Neurodegenerative Diseases, Personalized Medicine, Regenerative Medicine
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Department of Clinical Aerospace Medicine

The Department of Clinical Aerospace Medicine is responsible for medical qualification and individual health prevention strategies in aviation, space flight, and other occupational settings. We primarily target private and professional pilots, aircrew members, astronauts as well as personnel in the other areas of aerospace, air traffic control and transportation. Additionally, we apply our experience in medical qualification examinations supporting the institute's departments in selecting test subjects for various clinical and physiological trials.

Our aim is to maintain flight safety as part of the flight medicine community. One key factor for flight safety is a healthy and well trained cockpit and cabin crew.

The department's mission support comprises pre-, in-, and postflight activities, as the European astronauts have returned directly to the :envihab after their Soyuz-landing in Kazakhstan, within the scope of the „direct return", since 2013. Given our strength in aerospace ophthalmology, we contributed to the discovery of eye changes in astronauts on long duration space flights.

The finding has led to an increased emphasis on eye health with regular follow ups and participation in several scientific studies.

International Collaborations

All International Space Agencies
European Aviation Safety Agency (EASA)
International Space University

National Collaborations

European Astronaut Center
Technical University Braunschweig
University Bonn Eye Hospital

Research Field	Health
Keywords	Aerospace Medicine, Neurodegenerative Disease, Regenerative Medicine
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Research Field	Cell Biology, Cellular Neuromuscular Research, Biogeneration
Keywords	Bioregeneration, Cellular and Molecular Neuromuscular Research
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Department of Gravitational Biology

Life evolved in terrestrial gravity, which is the only environmental factor that has remained constant for billions of years. The lack of gravity poses health challenges to astronauts while providing unique insight in the fundamental mechanisms of gravity-/mechano-sensing. Indeed, biological systems perceive gravity directly and indirectly through mechanosensitive structures and pathways. Our goal is to elucidate molecular mechanisms of gravity perception and resulting biological responses. We apply the acquired mechanistic knowledge to develop and refine countermeasures for space travel and translate to terrestrial medicine. Another main focus is to improve closed biological life-support systems, which are a prerequisite for long-term human space missions. With our innovative DLR C.R.O.P.® (Combined Regenerative Organic food Production) technology we aim at optimizing waste recycling for food production. The technology is applicable for stations on Moon and Mars, but also for sustainable agricultural systems on Earth.

International Collaborations

Universtity of Aarhus, Denmark
La Trobe University, Melbourne
European Astronaut Center

National Collaborations

University Bonn
University of Cologne
LMU Munich

Membership in local and regional Networks

Bonner Forum Biomedizin

Research Field	Physiology
Keywords	Ageing, Diabetes, Environmental Research, Metabolomics, Nutrition, Mitochondria
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Department of Muscle and Bone Metabolism

The Muscle and Bone Metabolism department examines the adaptation of the human body to changing environmental conditions, such as microgravity, atmospheric composition, nutrition and physical inactivity. Genetic predisposition and the ageing process are also taken into account, as are the overall effects on health. A good understanding of biomechanics and metabolism helps us to develop efficient measures to counteract muscle atrophy, bone atrophy and metabolic disorders in space.
The research also focuses on possible clinical uses, such as in rehabilitation medicine and treatment of diabetes patients and other cardiometabolic disorders.

International Collaborations

Institute of Biomedical Problems (Moscow, Russia)
University of Bologna (Italy)
Harvard T.H. Chan School of Public Health (Boston, USA)

National Collaborations

University of Cologne
University Bonn
University of Erlangen

Membership in local and regional Networks

CECAD Excellent in Aging Research Cluster of Excellence at the University of Cologne

Department of Radiation Biology

The Radiation Biology department conducts biophysical and cell biological research to elucidate mechanisms of cell damage and repair following radiation exposure to improve individual risk prediction in space, in aeronautics, and on Earth. Radiation exposure can initiate and promote carcinogenesis, and cause cell death, cellular senescence, and genetic defects. Acute radiation sickness can occur. Therefore, cosmic radiation remains a major limiting factor for long-term space missions and an important occupational health issue at aviation altitudes. Another focus of the department is microbiology, which in addition to providing cell models for radiation biology research is applied to elucidating biotic and abiotic factors limiting microbiological life and adaptation to extreme conditions. We apply this knowledge to limit spread of infectious agents in space and on Earth, to investigate the human microbiome, and to support the search for extraterrestrial life and habitable environments on other celestial bodies.

International Collaborations

National Aeronautics and Space Administration (NASA)
European Space Agency (ESA)
EScience and Technology (QST)

National Collaborations

Universitätsklinikum Köln
Universitätsklinikum Bonn
Christian-Albrechts-Universität zu Kiel (CAU)

Membership in local and regional Networks

BFB

Research Field	Health, Microbiology, Radiation Biology and Astrobiology
Keywords	Environmental Research, Flow Cytometry, Oncology, Personalized Medicine, Signal Transduction
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Department of Sleep and Human Factors Research

The department's research focuses on human performance, sleep and wellbeing as subject to specific challenges and risks posed by the mobile 24-hour society. We study the effects of environmental influences as well as individual factors, and derive countermeasures and mitigation strategies that can be shared with stakeholders in the fields of aeronautics, space and transportation. Among the factors that are studied are sleep loss, circadian disruption, workload, noise, atmospheric pressure, hypoxia, and hypercapnia. The work is aimed at understanding and ultimately improving the conditions for operators, but also for residents impacted by transport systems particularly by noise. The research integrates both basic human science aspects as well as applied/translational aspects in the operational environment.

International Collaborations

University of Pennsylvania
Netherlands Aerospace Centre
University of Zurich

National Collaborations

Forschungszentrum Jülich
Universitätsklinikum Bonn
Universitätsklinikum Köln

Research Field	Health, Physiology
Keywords	Ageing, Human Performance, Sleep Research, Noise Effects Research, Hypoxia Research
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KEYWORDS
Genomics, Neurodegenerative Diseases, Platform Technology, Signal Transduction, Therapeutics

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Internet	www.dzne.de
Founded (year)	2009
Number of employees	scientific 600 administrative 550
Funding	Federal Government (Germany) 90% State Government NRW 10% The DZNE receives 10% funding from every state in which a DZNE site is located.

www.dzne.de

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German Center for Neurodegenerative Diseases – DZNE

Understand and investigate the causes, develop novel strategies for prevention, treatment and care

More than 1100 experts are working at the DZNE to understand what causes diseases of the brain and nervous system and to find new approaches for effective prevention, therapy, and patient care.

Its focus is on neurodegenerative diseases such as Alzheimer's, Parkinson's, frontotemporal dementia, childhood dementia, amyotrophic lateral sclerosis (ALS), spinocerebellar ataxia, and age-related macular degeneration.

The center was founded in 2009 as a member of the Helmholtz Association and the first of the German Centers for Health Research (Deutsche Zentren für Gesundheitsforschung, DZG). Today, it consists of ten sites – with headquarters in Bonn, as well as sites in Berlin, Dresden, Göttingen, Magdeburg, Munich, Rostock/Greifswald, Tübingen, Ulm and Witten – consequently pooling distributed expertise within a single research institute.

The DZNE is dedicated to exploring the entire spectrum from investigating molecular disease processes in the laboratory to conducting studies on humans, protection and risk factors, and developing measures for care and treatment. In order to cover this wide range of issues, it pursues an interdisciplinary scientific strategy that includes several interlinked research areas. Fundamental research is closely linked to clinical research, population studies, health care research and systems medicine, to identify new diagnostic markers and to enable rapid development of new therapies.

Its purpose is to ensure that research findings are applied in the medical field and in everyday life. Such efforts to build a bridge between science and practical application are called "translation", and thus the DZNE cooperates with universities, university hospitals, institutes and innovative companies – both in Germany and worldwide.

Worldwide, the DZNE is one of the largest research institutes dealing with this topic. It is sponsored by the Federal Ministry of Education and Research (BMBF) and by the federal states in which the DZNE sites are located.

German Center for Neurodegenerative Diseases/Bonn

Bonn is home of the the largest DZNE-site and of the national administrative office. With the support of basic research, DZNE scientists aim to develop new therapeutic approaches for neurodegenerative diseases. The Bonn researchers strive to understand the mechanisms of neuronal impairment. This includes investigating neural dysfunction, synaptic loss, synaptic regeneration, inflammation, and modified proteins. The role infection and modified proteins play is another important question studied in Bonn. Clinical research at DZNE Bonn seeks to improve diagnostic procedures and develop effective therapies. Systems Medicine takes a look at the big picture and brings together methods from biology, biotechnology, medicine, data science and mathematics. State-of-the-art imaging technology and biochemical methods are used to facilitate early diagnosis. We also look into the impact that vascular and infection related processes have.

International Collaborations

Centers of Excellence in Neurodegeneration Initiative (CoEN)
Medical Research Council, UK
Canadian Institutes of Health Research, Canada

National Collaborations

ImmunoSensation, Bonn
Synergy/ActiGlia, Munich
NeuroCure, Berlin

Research Field	Neurodegenerative Disease
Keywords	Ageing, Alzheimer's Disease, Biomarker, Neurodegenerative Diseases, Parkinson Disease
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Helmholtz Institute for Biomedical Engineering

RWTH AACHEN UNIVERSITY

KEYWORDS

Personalized Medicine, Regenerative Medicine, Stem Cell Research, Tissue Engineering

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Internet	www.hia.rwth-aachen.de
Founded (year)	1971
Number of employees	scientific 180 administrative 12
Funding	Federal Gouvernment Germany 47% EU 9% Others 20%

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RWTH Aachen University / Helmholtz-Institute for Biomedical Engineering

RWTH Aachen University - Thinking the Future -

The Helmholtz-Institute for Biomedical Engineering HIA represents a major hub for interdisciplinary basic as well as application-oriented research and development in biomedical engineering at RWTH Aachen University and beyond. Research projects target improved health care. Continuous refinement of methods and technologies helps to achieve personalized diagnostic and therapeutic options for patients. Networking and cooperation within RWTH Aachen University as well as with national and international clinicians, academic and industry researchers are key to our work. The HIA contributes to Bachelor and Master courses of the Medical, Engineering and Natural Sciences faculties of RWTH Aachen University. HIA Members coordinate master courses related to all fields of biomedical engineering.

Biointerface Laboratory

The Biointerface group studies two major topics – the biology of fetuin family proteins, and (stem) cell-material interactions. Fetuin biology involves tissue development and remodeling ranging from mineralized tissue metabolism to reproductive biology. We have developed genetically altered mouse strains to study aspects of tissue remodeling involved in human disease. Over the years we have thus developed diagnostics and experimental therapies in pathological calcification, atherosclerosis, and female reproductive biology.

Our second line of research deals with cell-material interactions including toxicity studies with (nano-) materials, cell sources and cell-scaffold interactions up to implantation models in experimental tissue engineering. Tissue engineering approaches address wound healing and bone tissue engineering. We study cell sources and precursors of cells required for new tissue formation and homeostasis. This involves mesenchymal stem cells as precursors of major tissue types as well as immune cell precursors as the regulators of tissue function.

International Collaborations

Maastricht University, The Netherlands
Mc Gill University, Montreal, Canada
Institute for Systems Biology, Seattle, WA, USA

National Collaborations

RWTH Aachen University
University Clinics Hamburg Eppendorf

Membership in local and regional Networks

Life Tec Aachen Jülich e. V.

Research Field	Biochemistry
Keywords	Animal Models, Biomarker, Biomaterials, Diagnostic Systems, Tissue Engineering
Head of Institute	Univ.-Prof. Dr. Wilhelm Jahnen-Dechent
Internet	www.biointerface.rwth-aachen.de
E-Mail	willi.jahnen@rwth-aachen.de
Address	Pauwelsstr. 30
Postal Code/City	52074 Aachen
Fon	+49 241 80-80163
Fax	+49 241 80-82573

Institute of Applied Medical Engineering AME

The defining feature of our institute is the pursuit of a future-oriented biomedical engineering research profile, combining conventional medical engineering with natural sciences, and especially with biosciences. Our team consists of medical scientists, engineers, physicists, information scientists and chemists, working closely together in more than 60 R&D projects.
Our R&D-projects comprise of modelling, construction, prototyping, experimental validation and preclinical testing of biomedical products and also the technical support of innovative methods and products for the clinical environment.
Our co-operations include a great variety of national and international industrial and academic partners.

International Collaborations

Tampere University (Finnland)
Zurich University Schweiz
Valladolid University Spain

National Collaborations

Medizinische Hochschule Hannover
Würzburg University
Rostock University

Membership in local and regional Networks

MedLife e.V.,

Research Field	Medical Devices, Tissue Engineering, Regenerative Medicine
Keywords	Biomaterials, Cardiovascular Research, Personalized Medicine, Regenerative Medicine, Tissue Engineering
Head of Institute	Prof. Dr. med. Dipl.-Ing. Thomas Schmitz-Rode
Internet	www.ame.hia.rwth-aachen.de
E-Mail	smiro@ame.rwth-aachen.de
Address	Pauwelsstr. 20
Postal Code/City	52074 Aachen
Fon	+49 241 808-7111
Fax	+49 241 808-2026

Research Field	Health, Medical Devices
Keywords	Drug Discovery/Drug Delivery, Oncology, Regenerative Medicine, Stem Cell Research, Tissue Engineering
Head of Institute	Prof. Dr. rer. nat. Martin Zenke
Internet	www.molcell.rwth-aachen.de
E-Mail	martin.zenke@rwth-aachen.de
Address Postal Code/City	Pauwelsstr. 20 52074 Aachen
Fon Fax	+49 241 80-80760 +49 241 80-82008

Institute of Cell Biology

The institute has a long-standing interest in stem cells and cellular engineering. A particular focus is on blood stem cells, mesenchymal stem cells and embryonic stem cells (ES cells), and their differentiated progeny. We also employ engineered stem cells, such as patient-specific induced pluripotent stem cells (iPS cells), for disease modeling and compound screening. In this context we develop lab automation of stem cell production and compound screening (StemCellFactory). The institute also investigates the impact of natural and synthetic biomaterials on cell growth, differentiation and function.

International Collaborations

Tokyo Institute of Technology, Kanagawa, Japan
Medical University Vienna, Austria
National Nanotechnology Laboratory, São Carlos, Brazil

National Collaborations

Max Planck Institute for Molecular Biomedicine, Münster
Lead Discovery Center, LDC, Dortmund
Life and Brain, Bonn University, Bonn

Membership in local and regional Networks

Stem Cell Network NRW
DFG Clinical Research Unit (CRU 344): "Untangeling and targeting mechanims of myelofibrosis in myeloproliferative neoplasms"
BMBF Consortium "Bio2Treat"
StemCellFactory – Automated derivation, expansion and differentiation of iPS cells

Research Field	Biotechnology, Medical Devices
Keywords	Biomarker, Diagnostics System, Immune Modulation, Oncology, Personalized Medicine, Therapeutics
Head of Institute	Prof. Fabian Kiessling
Internet	www.exmi.rwth-aachen.de
E-Mail	fkiessling@ukaachen.de
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Fon	+49 241 80-80116

Institute of Experimental Molecular Imaging (ExMI)

ExMI develops and evaluates novel imaging modalities, contrast agents and theranostics for the characterization and treatment of cancer, cardiovascular, and inflammatory diseases. Many projects are at the interface between preclinical and clinical research. Often a multimodality approach is taken combining MRI, CT, ultrasound, MPI, optical, photoacoustic, and nuclear imaging. To develop image-guided therapies, we closely link pathophysiologic and pharmacologic research with research on instrumentation, image reconstruction, and data processing. Imaging and omics data are comprehensively analyzed using radiomic approaches, and used to generate mathematical models of disease. Furthermore, ExMI is investigating materials and concepts to improve drug delivery to tumors. This includes novel biomaterials, e.g. nanoparticles, polymeric drug carriers, liposomes, micelles and microbubbles..

International Collaborations

FUJIFILM VisualSonics, Canada
Philips, NL
Universität Utrecht, NL

National Collaborations

Fraunhofer MEVIS, Bremen
Bruker, Ettlingen
Ruhr Universität Bochum

Membership in local and regional Networks

CIO ABCD (gefördert durch Krebshilfe)

Laboratory for Biomaterials

Laboratory for Biomaterials' research projects include the enzymatic synthesis of native and modified glycan structures and their interaction with glycan binding proteins (lectins). In cooperation with partners, the lab utilizes these carbohydyrate-protein interactions for the bio-functionalization of biomaterial surfaces and for targeting toxins and cancer cells. Further projects deal with the enzymatic synthesis of biopolymers, e.g. hyaluronan and automated enzymatic glycan synthesis.

International Collaborations
Industrial and academic partners

National Collaborations
Industrial and academic partners

Membership in local and regional Networks
Bioeconomy Science Center (BioSC), NRW

Research Field	Biotechnology, Glycobiotechnology
Keywords	Biocatalysts, Bioeconomy, Biomaterials, Enzymes, Glycobiotechnology
Head of Institute	Prof. Dr. Lothar Elling
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Address Postal Code/City	Pauwelsstr. 20 52074 Aachen
Fon	+49 241 80-28350

mediTEC – Chair of Medical Engineering

The mediTEC team is engaged in basic research issues as well as in application-oriented aspects of the development and evaluation of computer assisted and model driven therapy systems. The effective development of these systems is based on the successful interdisciplinary cooperation of medical and engineering sciences. Our activities cover a wide range of subjects from feasbility studies to usability testing and clinical trials e.g. in orthopaedics, traumatology, neurosurgery, general surgery, interventional radiology and cardiology in close cooperation with international academic, clinical and industrial partners. The research field consists of six research areas:

- Biomechanic Modelling and Simulation
- Image & Model Guided Surgery
- Mechatronics and Robotics
- Ultrasound and Shockwaves
- Usability & Risk Engineering

International Collaborations
Aalborg University
Delft University
ETH Zurich
Harvard University
Imperial College
Oxford University

Industrial Cooperations

National Collaborations
Charité Berlin
Essen University Hospital
Lübeck University
Leipzig University
LMU München

Membership in local and regional Networks
CeMPEG e.V.
OR.NET e.V.

Research Field	Computer Assisted Therapy, Health, Medical Devices
Keywords	Artificial Intelligence, Biomechanics, Robotics, Internet of Things, Shockwaves
Head of Institute	Univ.-Prof. Dr.-Ing. Klaus Radermacher
Internet E-Mail	www.meditec.rwth-aachen.de radermacher@hia.rwth-aachen.de
Address Postal Code/City Fon Fax	Pauwelsstr. 20 52074 Aachen +49 241 80-23873 +49 241 80-23870

Research Field	Health, Medical Devices
Keywords	Ageing, Cardiovascular Research, Diabetes, Parkinson Disease, Personalized Medicine
Head of Institute	Univ.-Prof. Dr. med. Dr.-Ing. Steffen Leonhardt
Internet	www.medit.hia.rwth-aachen.de
E-Mail	medit@hia.rwth-aachen.de
Address Postal Code/City	Pauwelsstr. 20 52074 Aachen
Fon Fax	+49 241 80-23211 +49 241 80-623211

MedIT – Chair for Medical Information Technology

The Chair for Medical Information Technology is concerned with biomedical measurement instrumentation, automation of therapy and medical care outside the hospital. We develop both algorithms and device prototypes and test them in appropriate experimental or human trials. Topics include

- theory and applications of feedback control in medicine
- noncontact monitoring of vital signs
- bioimpedance spectroscopy and tomography
- wearables and textile integration

International Collaborations

India Institute of Technology Madras, Chennai, India
Bauman Moscow State Technical University, Moscow, Russia
Tsinghua University, Bejiing, China

National Collaborations

Charité Berlin
University of Bonn

Membership in local and regional Networks

Smart Care Unit (ZIM/AiF)
MoDiPro (ZIM)
BioMed-IoT (ZIM)
Health.ai (BMBF)

Leibniz Association

Luxembourg

Leibniz Association

The Leibniz Association ("Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.") has more than 20,500 employees (roughly 56 % of whom are scientific staff [1]) and connects 96 independent research institutions (including 9 located in North Rhine-Westphalia). [2] The 96 research institutes focus on a broad spectrum of topics ranging from natural, engineering, and environmental sciences to economics, spatial and social sciences, and the humanities. Leibniz institutes address issues of a social, economic, and ecological relevance. They conduct basic and applied research, uphold scientific infrastructure, provide research-based services, and maintain research museums to educate the general public. [3] The Leibniz Association is named after the German philosopher, mathematician, scientist, and inventor Gottfried Wilhelm Leibniz. [4]

The Leibniz Association identifies focus areas for knowledge transfer to policymakers, academia, business, and the public. Leibniz institutes collaborate intensively with universities – for example in the form of ScienceCampi (thematic partnerships between university and non-university research institutes) – as well as with industry and other partners at home and abroad. They are subject to an independent evaluation procedure that is unparalleled in its transparency. [3] Due to the importance of the institutions for the country as a whole, they are mainly funded by the government at federal and state levels. The total annual budget of all the institutes exceeded € 2 billion in 2020 and more than 25 % of the budget is currently acquired through third-party funds. [1] In 2012, the General Assembly of the Leibniz Association committed itself to the guiding principle of a coordinated, decentralized structure. At the same time, it took the decision to strengthen the central service functions of the Leibniz Association and to expand its headquarters. [5]

Scientific profile

The 96 Leibniz institutes are divided into five sections, each with a different focus area. Active knowledge sharing takes place both within and between the sections, providing an initial overview of the Leibniz Association's scientific profile [6]:

Section A - Humanities and Educational Research
Section B - Economics, Social Sciences, Spatial Research
Section C - Life Sciences
Section D - Mathematics, Natural Sciences, Engineering
Section E - Environmental Research

The latter three sections are most relevant for research disciplines from the life sciences.

The Leibniz institutes in **Section C** concentrate on research in the life sciences with a focus on four key areas: biodiversity; infection and inflammation; lifestyle, the environment, and healthy ageing; and bioactive compounds and biotechnology. While research into the fields of lifestyle, the environment, and healthy ageing are mostly centred on human beings, all other key areas feature a more widespread scope. Beyond the research laboratories, the institutes offer other important research facilities such as special clinics, technology platforms, research collections, and field stations, which help to produce and to utilize the research data. [7]

Section D comprises the institutions and infrastructure facilities in the Leibniz Association that conduct research into mathematics, natural sciences, and engineering. These Leibniz institutes ideally combine knowledge-driven research in communications technologies and microelectronics; optics and photonics; mathematics and modelling; astrophysics and the Earth's atmosphere; materials research and nanotechnology; biomedical research and health technologies; digital transformation, and research data management and infrastructures. New approaches to technology transfer and the presentation of outcomes extend beyond the individual sections and are actively embraced by the scientific infrastructure facilities. [8]

Section E focuses on environmentally relevant issues, for example in the natural sciences, engineering, social sciences, and economics, using a multidisciplinary approach. Ecosystems and biotic communities are studied with the aid of laboratory and field work, the development of analytical procedures, and mathematical modelling, particularly against the backdrop of global change. These Leibniz institutes investigate the interdependency between the natural environment and human activity, providing a basis for decision-making with regard to securing sustainable resources in the political, economic, and social spheres. They therefore focus on four key research areas according to the spheres of the Earth: hydrosphere, atmosphere, lithosphere, and a cross-sectional task area. [9]

Alongside its division into different research sections, the Leibniz Association also maintains internal research alliances and research networks. Within the Leibniz research alliances, interdisciplinary and transdisciplinary teams jointly investigate topical issues of great rel-

evance to science and society, such as "Bioactive Compounds and Biotechnology" or "Biodiversity". [10] In contrast, the Leibniz research networks focus on a particular key topic or technology. They form a communicative platform on which the participating institutes can exchange and develop subject-based, methodological, and technical expertise. The Leibniz research networks include: "Green Nutrition – Health Society" and "Immune-Mediated Diseases". [11]

If you want to find out more about the Leibniz Association, please visit the association's website (www.leibniz-gemeinschaft.de/en.html).

[1] https://www.leibniz-gemeinschaft.de/en/about-us/organisation/leibniz-in-figures.html
Accessed 17.08.2021
[2] https://www.leibniz-gemeinschaft.de/en/institutes/leibniz-institutes-all-lists.html
Accessed 06.08.2021
[3] https://www.leibniz-gemeinschaft.de/en/about-us/about-the-leibniz-association.html
Accessed 17.08.2021
[4] https://www.leibniz-gemeinschaft.de/en/about-us/history/gottfried-wilhelm-leibniz.html
Accessed 17.08.2021
[5] https://www.leibniz-gemeinschaft.de/en/about-us/organisation/leibniz-in-figures.html
Accessed 06.08.2021
[6] https://www.leibniz-gemeinschaft.de/en/research/scientific-profile.html
Accessed 17.08.2021
[7] https://www.leibniz-gemeinschaft.de/en/research/scientific-profile/biodiversity-and-health.html
Accessed 17.08.201
[8] https://www.leibniz-gemeinschaft.de/en/research/scientific-profile/light-matter-information.html
Accessed 17.08.2021
[9] https://www.leibniz-gemeinschaft.de/en/research/scientific-profile/environment-and-sustainable-development.html
Accessed 17.08.2021
[10] https://www.leibniz-gemeinschaft.de/en/research/leibniz-research-alliances.html
Accessed 17.08.2021
[11] https://www.leibniz-gemeinschaft.de/en/research/leibniz-research-networks.html
Accessed 17.08.2021

DWI – Leibniz Institute for Interactive Materials

Materials for a better Life

The world today is unimaginable without natural and synthetic materials. In many cases, the development of new materials forms an important basis for technological progress with immense social benefits. However, material innovations are complex and require concerted multidisciplinary approaches. At the DWI – Leibniz Institute for Interactive Materials (Leibniz-Institut für Interaktive Materialien e.V.), scientists from various disciplines therefore conduct research and jointly develop materials with programmable properties and (inter)active functions.

The DWI research takes place on very different length scales: From the nanometer scale, which is relevant for the study of molecular building blocks and their chemical synthesis, to the macroscopic scale, which is concerned with the composition of larger functional systems and their understanding and application. Inspiration for research can be found in living systems and biological materials that have a wide range of active and adaptive functions. For example, the wealth of information encoded in biomacromolecules and biomaterials made from them far surpasses that of conventional artificial materials.

By bringing together diverse and rapidly developing disciplines, the DWI has a unique scientific and technological basis to significantly impact this new field of materials science. In accordance with the goals of the Leibniz Association, the DWI aims to gain fundamental knowledge as well as to further develop and use this knowledge in application-oriented research. For this reason, the institute maintains an extensive network that has grown over decades with cooperation partners, other research institutions and various companies. DWI materials and technologies are particularly important in medicine and in connection with sustainability.

DWI
Leibniz Institute for
Interactive Materials

KEYWORDS
Bioeconomy, Biomaterials, Drug Discovery/Drug Delivery, Platform Technology, Tissue Engineering

Name	DWI - Leibniz Institute for Interactive Materials
Address Postal Code/City	Forckenbeckstr. 52074 Aachen
Contact Person	Prof. Stefan Hecht, Ph.D.
Fon	+49 241 80-23300
E-Mail	contact@dwi.rwth-aachen.de
Internet	www.dwi.rwth-aachen.de
Founded (year)	1952
Number of employees	scientific 119 administrative 54
Funding	Federal Government (Germany) 20% State Government NRW 20% Third-party funding by national and international governmental and private funders 60%

www.dwi.rwth-aachen.de

Research Field	Chemistry in Water
Keywords	Biomaterials, Enzymes, Peptide Synthesis, Platform Technology, Small Molecules
Head of Group	Prof. Dr. Andrij Pich
Internet	www.dwi.rwth-aachen.de/en/research-program/aqua-materials
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Address Postal Code/City	Forckenbeckstraße 50 52074 Aachen
Fon	+49 241 80-23300

Research Program 1: Aqua Materials

RP 1 focuses on the development of water-based synthetic methods to generate molecular building blocks that enable the complex and hierarchical formation of materials. We strive to address the grand challenges of how properties of matter emerge from the complex correlations of their constituents and how to characterize and control complex material systems.

We tackle this challenge by focusing research efforts on protein engineering, improvement of chemical and enzymatic ligation, conjugation, precipitation, and polymerization reactions with emphasis on fast kinetics, quantitative turnover, and bio-orthogonality. We design and synthesize (bio)macromolecules and colloids with precise control over their chemical structure, topology, and architecture to steer their self-assembly into hierarchically organized materials and fabricate complex structured materials using spinning, printing, and casting techniques.

Research Field	Microfluidics, Chemical Syntheses
Keywords	Analytics, Diagnostic Systems, Platform Technology
Head of Group	Prof. Dr.-Ing. Matthias Wessling
Internet	www.dwi.rwth-aachen.de/en/research-program/synthiofluidics
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Fon	+49 241 80-23300

Research Program 2: Synthiofluidics

The RP 2 'Synthiofluidics' deals with microphase and microfluidic controlled synthesis and processes. Flow-induced confinement, phase separation, syneresis, and external transport processes provide the necessary control over reactant and component transport during synthesis and processing. This method-oriented research drives the development of new processing conditions, reaction vessels, and new microenvironments for chemical reactions. Core competencies of RP 2 are the synthesis of particles, microstructures, and fibers in the nano- and micrometer size range, the combination of fluidics with other techniques, and the wide range of manufactured materials and approaches for these materials. RP 2 is divided into three parts according to principles and processes used to access unique materials, i.e., phase separation, 3D printing, and microfluidics.

Research Program 3: Macromolecular Films and Fibers

RP 3 controls and utilizes the structure formation of films and interfaces consisting of macromolecules for controlled interactions with liquids, polymers, biological components and cells. The long-term goal is to develop systems that autonomously and selectively react towards external stimuli while neglecting others. RP 3 focuses on surfaces, interfaces and the transition area between two bulk phases, which are produced in resource-efficient, scalable, and sustainable processes.

Synthetic and biological macromolecules as well as liquids adapt their structure at interfaces. The interface controls their alignment and in some cases, the equilibrium bulk structure is frustrated. This leads to 'special' effects resulting from molecular self-assembly, e.g. layer formation, increased or decreased melting points, molecular spreading or lateral segregation. DWI researchers are developing hierarchically switchable and adaptive systems through the controlled use of metastable states.

Research Field	Functional Surfaces and Interfaces
Keywords	Biomaterials, Platform Technology
Head of Institute	Prof. Dr. Ulrich Schwaneberg
Internet	www.dwi.rwth-aachen.de/en/research-program/macromolecular-films-and-fibers
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Fon	+49 241 80-23300

Research Program 4: Transport, Reaction and Exchange Systems

Molecular separation, energy storage and chemical conversion are essential functionalities for the creation of interactive material systems. Such systems are developed as highly integrated multicomponent and multiscale materials. The vision of RP 4 is to integrate these basic principles into new complex and interactive material systems. They are inspired by biological organisms, which generally incorporate these functions at the subcellular, cellular and tissue level. RP 4 addresses two types of systems: 1. Microscopic systems which are multicomponent and multifunctional nano- and micrometer objects. These include droplets, capsules, vesicles, or microgel suspensions acting as reservoirs for controlled release, uptake, and conversion are typical examples. 2. Macroscopic systems which are tangible devices for molecular separations such as desalination, protein separation, energy storage using electrolytes, and conversion or polymerization reactions.

Research Field	Interactive Material Systems
Keywords	Biomaterials, Bioprocessing, Platform Technology, Signal Transduction
Head of Institute	Prof. Dr.-Ing. Matthias Wessling
Internet	www.dwi.rwth-aachen.de/en/research-program/transport-reaction-and-exchange-systems
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Fon	+49 241 80-23300

Research Field	Materials for Biological Environment
Keywords	Drug Discovery/ Drug Delivery, Personalized Medicine, Regenerative Medicine, Therapeutics, Tissue Engineering
Head of Group	Prof. Dr. Andreas Herrmann
Internet	www.dwi.rwth-aachen.de/en/research-program/bioactive-and-bioinstructive-materials
E-Mail	herrmann@dwi.rwth-aachen.de
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Research Program 5: Bioactive and Bioinstructive Materials

The main objective of RP 5 is to develop novel materials capable of directing the function of living environments, such as plants, bacteria, blood, cells, and tissues. This is achieved by designing and producing materials with specific (bio)chemical, mechanical, and structural properties that can be controlled or turned on and off either by environmental stimuli or external triggers. Hierarchical materials and interactive systems are constructed at all length scales. Five research subcategories are addressed in RP 5: drug carriers, bioinspired functional surfaces, *ex vivo* tissue models, regenerative scaffolds, and diagnostic systems. To design and produce our new material developments better and more efficiently, DWI will establish a new working group 'Data-driven Interactive Materials Simulation' to employ theoretical concepts and models with the aim to predict the properties and functions of biomedical materials.

German Diabetes Center (DDZ)

Reducing the individual and societal burden of diabetes mellitus based on interdisciplinary research

The German Diabetes Center (DDZ), Leibniz Center for Diabetes Research at Heinrich Heine University Düsseldorf, is an interdisciplinary research center. The focus of the DDZ is to offer translational networking of fundamental molecular and cell biology research with clinical, epidemiological and care-related research. The scientific contributions aim at improving prevention, early detection, diagnosis and treatment of diabetes and its comorbidities and complications, as well as to increasing the knowledge on the epidemiology and health economics of diabetes in Germany. The Institute for Clinical Diabetology investigates mechanisms of the development and progression of diabetes mellitus and its sequelae. The research groups also perform studies on the prevention, as well as the efficacy and safety of new concepts for treating diabetes and its comorbidities and complications.

The Institute for Clinical Biochemistry and Pathobiochemistry investigates the molecular basis of onset and progression of obesity, insulin resistance and type 2 diabetes. Our aim is to gain insights that may lead to improvements in prevention, prediction and therapy of diabetes.

The Institute for Biometrics and Epidemiology conducts population-based studies on the descriptive epidemiology of the two types of diabetes and its complications to improve prevention and early detection, as well as medical care of patients with diabetes.

At the Institute for Vascular and Islet Cell Biology, the pathomechanisms in beta cells and endothelial cells in glucose intolerance and type 2 diabetes are researched.

The Institute for Health Services Research and Health Economics studies the demand for and utilization of health care services, health care structures and processes, and their clinical and cost-effectiveness, in particular under everyday conditions and considering patient needs and preferences.

DDZ Deutsches Diabetes-Zentrum

KEYWORDS
Diabetes, Metabolomics, Nutrition

Name	German Diabetes Center (DDZ) Leibniz Center for Diabetes Research at Heinrich Heine University Düsseldorf
Address	Auf'm Hennekamp 65
Postal Code/City	40225 Düsseldorf
Contact Person	Prof. Dr. Michael Roden
Fon	+49 221 3382-0
E-Mail	kontakt@ddz.de
Internet	www.ddz.de
Founded (year)	1964
Number of employees	245 (in total)
Funding	Federal Government (Germany) 50% State Government NRW 50%

www.ddz.de

Research Field	Biometrics and Epidemiology
Keywords	Diabetes, Epidemiology, Biometrics, Systematic Reviews, Meta-Analyses
Head of Institute	Prof. Dr. sc. hum. Oliver Kuß
Internet	https://ddz.de/forschung/institut-fuer-biometrie-und-epidemiologie/
E-Mail	oliver.kuss@ddz.de
Address Postal Code/City	Auf'm Hennekamp 65 40225 Düsseldorf
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Institute for Biometrics and Epidemiology

The Institute for Biometrics and Epidemiology (IBE) works on the population-based aspects of diabetes. This work covers a wide spectrum from only apparently simple questions on the frequency of diabetes (How many people have been diagnosed with diabetes? How many are newly diagnosed each year?) over risk factors for the disease (Which characteristics or behaviors increase risk?) to questions of diabetes treatment (How effective and safe are current glucose-lowering treatments?). To answer these questions, the IBE collects own data, but also cooperates with external partners like population-based cohorts or providers of routine data. The IBE advises all research groups of the DDZ on methodical issues, and also develops new statistical methods for diabetes research.

International Collaborations

IDF (International Diabetes Federation)
University of Leicester, Leicester, UK
CDC (Centers for Disease Control and Prevention), Atlanta, Georgia, USA
Imperial College London, School of Public Health, London, UK

National Collaborations

Helmholtz Center Munich
Leibniz Institute for Environmental Research (IUF). Düsseldorf
Institute for Evidence in Medicine, Freiburg
Institute of Epidemiology and Medical Biometry, Ulm

Membership in local and regional Networks

GNC/NAKO Gesundheitsstudie

Research Field	Genetics/Molecular Biology
Keywords	Animal Models, Biomarker, Diabetes, Proteomics, Signal Transduction
Head of Institute	Prof. Dr. rer. nat. Hadi Al-Hasani
Internet	https://ddz.de/forschung/institut-fuer-klinische-biochemie-und-pathobiochemie/
E-Mail	hadi.al-hasani@ddz.de
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Institute for Clinical Biochemistry and Pathobiochemistry

The Institute for Clinical Biochemistry and Pathobiochemistry investigates the molecular basis of onset and progression of obesity, insulin resistance and type 2 diabetes. The aim is to gain insights that may lead to improvements in prevention, prediction and therapy of diabetes.

Therefore, several research strategies are pursued, including experimental mouse genetics to identify novel risk genes, gene/gene and gene/environment interactions, molecular and cell biology studies and mass spectroscopy-based proteome mapping to investigate regulatory networks and to identify novel predictive biomarkers for diabetes mellitus and secondary complications.

International Collaborations

Ghent University Hospital, Ghent, Belgium
University of Copenhagen, Copenhagen, Denmark
University of Oslo, Oslo, Norway

National Collaborations

German Institute for Human Nutrition, Potsdam
Max Planck Institute for Molecular Genetics, Berlin
Medical Center University of Leipzig

Membership in local and regional Networks

DFG Research Training Group RTG2576 'vivid'

Institute for Clinical Diabetology

Diabetes mellitus comprises heterogeneous metabolic disorders, which have hyperglycemia as their common feature. Various factors contribute to the pathogenesis and progression to diabetes mellitus. Identification of these factors and their integration into a pathophysiological concept are key to develop innovative approaches for the prevention and therapy of diabetes, prediabetic states and associated diseases. Researchers of six Research Groups of the Institute for Clinical Diabetology investigate mechanisms of the development and progression of diabetes mellitus and its sequelae. The research groups also perform studies on the prevention, as well as the efficacy and safety of new concepts for treating diabetes and its comorbidities and complications.

International Collaborations

Howard-Hughes Institute at Yale University, USA
Monash University, Melbourne, Australia
University of Athens, Greece

National Collaborations

Helmholtz Zentrum Muenchen Institute for Diabetes Research and Metabolic Diseases of the Helmholtz Zentrum München at the Eberhard-Karls-University of Tübingen
German Institute of Human Nutrition Potsdam-Rehbruecke

Membership in local and regional Networks

Sonderforschungsbereich (SFB) 575, Heinrich Heine University Düsseldorf

Research Field	Diabetes
Keywords	Inflammation, Nephropathy, Neuropathy, Metabolic Imaging, Clinical Studies
Head of Institute	Prof. Dr. Dr. h. c. Michael Roden
Internet	https://ddz.de/forschung/institut-fuer-klinische-diabetologie/
E-Mail	kontakt@ddz.de
Address Postal Code/City	Auf'm Hennekamp 65 40225 Düsseldorf
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Institute for Vascular and Islet Cell Biology

The institute investigates the pathomechanisms in pancreatic beta cells, neurons, hepatocytes and endothelial cells contributing to type 2 diabetes and its complications. Preclinical drug development is combined with basic research on these cell types. Morphinane derivatives have been developed, as to stop beta cell dysfunction, insulin secretory defects and diabetic neuropathy. The goal is to develop drugs to halt progression of type 2 diabetes to a disease characterised by loss of beta cell function and thus loss of endogenous insulin release as well as defects in sensory neurons. The latter severe form of diabetes is called SIDD. In general, cell protective drugs to improve the quality of life in individuals with diabetes are developed and pre-clinically tested with the ultimate goal to treat patients with SIDD.

International Collaborations

UNC Nutrition Research Institute, Chapel Hill, USA
University of Virginia, Charlottesville, USA
Uppsala University, Uppsala, Sweden

National Collaborations

University of Münster, Münster
Ludwig Maximilian University, München
Karlsruhe Institute of Technology, Karlsruhe

Research Field	Beta Cell Biology, Cell Biology/Physiology
Keywords	Diabetes, Platform Technology, Therapeutics
Head of Institute	Prof. Dr. rer. nat. Eckhard Lammert
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IUF

LEIBNIZ-INSTITUT FÜR UMWELT-MEDIZINISCHE FORSCHUNG

KEYWORDS
Ageing, Environmental Research, Genetic Engineering, Neurodegenerative Diseases, Stem Cell Research

Name	IUF - Leibniz Research Institute for Environmental Medicine
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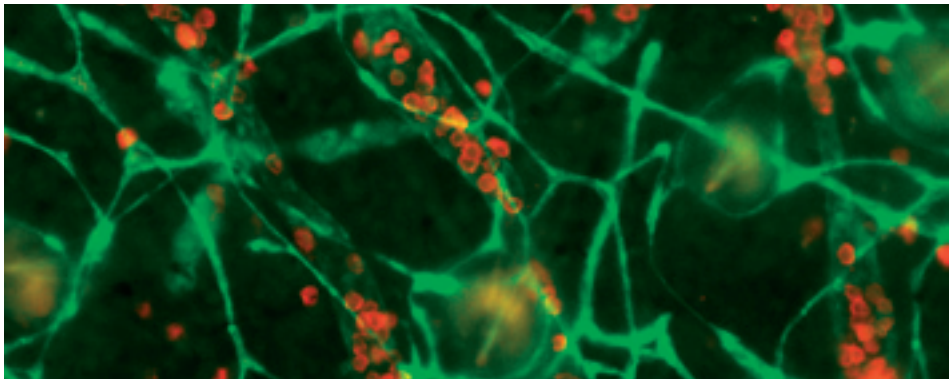
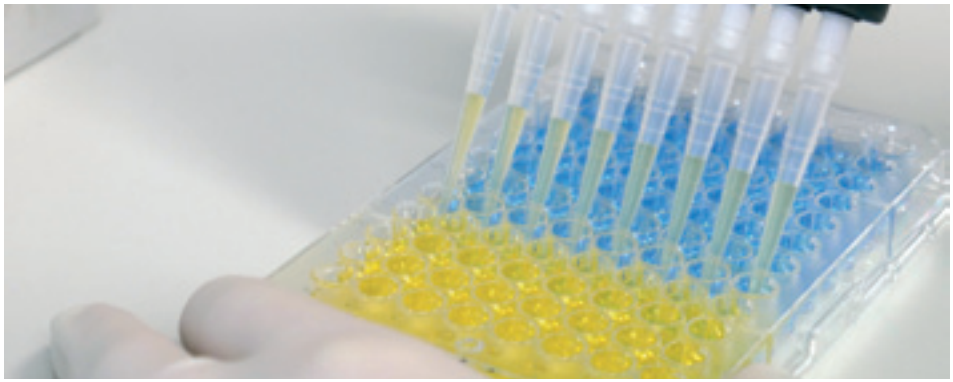
E-Mail	info@iuf-duesseldorf.de
Internet	www.iuf-duesseldorf.de
Founded (year)	2001
Number of employees	scientific 110 administrative 24
Funding	Federal Government (Germany) 50% State Government NRW 50%

www.iuf-duesseldorf.de



IUF – Leibniz Research Institute for Environmental Medicine

The IUF's major task is to carry out molecular preventive medical research of environmentally-induced disorders. The main objective is to improve health care with regards to environmental pollution and to develop preventive strategies. The IUF carries out research projects addressing the biological effects that pollutants (in particular particles, non-ionizing radiation and chemicals) have on humans. Environmentally-induced aging processes of the lung and the skin as well as environmentally-induced disturbances of the immune system and damages to the brain are in focus. Based on the scientific competence in the institute these investigations are carried out interdisciplinary. The IUF bundles scientific expertise in the fields of toxicology, immunology, molecular aging research and epidemiology. This interdisciplinary research approach needs experimental models of one or more barrier organs. For these studies, IUF uses cutting edge in-vitro, ex-vivo and in-vivo models and conducts epidemiological studies. Recent research questions are related to interorgan crosstalk mechanisms, the characterization of susceptible groups and the interplay of relevant exposomal factors.



IfADo – Leibniz Research Centre for Working Environment and Human Factors

Our focus is the working individual

The modern working world is constantly changing while human physiology remains relatively static. This creates a friction between work and individuals. Therefore, new and adequate responses and solutions are required. The IfADo promotes research of the potentials and risks of modern work based on life and behavioural sciences.

The unique position of the Leibniz Institute results from the combination of work-related with life- and behaviour-related scientific questions, theories and methods for researching working humans from the cell to the workplace. This research contributes to an adequate design of the working environment, for the benefit und well-being of working people, and for the maintenance and promotion of performance, health and competitiveness.

The Institute addresses the requirements of the modern working world with its broad interdisciplinary spectrum of core competencies in the fields of occupational medicine and toxicology, immunology, ergonomics, psychology and neurosciences. In order to meet the challenges of the modern world of work and to optimize work tasks and work environments, the causal relationships between health and performance are explored.

IfADo's research fields are orientated towards developments in the world of work and in the life and behavioural sciences. Currently important fields include:

- Toxic agents and their effects
- Immunology and health
- Interaction of humans and technology
- Psychosocial, physical and temporal effects on health and performance
- Work and ageing

The Institute seeks solutions and explanations concerning especially burnout, age-related performance reduction, toxicological risks, age- or stress-related changes in immunity, neurological bases and human-machine interfaces.

The scientific results are not only communicated to the scientific community, they form the basis for contributions to regulatory bodies. The Institute is associated with the TU Dortmund and actively involved in teaching and training of young scientists.

LEIBNIZ RESEARCH CENTRE FOR WORKING ENVIRONMENT AND HUMAN FACTORS

KEYWORDS
Antibody, Cell lines/Cell banks, Diagnostic Systems, Immune Modulation, Cognition

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Internet	www.ifado.de
Founded (year)	1969
Number of employees	scientific 156 administrative 44
Funding	Federal Government Germany 50% State Government NRW 50%

www.ifado.de

Research Field	Health
Keywords	Ageing, Human Machine Interaction, Workplace Design, Cognition
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Department of Ergonomics

Central tasks of ergonomics are the design and the evaluation of work situations and their adaptation to human needs. The well-being of the acting person as well as their efficiency play an equal role.

As a result of recent developments in working environments, cognitive aspects (e. g. information processing), mental strain, and demographic change have become increasingly important for ergonomic research. Therefore, the spectrum of ergonomic research at the IfADo extends from the psycho-neuroscientific investigation of human information processing to the design of age-appropriate jobs.

The research interest of the department is expressed in three core topics:

- Information processing: How is information recorded, processed and stored for further use? How is this process influenced by other cognitive aspects?
- Experimental ergonomics: Which factors influence cognition in modern work environments?
- Designing work: How must a modern workplace be designed to ensure a safe interaction between human and machine?

Research Field	Immunology
Keywords	Antibody, Cell Line/ Cell Banks, Immune Modulation, Cancer, Natural Killer Cells
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Department of Immunology

Under physiological conditions, the immune system successfully protects us from infections and cancer – a process that normally takes place without us even noticing it. Only when this system is disturbed, pathological processes such as infections and cancer, but also allergies, autoimmune diseases or chronic inflammatory diseases can occur. It is therefore essential to understand the function of the immune system in order to avoid or to correct these disturbances. The department focuses its work on the regulation of Natural Killer (NK) cells. The activities of NK cells are important for shaping effective adaptive immune responses.

The activity of the immune system can be modulated by occupational-relevant factors such as stress, exposure to chemicals or aging. This may result in weakened immune responses and has important consequences for the health and the productivity of the working individual. To identify important modulators, the department studies how the immune system is influenced by various factors.

Department of Psychology & Neurosciences

Modern working conditions place high demands on cognitive processing, including life-long learning, flexibility of behavioral control, problem solving, and affective/emotional components. The department aims to understand the physiological and psychological underpinnings of these performance-relevant processes, from basic research to application in real work scenarios. An improved understanding of factors which influence the respective processes should help to identify and implement both beneficial and aversive working conditions on a rational basis, optimizing performance and preventing work-related disease. The research projects of the department are therefore organized along the following topics, which are strongly connected:

- Determinants and modulators of cortical activity, and neuroplasticity in the human brain
- Physiological basis, and psychological mechanisms of cognition, motor functions, and emotion
- Physiology-based improvement of work conditions

Research Field	Neurobiology
Keywords	Diagnostic Systems, Neurodegenerative Diseases, Cognition, Neurostimulation
Head of Department	Univ.-Prof. Dr. med. Michael Nitsche
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Department of Toxicology

Chemicals are essential in modern working environments. To avoid toxic exposures a careful risk evaluation of chemicals is required. Ideally, risk evaluation is based on precise knowledge by which mechanisms toxic chemicals cause adverse effects. The department pursues this goal using six lines of investigation:

- Focus on metabolic networks and their influence on the phenotype of cells, organs and organisms
- Study how multivariate variables influence cell and organ function with a specific focus on liver physiology
- Investigation how disturbed functions of one organ can lead to disturbances of other organs
- Use of intravital imaging to investigate toxic mechanisms at the cellular and subcellular level
- Focus on the human nervous system as the target organ of many toxic agents with the goals of providing data for health-based occupational exposure limits and describing neurobiological mechanisms for these effects
- Investigation of functional principles of organs at the cellular and subcellular level using functional imaging methods

Research Field	Genetics/ Molecular Biology
Keywords	Cell lines / Cell banks, Drug discovery / Drug delivery, Signal Transduction, Stem Cell Research, Liver Regeneration
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isas

KEYWORDS
Analytics, Biomarker, Metabolomics, Personalized Medicine, Proteomics

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Founded (year)	1952
Number of employees	scientific 77 administrative 77
Funding	Federal Government Germany 50% State Government NRW 50%

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Leibniz-Institut für Analytische Wissenschaften – ISAS – e.V.

advancing analytics

ISAS develops efficient and cost-effective analytical methods for health research. Thus, it contributes to improving the prevention, early diagnosis and therapy of diseases. Overall, ISAS strives to advance precision medicine by combining knowledge from different fields such as chemistry, biology, pharmacology, physics and computer science. The institute works closely with universities in Germany and abroad, for example through joint appointments. It also cooperates with national and international partners from science and industry.

At ISAS, research and development range from basic research to the development of instrument prototypes and cutting-edge analytical services. The institute has four research departments: Bioanalytics, Biospectroscopy, Translational Research and Interface Analytics. ISAS currently employs scientists from 20 different nations. They combine their expertise by conducting interdisciplinary research throughout the programmes Disease Mechanisms & Targets, Biomarker, Bio-Imaging, and Biointerfaces.

4D-Analytics

How much of what substance is where and when? 4D Analytics provides the answer to this question. At ISAS, it forms the technological basis for the comprehensive elucidation of pathological processes. The institute develops, refines and combines measurement methods for a "four-dimensional" analysis. Thus, scientists at ISAS can – simultaneously and at any given time – measure the quantities and types of various substances as well as determine their location within one sample.

Early promotion of young scientists

ISAS has established programmes for all levels of academic careers: They are aimed at bachelor and master students, include a structured graduate programme for PhD students and training opportunities for postdocs. Moreover, the institute promotes the career opportunities of young scientists by enabling them to lead projects. The early responsibility as a junior group leader is intended to support everyone who is striving for a further career in science.

Department of Bioanalytics

Understanding the highly complex signalling and metabolic pathways in cells and cell layers in the human body at different levels – from lipids to intercellular communication processes – is our goal in this research department. Our scientists develop techniques to measure molecule diffusion with spatial and temporal resolution. We hope that these measurement techniques and the results of our analyses can be used to help diagnose a variety of illnesses more easily in the future and develop new therapies. In order to explain the multitude of single processes in as many details and as reliably as possible, our scientists work on living cells and with microchips on which the transport and signalling paths of human cells are simulated.

International Collaborations
Cardiovascular Research Institute Maastricht (CARIM)
McGill University, Canada
University of Aberdeen, UK

National Collaborations
University of Freiburg
Julius-Maximilians-University Würzburg
Bielefeld University

Membership in local and regional Networks
bio.dortmund, de.NBI, windo e.V., Wissenschaftsforum Ruhr, BioIndustry e.V.

Research Field	Health
Keywords	Analytics, Metabolomics, Peptide Synthesis, Personalized Medicine, Proteomics
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Department of Biospectroscopy

Modern imaging processes have long been considered one of the key technologies for first-class medical research. In the Department of Biospectroscopy, the scientists' aim is to understand the molecular and cellular processes that accompany inflammatory processes – the basis of many pathological processes in the human body. Our researchers are working on improving the early detection of diseases, especially those of the cardiovascular system as well as autoimmune diseases or tumors, and further developing the assessment of individual risks with the help of modern imaging methods.

International Collaborations
Weizman-Institute of Science, Israel
Amsterdam UMC, Netherlands
CNIC, Madrid, Spain

National Collaborations
University of Duisburg-Essen
Essen University Hospital
University of Tübingen
Universitätsklinikum Erlangen

Membership in local and regional Networks
KFO 337 "PhenoTime", FOR 2879 "Immunostroke"

Research Field	Health
Keywords	Analytics, Biomarker, Cardiovascular Research, Oncology, Personalized Medicine
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Research Field	Health, Pharmacology
Keywords	Biomarker, Cardiovascular Research, Drug Discovery/ Drug Delivery, Oncology, Personalized Medicine
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Department of Translational Research

In the Translational Research department, our scientists aim to better understand the causes of diseases, to find new ways to diagnose them as early as possible and to treat them sustainably. In order to achieve this, they investigate key molecular events, for example for the identification of targets and biomarkers in cardiovascular diseases such as heart failure. Research topics also include the development and improvement of analytical test procedures. In addition, our researchers are also dedicated to the analysis of bioactive surfaces and the interaction with their environment in terms of molecular organization, transport, catalytic reactions and biological compatibility. Structurally, the researchers orientate themselves towards supporting what is needed in (pre-) clinical research with their developments in order to enable a later easy translation into applications for diagnostics and therapy monitoring.

International Collaborations

McGill University, Canada
University of Chicago, USA

National Collaborations

Julius-Maximilians-University Würzburg
University of Duisburg-Essen
TU Dresden

Membership in local and regional Networks

bio.dortmund, windo e.V., Wissenschaftsforum Ruhr, BioIndustry e.V., pro Ruhrgebiet

Research Field	Health
Keywords	Analytics, Optical Spectrometry
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Department of Interface Analytics

In this department, our researchers are concerned with molecular processes at interfaces and on surfaces, such as molecule bonding on surfaces or the formation and properties of nanostructures. The work focuses on biological and biomedical applications. Our area of activity is the detailed investigation of materials, structures and surfaces that consist of a mixture of organic molecules and inorganic materials or that interact with biomolecules. We deploy different methods of optical spectroscopy to analyze these materials and surfaces, in situ without having to destroy them.

International Collaborations

Johannes Kepler University Linz

National Collaborations

Helmholtz-Zentrum Berlin
Humboldt-Universität zu Berlin
TU Berlin

Leibniz Institute for the Analysis of Biodiversity Change (LIB) – Zoological Research Museum Alexander Koenig

The Leibniz Institute for the Analysis of Biodiversity Change (LIB) is an internationally operating biodiversity research facility with its headquarters in NRW. It originated in 2021 by joining the Zoological Research Museum Alexander Koenig, Bonn and three museums in Hamburg (previously Centre of Natural History, CeNak, at University of Hamburg).

The mission of the LIB is dedicated to do research on biodiversity and its changes. To better understand the current mass extinction of flora and fauna, researchers are looking for connections and causes of – often – human-made changes. One goal is to develop solutions for the preservation of ecosystems and species to maintain the diversity and richness of current life. The LIB contributes to taxonomics, systematics, genomics, and to morphological and molecular biodiversity research as well as to the monitoring and modelling of global biodiversity – including ecological aspects.

The LIB at Bonn and Hamburg houses scientific collections of 15 million objects, which are the basis of the scientific research and heart of the museums. The collections are continuously growing and currently represent one of the third largest collections within Germany. Using state-of-the-art technology and using collections as reference enables us to answer relevant questions of our society for the future. Comparing collection data to current data and evidence from organisms, anthropogenic influence on the environment can be mapped and future change scenarios developed.

The exhibitions are highlighting cutting-edge scientific findings and questions that our researchers currently strive to answer.

The LIB is structured in four centres that are closely intertwined, with "biodiversity in transition" and "biodiversity in dialogue" as unifying topics across centres.

- Centre for Taxonomy and Morphology (ztm)
- Centre for Molecular Biodiversity Research (zmb)
- Centre for Biodiversity Monitoring and Nature Conservation Research (zbm)
- Centre for Knowledge Transfer (zwt)

LIB Leibniz Institute for the Analysis of Biodiversity Change

KEYWORDS
Animal Models, Environmental Research, Genomics, Molecular Library

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E-Mail	s.heine@leibniz-zfmk.de
Internet	https://bonn.leibniz-lib.de/de
Founded (year)	1912
Number of employees	scientific 135 administrative 18
Funding	Federal Government Germany 50% Ministry of Culture and Science 50%

www.bonn.leibniz-lib.de

Max Planck Society

Max Planck Society
„Insight must precede application.“ (Max Planck)

The Max Planck Society for the Advancement of Science (“Max-Planck-Gesellschaft zur Förderung der Wissenschaften”) is an independent, non-profit research organization. It is the successor organization to the “Kaiser Wilhelm Society”, which was founded in 1911 and was renamed the “Max Planck Society” in 1948 in honour of its former president, the German theoretical physicist Max Planck. [1]

Since its establishment, no fewer than 20 Nobel laureates (35 including the Kaiser Wilhelm Society) have emerged from the ranks of its scientists, putting it on a par with the best and most prestigious research organizations worldwide. [2]

As recently as 2020, two Max Planck researchers received the Nobel Prize. One of them, Emmanuelle Charpentier, received the honour for her groundbreaking work on CRISPR-Cas9, a tool that is today revolutionizing medicine, biotechnology, and agriculture. [3]

Organization

The primary goal of the Max Planck Society is to promote research at its own institutes. It is not a governmental institution, although it is largely funded by the federal and state governments. Instead, it is a registered association that is based in Berlin, while its administrative headquarters and office of the president are located in Munich. Max Planck institutes are organized into research departments headed by scientific members as directors. Individual governing bodies within the society make the decisions required to ensure that the Max Planck Society functions efficiently as a large research organization.
As of now, the Max Planck Society comprises 86 institutes and research facilities, including five institutes and one research facility situated abroad. The organization has a total of about 21,000 employees, including approx. 7,000 scientists, around 3,500 doctoral students with funding contracts, and around 1,600 students and graduate assistants. [3] In addition, approximately 2,000 guest scientists and around 550 scholarship holders worked at the Max Planck Society in 2020. [3] Its annual budget amounts to approximately € 2.5 billion, around 80 % of which is made up of basic financing from the public sector.[3] From 2021 onwards, the Max Planck Society will receive an annual budget increase of 3 % issued by the public sector for the next ten years. [3] In addition, third-party funding and donations contribute to the budget. The funding is used by the Max Planck institutes to conduct basic research in the natural sciences, biological sciences, social sciences, and the humanities. Max Planck institutes focus on research fields that are highly relevant and promising from a scientific standpoint. They also work on newly emerging areas of research that lie outside of established disciplines or at the boundaries between them. Furthermore, their research spectrum is continually evolving: new institutes are being established to discover answers to seminal, forward-looking scientific questions, while other institutes are closed when, for example, their research field has been widely established at universities. This process of continuous renewal preserves the scope that the Max Planck Society requires to react quickly to pioneering scientific developments.

Fostering Creative Potential

As a result of demographic change, Europe will soon have a shortage of young talent: as early as 2030, there will be an estimated 50,000 fewer university graduates than in 2005. Natural and engineering sciences in particular are already experiencing a shortage of junior researchers.

The number of talented junior scientists from Germany will never fully meet the level of demand in science and research. That is why, in 1998, the Max Planck Society developed a programme in collaboration with the universities to motivate talented young PhD students from all over the world to come to Germany for their studies: the International Max Planck Research Schools (IMPRS). These schools offer junior scientists excellent research opportunities, providing them with extensive support and special offers to foster their development. In 2020, there was a total of 64 IMPRS. [2]

In order to attract and retain particularly promising scientific talent for the German science system as early as possible, the Max Planck Society has set up the Max Planck Schools, a joint initiative between German universities and German research organizations with the support of the German Rectors’ Conference and other non-university research institutions (Fraunhofer-Gesellschaft, the Helmholtz Association, and the Leibniz-Association). Since this is a cross-site and cross-organizational initiative, each of the three pilot schools clusters the excellence distributed throughout Germany into an innovative field of research by bringing together scientists as fellows. [3]

If you want to know more about The Max Planck Society, please visit the organization’s website http://www.mpg.de/en

[1] https://www.mpg.de/183298/history
Accessed 17.08.2021
[2] https://www.mpg.de/short-portrait
Accessed 17.08.2021
[3] Max Planck Annual Report 2020
https://www.mpg.de/17035587/jahresbericht-2020.pdf

MAX PLANCK INSTITUTE
FOR BIOLOGY OF AGEING

KEYWORDS
Ageing, Animal Models, Biomarker, Metabolomics, Neurodegenerative Diseases

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E-Mail	maren.berghoff@age.mpg.de
Internet	www.age.mpg.de
Founded (year)	28.06.2007 (Foundation) 01.01.2008 (Work commenced)
Number of employees	scientific 190 administrative 40
Funding	Federal Government Germany 45%, State Government NRW 45% Other 10% (ERC, DFG, Europ. Structural Funds, misc. third-party funds)

www.age.mpg.de

Max Planck Institute for Biology of Ageing

The Max Planck Institute for Biology of Ageing is one of more than 80 independent and non-profit research institutions under the umbrella of the Max Planck Society. Understanding the natural ageing process as well as the nature of longevity and age-related diseases is at the center of the basic research carried out at the Institute. Its aim is to make fundamental discoveries into the underlying molecular, physiological and evolutionary mechanisms, by using mice, flies and worms as model organisms. The long-term goal is to pave the way towards increasing health during ageing in humans. Thus, a key line of research is to investigate interventions that can ameliorate the ageing process. A ground-breaking discovery of recent years is that mutations in single genes in the simple, single-celled yeast, in multi-cellular animals such as worms and flies as well as in mice, can extend lifespan and produce a broad-spectrum improvement in health during ageing. The mechanisms involved seem to be similar in these very different organisms, and the same kinds of genes are turning out to be associated with human lifespan.

Hence, there is an unprecedented opportunity to use simpler organisms to make discoveries of relevance to the amelioration of human ageing – and thereby to meet the challenges of global changes associated with ageing and longer lifespan.

In particular, the Institute's research focuses on the roles of

- insulin/IGF and steroidal hormones,
- cellular components involved in growth control and nutrient sensing,
- factors regulating metabolism and function of mitochondria and
- various molecular signaling pathways in ageing, neurodegeneration and other ageing-related diseases.

Founded in 2008 the MPI for Biology of Ageing is one of Europe's first scientific facilities of this kind and as such is at the forefront of basic biomedical science.

It is part of a developing life science cluster focusing on ageing research that will have global impact (partner organisations being the Max Planck Institute for Metabolism Research, the Cologne Cluster of Excellence in Cellular Stress Responses in Aging-associated Diseases, the DZNE, the caesar and the University of Cologne).

Mitochondrial Proteostasis

Mitochondria are dynamic metabolic organelles that participate in cellular signaling and adapt to varying physiological demands. The activity of mitochondria declines with age and a dysfunction of these organelles is associated with numerous age-associated diseases, raising the question: how do mitochondria influence cell fitness and ageing? In order to understand the role of mitochondria in ageing and age-associated disease, the department seeks to define molecular mechanisms that preserve mitochondrial function with age and allow the dynamic adaptation of the mitochondrial proteome in a cell- and tissue-specific manner. Projects focus on the function of mitochondrial proteases that are emerging as central regulators and orchestrate complex interactions of mitochondria with their cellular environment.

International Collaborations

Imperial College London, London, UK
Karolinska Institute Stockholm, Sweden
McGill University, Montreal, Canada

National Collaborations

CECAD: Cluster of Excellence at the University of Cologne, Cologne Germany

Research Field	Genetics/Molecular Biology
Keywords	Ageing, Metabolomics, Neurodegenerative Diseases
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Molecular Genetics of Ageing/Antebi

The laboratory of Adam Antebi studies the regulatory mechanisms that govern the gradual decline of organismal homeostasis and of physiologic functions during ageing using the nematode worm *C. elegans*, the African turquoise killifish Nothobranchius furzeri and human cells. His work brings together traditional genetic approaches with systems biology (transcriptomics, proteomics, interactomics and imaging) and state-of-the-art metabolomic and lipidomic profiling of ageing-related processes.

Historically Professor Antebi has been instrumental in elucidating some of the key players in different longevity pathways, and his current research expands on this work, focusing on determining the convergent factors that are shared between different pathways. Additional areas of interest are the identification of metabolites that regulate lifespan, and the study of different states of long-lived quiescence (so-called diapause) and how they relate to longevity.

International Collaborations

Massachusetts Institute of Technology (MIT), USA, A. Amon, J. Lengefeld
Cornell University, B. Thompson
Institute for Plant Research NY, USA, F. Schroeder
Korean Advanced Institute of Science and Technology, S.-Jae Lee

National Collaborations

University of Cologne & Cologne Cluster of Excellence in Cellular Stress Responses in Aging-associated Diseases (CECAD)
T. Benzing, T. Hoppe, M. Koch
Uniclinic Cologne, J. Fischer, R. Müller
University of Aachen, R. Leube

Research Field	Genetics/Molecular Biology, Developmental Biology
Keywords	Ageing, Animal Models, Metabolomics, Systems Biology
Head of Department	Prof. Dr. Adam Antebi
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Max-Planck-Institut für Stoffwechselforschung

KEYWORDS
Diabetes, Metabolomics, Nutrition

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Internet	www.sf.mpg.de
Founded (year)	2014
Number of employees	scientific 67 administrative 77, including technicians

www.sf.mpg.de

Max Planck Institute for Metabolism Research

The balance between caloric intake and energy expenditure has to be maintained in a tight range to ensure metabolic homeostasis, health, and survival. A sophisticated neuronal network integrates information from the periphery of the organism about the energy availability and enables the body to adapt a wide range of behavioural responses to precisely control food intake, energy expenditure, and substrate flux across different peripheral organs. Even small deviations in this homeostatic regulatory network can result in either massive weight loss or weight gain, as well as associated metabolic disturbances. Worrisomely, the incidence of increased body weight, i.e. obesity, has reached epidemic proportions with more than 30% of the population of industrialized countries being overtly obese and close to 10% developing obesity associated type 2 diabetes mellitus. Altered energy homeostasis and obesity not only represent a major risk factor for the development of type 2 diabetes mellitus, but also for cardiovascular disease, neurodegenerative disorders, and certain types of cancer.

The research goal of the MPI for Metabolism Research is to define the physiological regulatory principles in energy and glucose homeostasis, the genetic and environmental factors that alter energy and glucose homeostasis in disease, and to ultimately identify novel therapeutic targets as a first step to developing new treatments for obesity and obesity-associated diseases.

Researchers of the Institute employ state-of-the-art methodologies and technologies to pursue translational research approaches ranging from studies on underlying molecular mechanisms in cells to defining regulatory mechanisms in model organisms. Hypotheses derived from these approaches are tested and validated through functional imaging in control human subjects and patients suffering from obesity and obesity-associated diseases.

The Institute is located in the heart of the medical and natural sciences campus of the University in Cologne. Our immediate neighbours are the natural science and medicine faculties of the University of Cologne, the Cologne Excellence Cluster on Cellular Stress Responses in Aging-Associated Diseases (CECAD), the Max Planck Institute for Biology of Ageing, as well as the Centre for Advanced Studies (CAESAR) in Bonn.

MAX-PLANCK-GESELLSCHAFT

KEYWORDS
Immune Modulation, Signal Transduction, Stem Cell Research, Tissue Engineering, Angiogenesis

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Internet	www.mpi-muenster.mpg.de
Founded (year)	2001
Number of employees	scientific 169 administrative 37
Funding	Max Planck Society 82% Other 18% Third-party funding

www.mpi-muenster.mpg.de

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Max Planck Institute for Molecular Biomedicine

The Max Planck Institute (MPI) for Molecular Biomedicine is devoted to basic science involving cell biology of the endothelium, developmental biology and cell-renewal, development of the vascular system, and structural biology. How can a complete human being develop from a single fertilized egg cell? How do the cells of an embryo "know" when and where they should form arteries, nerves or muscles? And: What tricks do immune cells use to migrate from the blood into the infected tissue – although the arteries are impermeable? In our various research teams, we are seeking answers to these and other questions about important life processes. Using gene technology, molecular biology, and electron and laser microscopy, the researchers are investigating how cells exchange information, which molecules regulate their behavior and which crosstalk errors between cells lead to diseases like cancer and multiple sclerosis.

The internationally staffed teams are subdivided into three departments and several research and project groups. As in all 86 institutes and facilities of the Max Planck Society, the MPI for Molecular Biomedicine is fully committed to educating and promoting the next generation of scientists. Together with the Westphalian Wilhelms University in Münster the institute runs the joint CiM Graduate School of the "Cells in Motion" Cluster of Excellence and International Max Planck Research School for Molecular Biomedicine, allowing 16 talented German and foreign junior scientists each year to complete a well-structured doctoral studies program under excellent conditions. Promising junior scientists with a doctoral degree obtain an excellent opportunity to qualify for a further career at a high level as Max Planck Research Group leaders.

Life science is a core theme of research in Münster, with a strong emphasis on molecular medicine and optical imaging, and distinctly benefits from the vicinity and cooperations between the MPI for Molecular Biomedicine, the Technology Park Münster GmbH, the University Hospital and of course the University of Münster. Especially to the latter, the institute tightly connects at several scientific and organizational levels. All these conditions make a unique scientific framework for the internationally oriented MPI for Molecular Biomedicine, which enables the institute to pioneer in the modern, medically relevant research of organ system development, like that of the vascular system.

Department Tissue Morphogenesis

Tissue morphogenesis involves complex and interdependent processes such as the coordinated generation of different cell types and their assembly into functional structures. "How cells make tissues" is the central research interest in our department. We mainly focus on the vertebrate vascular system, in which blood vessels need to integrate precisely into different organ environments and retain plasticity allowing them to adapt to changing local requirements and cues. Angiogenesis in the adult organism is critical for tissue repair and regeneration, but also plays important roles in pathological processes. Angiogenesis in cancer promotes tumor growth and metastasis. By understanding the cellular mechanisms and the molecular regulation of physiological and pathological angiogenesis, we can identify potential targets for future therapies.

We are combining genetic approaches in the mouse with high resolution imaging by confocal and multiphoton microscopy, time-lapse microscopy, cell biology, biochemistry and expression profiling.

International Collaborations

Nagoya University, Nagoya, Japan
Karolinska Institute, Stockholm, Sweden
School of Sciences, University Milan, Italy

National Collaborations

Institute for Molecular Biology, Hannover
Medical School
Charité, Berlin
DZKF, Heidelberg

Membership in local and regional Networks

Cells in Motion, DFG SFB 1009, DFG SFB1348, DFG FOR2325, DFG CRC1366

Research Field	Genetics/Molecular Biology
Keywords	Angiogenesis, Cell Biology, Signal Transduction, Stem Cell Research, Vascular Biology
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Department Vascular Cell Biology

Research in our department is focused on various aspects of vascular cell biology. We concentrate on the molecular mechanism of leukocyte extravasation as the basis for inflammatory reactions. In addition, we work on novel molecular mechanisms involved in the formation of the cardiovascular system.
A major goal of our studies is to reveal the mechanisms by which endothelial cell layers control leukocyte extravasation. After analyzing the molecular components that control and mediate the docking of leukocytes to the endothelium, we focus now on the question how leukocytes actually move through the barrier of the blood vessel wall. Leukocyte-triggered opening of endothelial junctions is a key event during this process. We also study the regulation of endothelial junctions in the context of other processes. Various pathological stimuli induce vascular permeability by destabilizing endothelial junctions which is a major cause of death in sepsis patients. In addition, the formation and plasticity of endothelial junctions is an important aspect in blood vessel development. Adhesion and signaling mechanisms that modulate junctional integrity of endothelial cells in the context of these processes is a major focus of the lab.

International Collaborations

University of Uppsala, Sweden
Harvard University, Boston, USA
University of California, San Francisco, USA
University of Philadelphia, USA

National Collaborations

Ludwig Maximilians University München
Heinrich Heine University Düsseldorf

Membership in local and regional Networks

DFG SFB 1009, DFG SFB 1348, DFG SFB 1450, DFG KFO 342

Research Field	Cell Biology
Keywords	Animal Models, Antibody, Anti-Infective Research, Cardiovascular Research, Signal Transduction
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MAX-PLANCK-GESELLSCHAFT

KEYWORDS
Signal Transduction, Small Molecules, Structural Biology, Sytems Biology

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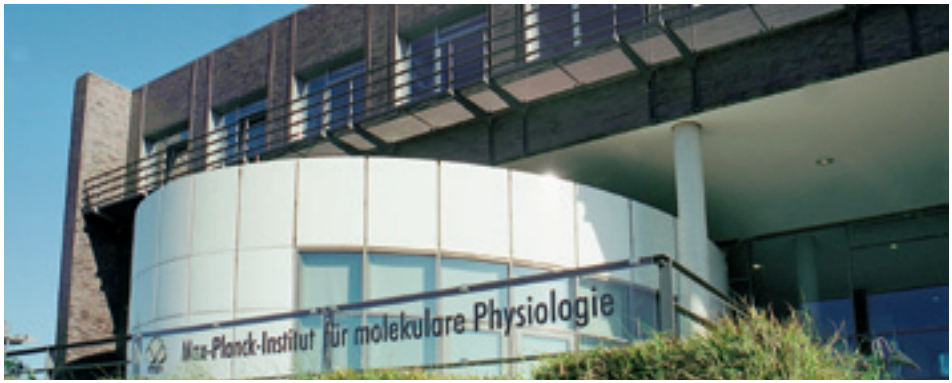

Max Planck Institute of Molecular Physiology

From Molecule to man

The Max Planck Institute of Molecular Physiology in Dortmund conducts basic biomedical research in line with a scientific mission that aims to understand the molecular basis of cell physiology in living beings. The institute's scientists pursue interdisciplinary research approaches founded on a unique liaison between structural biology, molecular cell biology, and chemical biology. This liaison is exemplified in the institute's concept of bridging the physical scales in a range that starts with small bioactive molecules – the interest of chemists – and ends with the cell, the fundamental principle of biological organization – the interest of cell and systems biologists. In between these two extremes are the macromolecules, which self-organize to generate dynamic subcellular structures and reaction networks, which are the targets of the structural biologists. Thus the institute aims to building an integrative and creative description of cell function that combines reductionist and holistic views of biological networks and their dynamics. Ultimately, this approach to studying biological self-organization will likely shed light on the perturbations occurring in devastating diseases such as cancer.

Department of Chemical Biology

Research in the Department of Chemical Biology is focused on the interface between organic chemistry and biology. We develop new synthesis methods and strategies and employ them for the synthesis of compounds which then are used as probes for the study of biological phenomena.

The Department has intense activities in small molecule development for chemical biology research in particular based on natural products and compound collections derived therefrom. These activities include the establishment of screening capacity employing both isolated proteins and cell-based screens and the identification of cellular target proteins and the development of new phenotype-based screening methods.

Membership in local and regional Networks

Drug Discovery Hub Dortmund,
Masterplan Wissenschaft Dortmund

Research Field	Chemical Biology
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Department of Structural Biochemistry

The primary aim of the Department of Structural Biochemistry is to understand biological processes in molecular detail. In particular, we intend to reveal the molecular mechanisms of muscle contraction, bacterial infection and cellular cholesterol homeostasis. We want to understand how malfunction of these processes results in human diseases, such as cardiomyopathies, arteriosclerosis and infectious diseases. Ultimately, we aim at providing a strong foundation for the targeted development of drugs.

Our studies involve heterologous expression of soluble and transmembrane protein complexes, their biochemical reconstitution and biophysical, biochemical and structural analysis. The department's main area of expertise is in high-resolution electron cryo microscopy (cryo-EM), but we also successfully use X-ray crystallography to determine the structure of macromolecular protein complexes.

International Collaborations

ETH Zurich, Switzerland
University of Texas Houston, USA
Umeå Universitet, Sweden

National Collaborations

University of Osnabrück
MHH Hannover

Research Field	Biochemistry
Keywords	Recombinant Proteins, Structural Biology, Electron Cryo Microscopy (cryo-EM)
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Research Field	Cell Biology/Physiology
Keywords	Self-organization, Collective Computing, Cancer Biology, Systems Biology, Synthetic Biology
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Department of Cell Biology/Physiology

Our main objective is to elucidate how intracellular signaling networks process time-varying extracellular information in a cognitive manner.

We develop quantitative experimental and theoretical approaches to derive and conceptualize physical principles that underlie intracellular signaling dynamics and cellular organization. The spatial-temporal organization of protein reactions in single cells within healthy and cancer cells of developing tissues is assessed by functional microscopic imaging approaches at multiple scales. This entails a strong recursion between modeling of network dynamics and imaging experiments that reveal dynamic properties of networks in living cells.

The obtained information from natural cellular systems is used to reconstitute from biochemical building blocks out-of-equilibrium 'life-like' morphogenic protocells that use the same self-organizing information processing abilities as natural cells. The aim of this research is to deploy these artificial 'life-like' systems to observe and redirect evolving biochemical processes within cells of diseased tissues.

International Collaborations

MRC Laboratory of Molecular Biology, Cambridge, UK

National Collaborations

University of Dortmund,
University of Bochum

Membership in local and regional Networks

Fellow of the MPG Matter to life School
Member of the IMPRS for Living Matter
Bioband Dortmund

Max Planck Institute for Plant Breeding Research

The Max Planck Institute for Plant Breeding Research conducts basic molecular biological research on plants with the goal of developing more efficient breeding techniques and environmentally sound plant protection strategies for agricultural crops. We wish to determine whether and how a detailed understanding of molecular mechanisms defined in model plant species can be used to rationally manipulate selected traits in crop plants. The primary scientific goal of the **Department of Plant Developmental Biology** is to study molecular mechanisms that regulate the responsiveness of plant development to environmental cues. In particular, a strong emphasis is placed on understanding the mechanisms controlling the transition to flowering in response to environmental signals and in explaining the diversity in flowering responses observed between species. Research in the **Department of Plant Microbe Interactions** concentrates on fundamental molecular processes underlying interactions between plants and pathogens. The innate immune system of plants and mechanisms of microbial pathogenesis have a central role in the discovery programme. The establishment of plant-associated microbial communities with healthy plants, called the plant microbiota, defines a second major research theme. The **Department of Comparative Development and Genetics** seeks to address two fundamental questions in biology: how do biological forms develop and what is the basis for their diversity? To address these questions we first aim to elucidate how genotypes are translated into organismal forms through the process of morphogenesis. Secondly, we seek to conceptualize how the balance of conservation versus divergence in morphogenetic regulatory networks yields different organismal forms during evolution. The **Department of Chromosome Biology** uses cutting-edge technologies in microscopy, genetics and genomics to explore the mechanisms and consequences of meiosis from multiple perspectives. We aim to decipher the molecular mechanisms of recombination, cell cycle control and chromosome distribution at meiosis, using complementary plant models. We also investigate how recombination evolves, and conversely, how recombination influences adaptation. Finally, we explore the possibility opened by the understanding of meiosis to propose innovations for plant breeding.

Max Planck Institute for Plant Breeding Research

KEYWORDS
Agricultural Biotechnology, Crop Research, Genetic Engineering, Genomics, Sequencing

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Founded (year)	1928
Number of employees	scientific 220 administrative 160
Funding	Federal Government Germany 43% State Government NRW 42% others (DFG, EU) 15%

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caesar

center of advanced european studies and research

KEYWORDS

Neuroscience, Neuroethology, Computational Neuroscience, Behavior

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Founded (year)	1995
Number of employees	118 (+24 employees scientific support) administrative 49
Funding	Federal Government (Germany) 92% State Government NRW 8%

www.caesar.de

Caesar – Asscoicated with the Max Planck Society

Question of how the brain controls behavior. The research spans a large range of scales from the nano-scale imaging of the brain, to large-scale functional imaging of thousands of neurons in the brain, to the quantification of natural animal behavior.

As of 2021, caesar hosts two departments: the department of behavior and brain organization (Jason Kerr) and the department of computational neuroethology (Kevin Briggman). In addition, nine research groups have been established: the max planck fellow group chemical biology (Michael Famulok), the max planck research groups neurobiology of magnetoreception (Pascal Malkemper), in silico brain sciences (Marcel Oberlaender), neural information flow (Monika Scholz), neural circuits (Johannes Seelig), self-recognition and cannibalism (James Lightfoot), the lise meitner research group cellular computations and learning (Aneta Koseska), the emmy noether research group neurobiology of flight control (Bettina Schnell), as well as the emeritus group molecular sensory systems (Benjamin Kaupp).

The institute is operated by a non-profit foundation under private law. The president of the max planck society chairs the foundation board. The scientific evaluation, as well as all other scientific measures are being conducted according to the procedures and criteria of the Max Planck Society. Caesar is part of a cluster for neurosciences in the Bonn-Cologne region and has multiple ties with the university of bonn. Caesar is involved in collaborative research centers (Sonderforschungsbereiche). In collaboration with the Max Planck Florida Institute for Neuroscience (MPFI), the university of bonn and florida atlantic university, caesar runs an international Max Planck Research School (IMRS) as a graduate program focudes on brain and behavior. Imprs aims to train students in a large range of cutting-edge techniques which are currently instrumental in the quest for understanding brain circuit function in the whole animal and its role in defining behavior.

Department of Behavior and Brain Organization

The primary aim of the Department of Behavior and Brain Organization (BBO) is to understand how mammals use vision to make decisions and what the underlying neural processes are. BBO combines imaging, computation, behavioral analysis, electrophysiological recordings, and anatomical mapping to explore the connection between behavior and neuronal activity. The research can be divided into two broad regions. The first develops tools and techniques for recording and analyzing neuronal activity, with single-cell and single action-potential resolution, from large populations of cortical neurons in awake and freely moving mammals. The second is focused on understanding the neuronal mechanisms underlying vision-based decision making in freely moving mammals. This involves the development of special multiphoton microscopes and of optics-based head and eye-tracking techniques. The overall aim of this approach is to generate a thorough understanding of mammalian vision and the organization of the circuits that underlie it.

International Collaborations

Max Planck Florida Institute for Neuroscience, Jupiter, USA
Howard Hughes Medical Institute, Janelia Research Campus, USA

National Collaborations

Max Planck Institute for Brain Research, Frankfurt, Max Planck Institute for Biological Cybernetics, Tübingen
Max Planck Institute of Neurobiology, Munich

Membership in local and regional Networks

IMPRS for Brain and Behavior
Society for Neuroscience

Research Field	Biophysics, Neurobiology, Behavior Research
Keywords	Animal Models, Imaging, Microscopy, Tool Development
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Department of Computational Neuroethology

The goal of the Department of Computational Neuroethology (CNE) is to develop computational models which can predict goal-directed animal behaviors. To acquire the data needed to build biologically plausible models, the researchers develop and utilize a multidisciplinary range of experimental techniques. They record cellular resolution images of neuronal populations from behaving animals. In addition, they use fluorescence microscopy to identify the expression patterns of specific proteins. Finally, the scientists reconstruct synaptic connectivity using 3D electron microscopy.

By combining these methods within individual brains, the group aims to discover the relationships between the structure and function of neuronal networks driving behavior. Firstly, they want to understand how sensory stimuli are transformed in the brain to ultimately generate motor decisions. Building on this understanding, they aim to identify the sources of variability during goal-directed behaviors. To address these questions, the scientists compare and analyze neural circuits across mammals, fish and amphibians to determine which aspects of a computation are species-specific and which generalize across species.

International Collaborations

Standford University
University of Sussex

National Collaborations

University of Tübingen
Charité/Humboldt University
University of Oldenburg

Membership in local and regional Networks

IMPRS for Brain and Behavior
Society for Neuroscience, BIGS - Bonn

Research Field	Bioinformatics, Neurobiology, Behavior Research, Neuroethology
Keywords	Neuroscience
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Research Field	Neurobiology, Behavior Research
Keywords	Animal Models, Neuroethology, Behavior, Drosophila Melanogaster, Decision Making
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Emmy Noether Group: Neurobiology of Flight Control

Flight poses a set of unique challenges to an organism. Flies need elaborate and fast stabilizing reflexes and need to use precise enough sensory information to orient in and find their way through a complex world.

The researchers are interested in how the tiny brain of *Drosophila melanogaster* controls steering maneuvers during flight. To answer that question, they make use of recent technological advances, which allow them to measure the activity of single neurons in behaving animals. They can monitor intended steering maneuvers by tracking the motion of the wings in head-fixed flies. In addition, they use the elaborate genetic tool kit available in Drosophila to manipulate the function of specific neurons. Combining all these techniques the group aims to identify and study individual neurons that control steering maneuvers during flight, the circuits they are embedded in, and the computations they perform. Hopefully, this work will provide insights into general mechanisms of how neural circuits control behavior and decision-making.

International Collaborations

Prof. Michael Dickinson, Caltech, Pasadena, USA

Research Field	Biophysics, Neurobiology, Physics of Living Systems, Devices
Keywords	Bio-processing, Signal Transduction, Systems Biology
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Lise Meitner Group: Cellular Computations and Learning

Mammalian cells continuously sense and respond to chemical signals that vary in space and time. To operate in a changing environment, they carry out complex computational tasks in real time. Such processing resembles in a way the sensory computations of the neural microcircuits in the cerebral cortex.

The Lise Meitner group, led by Dr. Aneta Koseska, focuses on developing a generic theory of computations and learning on the level of biochemical networks in single cells, by determining the underlying dynamical principles through which such information processing features emerge. They investigate how single cells employ working memory to integrate multiple time-varying signals as a means to generate stable identity, while simultaneously balancing plasticity in cellular responses. They also explore whether single cells can learn. Using quantitative imaging, the group experimentally validates the proposed conceptual basis how cells process non-stationary signals and learn to generalize their responses to a changing environment.

International Collaborations

St. Petersburg State University, Saint-Petersburg, Russia
Lebedev Physical Institute of the Russian National Academy of Sciences, Moscow, Russia

National Collaborations

Philippe Bastiaens, Max Planck Institute of Molecular Physiology, Dortmund
Christian Schröter, Max Planck Institute of Molecular Physiology, Dortmund

Membership in local and regional Networks

IMPRS for Brain and Behavior
Society for Neuroscience

Max Planck Research Group: In Silico Brain Sciences

How do animals build robust precepts of their environment despite variations in stimulus configurations and context? How can they do this without the need of massive training? Could artificial systems ever achieve such levels of "general" biological intelligence? To answer these questions, the group combines computational approaches with experiments in the living animal. They build realistic models of the brain from empirical data that they systematically collect at synaptic, cellular and network scales. They use the models to perform multi-scale simulations that mimic activity recordings in the brain of behaving animals. In the simulations, they explore which cellular and circuit mechanisms could in principle account for the measured activity, and test these predictions in the living animal. Ultimately, they translate the hence uncovered mechanisms into design principles for artificial neural networks, to reveal how higher brain functions – such as robust perception – can emerge from their neurobiological implementations.

International Collaborations
University of Pittsburgh, USA
VU University, Amsterdam, NL
Hebrew University, Israel

National Collaborations
Research Center Jülich
University of Tübingen
Zuse Institute, Berlin

Membership in local and regional Networks
Faculty member, Bonn International Graduate School of Neuroscience
Faculty member, IMPRS for Brain & Behavior, Bonn
Member of the Society for Neuroscience, USA

Research Field	Neurobiology
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Max Planck Research Group: Neural Circuits/Lightfoot

Self-recognition regulates diverse behaviors of social interactions, including mating behaviors and predator-prey dynamics. It is found in organisms with the capability to harm or even kill their relatives, whereby it is fundamental to prevent cannibalism of kin.

The group explores the self-recognition system evident in the omnivorous roundworm, Pristionchus pacificus. This nematode has evolved teeth-like denticles and is capable of both feeding on bacteria and killing other nematode larvae. However, it does not kill its own progeny; researchers therefore investigate this self-recognition system which protects the offspring from the predatory parent. They are identifying the signals transmitted by P. pacificus to indicate self and prevent attack by their relatives. The group elucidates the receptors and circuits behind the killing decision and which distinguish between foreign and self-progeny. They are analyzing the evolution of these processes by utilising a worldwide representation of P. pacificus from a vast library of strains.

Membership in local and regional Networks
IMPRS for Brain and Behavior
Society for Neuroscience

Research Field	Neurobiology, Behavior Research
Keywords	Behavior, Kin-recognition, Genetics, Neuroscience
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Max Planck Research Group: Neural Circuits/Seelig

The Max Planck research group Neural Circuits uses optical microscopy techniques, such as two-photon calcium imaging, to understand how neural networks in the brain change over time, from single synapses to entire circuits, and how these changes relate to behavior. Their research focuses on the model organism *Drosophila melanogaster* where genetically identified, comprehensive neural networks underlying adaptive behaviors can be studied. The researchers interpret and guide these experiments using computational modeling of neural circuit dynamics. Molecular, structural, and functional similarities of neural circuits across species suggest that insights gained in the fly brain will also contribute to an understanding of the mammalian brain.

In a second line of research they use machine learning in combination with optical microscopy with the aim of optimizing the temporal as well as spatial resolution of functional imaging in animals engaged in virtual reality behavior.

National Collaborations

Janelia Research Campus - Gerrald M. Rubin

Membership in local and regional Networks

IMPRS for Brain and Behavior

Research Field	Neurobiology
Keywords	Behavior, Invertebrate, Foraging, Microscopy, C. Elegans
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Max Planck Research Group: Neural Information Flow

The Max Planck research group Neural Information Flow, led by Dr. Monika Scholz, studies how animals use information to make behavioral decisions. They study foraging of the small roundworm *C. elegans*, a highly ecologically relevant behavior. To successfully forage, the animal needs to combine sensory information obtained from its environment with information about its own behavioral state. The researchers follow this information flow experimentally using behavioral assays, neural activity imaging, optogenetics and genetic perturbations. Ultimately, they want to understand how animals integrate multiple sources of information and how this drives the foraging strategy of *C. elegans*.

Their research program encompasses two main directions: Information bottlenecks and organization of coupled behaviors. Their aim is to understand how information enters, flows through, and is altered in neural networks. Hopefully, their studies will help to identify general principles of signal compression, attention and context-dependency in neural systems.

International Collaborations

The University of Chicago, USA
Jerusalem University, Israel
Columbia University, USA

National Collaborations

caesar, Germany

Membership in local and regional Networks

GENIE - Group of C. elegans new investigators in Europe
BIGS neuroscience Bonn international graduate school

Max Planck Research Group: Neurobiology of Magnetoreception

The Max Plack research group "Neurobiology of Magnetoreception, led by Dr. Pascal Malkemper, aims to understand how animals detect the Earth's magnetic field and use it for orientation. They study the neural circuits involved in the perception of magnetic fields. Their model species is an African mole-rat, a subterranean mammal and extraordinary magnetic navigator that spends its entire life in total darkness.

The group investigates the neuronal navigation circuits using whole brain stimulus induced activity mapping and single-unit recordings in freely moving animals complemented with anatomical and histological techniques. Their hope is to gain crucial insights into the neuronal machinery that enables animals to detect magnetic fields. An understanding of how mammals detect weak magnetic fields promises advances in the auspicious field of magnetogenetics and provides a basis to assess and predict effects of man-made electromagnetic fields on vertebrates.

International Collaborations

University of Melbourne, Australia
Research Institute of Molecular Pathology, Vienna, Austria
University of Strasbourg, France

National Collaborations

University of Duisburg-Essen, Essen
Leipniz Institute on Aging, Jena

Membership in local and regional Networks

IMPRS for Brain and Behavior
Society for Neuroscience

Research Field	Neurobiology, Behavior Research
Keywords	Animal Models, Biomaterials, Signal Transduction, Systems Biology, Behavioural Neuroscience
Head of Institute	Dr. Pascal Malkemper
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Other Research Institutions and Cluster of Excellence

Other Research Institutions and Cluster of Excellence

In addition to the universities, universities of applied sciences, and scientific organizations mentioned before, there are further research institutions and several Clusters of Excellence active in the field of life sciences. As a whole, this network of institutions emphasizes the outstanding NRW academic environment.

The **Bioeconomic Science Center (BioSC)** was founded in 2010 by RWTH Aachen University, the Universities of Bonn and Düsseldorf, and Forschungszentrum Jülich. It is based on a joint strategy involving numerous pre-existing scientific networks and collaborations for a sustainable supply of biomass and bio-based products or processes focusing on four key research areas: sustainable plant production, microbial/molecular transformation, process engineering of renewable resources as well as economic and social implications.

The **West German Cancer Centre Consortium (WTZ)**, founded in 1977 as a registered association, originally started in 1967 as the "Essen Tumour Hospital". It was the first cooperative institution exclusively dealing with diagnostics and therapy for tumour patients. In 2009, the WTZ was awarded the title of "Oncology Centre of Excellence" by the non-profit-organization Deutsche Krebshilfe e. V. (German Cancer Aid), which is comparable to the American Comprehensive Cancer Centers. One and a half years later, WTZ became part of the "German Cancer Consortium" and now belongs to a network of 14 "Top Oncology Centres". Today, several hundred physicians and medical scientists coming from different clinics and institutions work at WTZ.

Likewise, the **West German Heart and Vascular Center (WHGZ)** as well as the **West-German Center for Infectious Diseases (WZI)** are located in Essen. Both are not only providing patient treatments but also have excellent research reputations.

In a similar integrated approach as WTZ, the Center for Integrated Oncology (CIO Cologne Bonn) started as a virtual centre in 2007. In 2018 the CIO enlarged and today it is located at four different university hospitals (CIO Aachen Bonn Cologne Düsseldorf). In 2019 the new CIO Cologne, which is Germany's largest outpatient building for cancer patients, was opened. CIO is embedded in an extraordinarily rich life science landscape among these four universities, with the Center for Molecular Medicine Cologne (CMMC), the **West German Genome Center (WGGC)**, the Life & Medical Sciences Institute (LIMES), the **Cologne Cluster of Excellence Cellular Stress Responses in Aging-associated Diseases (CECAD)**, and the two Max-Planck-Institutes for Biology of Ageing and Metabolism Research all in the region.

The Protein Research Unit Ruhr within Europe (PURE), which launched in 2010, served as a platform for protein researchers and clinical researchers from Ruhr University Bochum (RUB) as well as the University of Duisburg-Essen (UDE) to pool their resources in the search for biomarkers that can provide an early indication of diseases such as cancer, Parkinson's, multiple sclerosis, and Alzheimer's. In the 2015 funding phase, PURE-scientists succeeded with their proposal for a research building for molecular protein diagnostics. In 2019, the new **Centre for Protein Diagnostics (PRODI)**, which was financed in equal parts by the federal government and the federal state with a total of around € 50 million, was finished. At PRODI innovative protein analytical methods are transferred into clinical application in order to identify disease-specific protein alterations in biological samples from patients.

Clusters of Excellence are part of the Excellence Strategy of the German Federal Ministry of Education and Research and the German Research Foundation. The Excellence Strategy provides funding for Clusters of Excellence and institutional strategies within the universities of excellence. In September 2018, the Grants Committee decided to support 57 Clusters of Excellence. The 34 universities will receive altogether around € 2.5 billion over seven years. Clusters of Excellence can receive up to € 10 million in funding, while universities with Clusters of Excellence can apply for additional subsidies. Clusters of Excellence aim to promote cutting-edge research and to create outstanding training and career conditions for young scientists at universities. They are intended to deepen cooperation between disciplines, institutions, and the business sector to enhance the international appeal of excellent German universities. Currently, 14 out of 57 cluster projects all over Germany are located in North Rhine-Westphalia and 5 of these clusters are associated specifically with biotechnology and life sciences: [1]

- **Cologne Cluster of Excellence on Cellular Stress Responses in Aging-associated Diseases (CECAD)**, Cologne
- **ImmunoSensation**[2] – the immune sensory system, Bonn
- **Cluster of Excellence on Plant Sciences (CEPLAS)** – SMART Plants for Tomorrow's Needs, Düsseldorf and Cologne
- **The Fuel Science Center** – Adaptive Conversion Systems for Renewable Energy and Carbon Sources, Aachen
- **PhenoRob** – Robotics and Phenotyping for Sustainable Crop Production, Bonn

[1] https://www.dfg.de/gefoerderte_projekte/programme_und_projekte/listen/index.jsp?id=EXSf
Accessed 14.08.2021

BioSC
Bioeconomy Science Center

KEYWORDS
Bioeconomy

Name	Bioeconomy Science Center – BioSC
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E-Mail	biosc@fz-juelich.de
Internet	www.biosc.de
Founded (year)	2010
Number of employees	1,900

www.biosc.de

Bioeconomy Science Center – BioSC

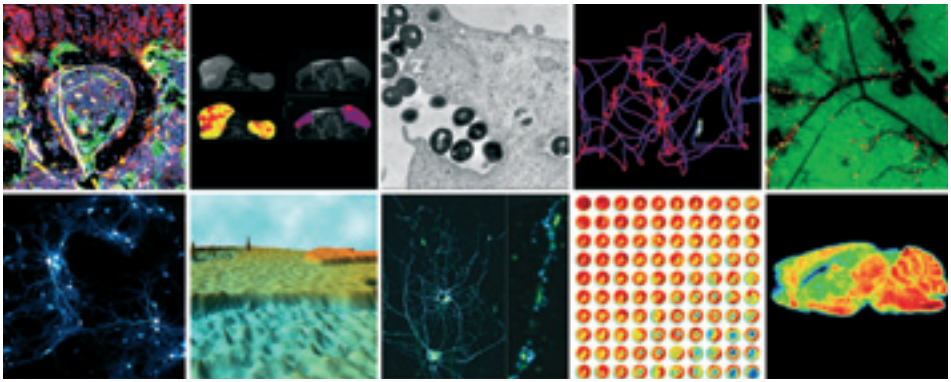
Competence, Knowledge and Technology for a Sustainable Bioeconomy

The generation and integration of knowledge about biological systems for the sustainable production of biomass and bio-based raw materials and its use for food, feed, bio-based materials and energy is an essential and emerging field within the development of the bioeconomy. Based on broad and excellent competencies in bioeconomy related research fields, the RWTH Aachen University, the Universities of Bonn and Duesseldorf, and the Forschungszentrum Juelich have established the Bioeconomy Science Center (BioSC).

The aim of the BioSC as a competence center for systemic research and education for a sustainable bioeconomy is to synergistically align existing scientific expertise and infrastructures of the partners in the fields of biotechnology, bio- and chemical science, plant and agricultural science, engineering science, and (socio-)economics in order to develop innovative concepts in the research fields as well in their interaction. The scientific and technological expertise in BioSC ranges from the sustainable production of plants for food/feed and as renewable feedstock, its molecular and microbial transformation to bio-based products (i.e. fine chemicals, biopolymers, materials, pharmaceuticals, enzymes, biofuels) in innovative processes (i.e. modular and integrated biorefinery concepts, cascade use) under consideration of the economic impact and social implication for and of the bioeconomy. BioSC encompasses more than 1,900 staff members working at 67 member institutes. A multi- and interdisciplinary academic education within different topics of a sustainable bioeconomy is another aim of the BioSC.

The BioSC is also designed as a regional hub for national and international scientific cooperation with e.g. bioeconomy clusters and expert networks, excellence clusters, European technology platforms and network projects with industry.

As a scientific core, the BioSC contributes significantly to the development of a model region for resource-efficient, bio-based economy in the Rhineland. In cooperation with the BioökoomieREVIER initiative, innovative solutions and concepts explored at the BioSC are further developed there, for regional implementation and value creation.



Cells in Motion (CiM) Interfaculty Centre

Imaging to understand cellular behaviour in organisms

In the Cells in Motion Interfaculty Centre (CiM), researchers from the fields of medicine, biology, chemistry, pharmacy, mathematics, computer science and physics join forces and carry out research relating to topics in cell dynamics and imaging – which is a research focus at the University of Münster.

In order to understand dynamic cellular processes in organisms scientists investigate which biochemical and biophysical properties of a cell influence its behaviour, how the molecular mechanisms in an organism remain in healthy balance, and what happens in the body in different diseases. A main focus is on cellular processes in the blood and lymphatic vessel system, and on inflammation. In tackling biomedical questions, researchers incorporate different imaging technologies – from light microscopy to whole-body imaging – into their investigations and integrate information gathered from the individual cellular level up to the level of the entire organism. This "multiscale imaging" strategy allows to identify links between cellular mechanisms and the function of organs and promotes the transfer of methods applied to animal models to clinically established imaging methods for exploitation in patient diagnosis. The approach requires new chemical-biological strategies to label the same cell type, or even the same cell, with different signal transmitters that can be employed in different imaging methods with different resolution. New challenges are also posed by the need to integrate data sets from different imaging techniques using mathematical models and artificial intelligence.

Embedded in the network is a graduate programme, the Imaging Network which promotes the joint use and sustainable further development of research infrastructure at Münster University, and the Multiscale Imaging Centre, a new research building where research groups from different faculties are based and bring together a core of the wide range of expertise in biomedical imaging, as well as the corresponding technologies.

CELLS IN MOTION
Interfaculty Centre

KEYWORDS
Cell Dynamics, Inflammation, Biomedical Imaging

Name	Cells in Motion (CiM) Interfaculty Centre
Applicant	Westfälische Wilhelms-Universität Münster Schlossplatz 2
Postal Code/City	48149 Münster
Contact Person	Scientific Spokesperson Prof. Dr. Lydia Sorokin Westfälische Wilhelms-Universität Münster Institut für Physiologische Chemie und Pathobiochemie Waldeyerstraße 15 48149 Münster
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E-Mail	cim@uni-muenster.de
Internet	www.cells-in-motion.com

www.cells-in-motion.com

CEPLAS

KEYWORDS
Crop Science, Plant Breeding, Genomics, Synthetic Biology, Bioeconomy

Name	Cluster of Excellence on Plant Sciences (CEPLAS) - EXC 2048
Address	40225 Düsseldorf
Postal Code/City	50923 Köln
Contact Person	Cluster Speaker Professor Dr. Andreas P. M. Weber Institute of Plant Biochemistry Heinrich-Heine-Universität Düsseldorf Universitätsstraße 1 40225 Düsseldorf
Fon	+49 211 81-12347
E-Mail	andreas.weber@hhu.de
Internet	www.ceplas.eu
Funding Period	II. 2019 – 2025

www.ceplas.eu

Cluster of Excellence on Plant Sciences CEPLAS

SMART Plants for Tomorrow's Needs

Plants enable life on Earth through the conversion of solar energy into chemical energy. Beginning with the Neolithic Revolution, the domestication of plants provided the basis for human population growth and, subsequently, the evolution of highly developed civilizations. However, the growing food demands imposed by an increasing population and the effects of anthropogenic climate change pose huge challenges for sustainable food production and ecosystem maintenance.

The Cluster of Excellence on Plant Sciences CEPLAS addresses these grand challenges through world-class fundamental research on complex plant traits of agronomic relevance that impact on yield and adaptation to limited resources. Hence this knowledge is essential for designing and breeding plants that react in a predictable way to future challenges (SMART plants).

CEPLAS integrates the resources of the Universities of Cologne and Düsseldorf, the Max Planck Institute for Plant Breeding Research, and the Forschungszentrum Jülich into an internationally leading plant science center that attracts world-class faculty and junior researchers.

Beyond its research mission, we aim for the Cologne/Düsseldorf area to become the location of choice for talented early career researchers wishing to develop their careers. To support this aim, CEPLAS provides novel forms of training for undergraduate and graduate researchers and postdoctoral scientists at the interface of plant and microbial biology, systems and synthetic biology, and theoretical biology.

Cluster of Excellence PhenoRob

PhenoRob – Robotics and Phenotyping for Sustainable Crop Production – is the only Cluster of Excellence in agriculture in Germany.

Here, the University of Bonn together with Forschungszentrum Jülich conducts research to change crop production by optimizing breeding and farming management with the help of new technologies.

Our research approach focuses on improving the fundamental understanding of all relevant parameters like plant growth, soil, biodiversity, or atmosphere.

PhenoRob is moving toward sustainable crop production, spanning from monitoring and understanding to assessment and identification of promising solutions to optimize breeding and farming management. We systematically monitor all essential aspects of crop production using sensor networks as well as ground and aerial robots. This enables a more targeted management of inputs (genetic resources, crop protection, fertilization) for optimizing outputs (yield, growth, environmental impact). We develop novel technologies to enable real-time and automated control of weeds and selective fertilization. We apply modern machine learning techniques to analyze large amounts of acquired crop data to improve the understanding and models of plant growth, and of nutrient and water use efficiency. And we predict the expected impacts of novel approaches on management decisions at the farm level.

UNIVERSITÄT BONN PHENOROB

KEYWORDS
Digital Technologies, Environmental Research, Machine Learning, Phenotyping, Plant Breeding

Name	Cluster of Excellence PhenoRob
Applicant	Universität Bonn
Address Postal Code/City	Niebuhrstraße 1a 53113 Bonn
Contact Person	Dr. Nora Berning
Fon E-Mail Internet	+49 228 73-60819 nberning@uni-bonn.de www.phenorob.de
Funding Period	2019-2025
Number of employees	50+ (PhD students, Postdocs & Junior Research Group Leaders) 5 (administrative employees)
Funding	100% DFG - Deutsche Forschungsgemeinschaft

www.phenorob.de

CECAD COLOGNE Excellent in Aging Research – Exzellent in Alternsforschung

KEYWORDS
Ageing, Metabolomics, Neurodegenerative Diseases, Regenerative Medicine, Systems Biology

Name	Cellular Stress Responses in Aging-associated Diseases (CECAD)
Applicant	Joseph-Stelzmann-Str. 26
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Fon	+49 221 478 84043
E-Mail	cecad-press@uni-koeln.de
Twitter	@CECAD_
Internet	www.cecad.uni-koeln.de
Number of employees	over 600 (including PhD students) ca. 100 (administrative employees)
Founded	2007

www.cecad.uni-koeln.de

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Cologne Cluster of Excellence Cellular Stress Responses in Aging-Associated Diseases (CECAD)

Together for Healthy Aging

CECAD is a globally leading research center for aging and aging-associated diseases. As consortium of the University of Cologne, the University Hospital, the two Max Planck Institutes (Biology of Ageing and Metabolism Research), and the DZNE, CECAD has made great progress in scientific output and visibility of this rather young research field. The aim of CECAD is to elucidate the molecular, cellular and systemic mechanisms of aging to identify novel common therapy opportunities that target a range of aging-associated diseases.

In an interdisciplinary approach, scientists communicate and exchange their findings of the aging process on three levels: intracellular, tissue and organ communication, and environment interaction. CECAD scientists are aiming at translating their results into new therapeutic approaches in the clinic. Conversely, clinical data are implemented into fundamental research programs to gain deeper understanding of disease mechanisms.

The demographic change will lead to a further increase of elderly that are affected by multimorbidity. CECAD's research mission is thus addressing a pressing societal challenge. Preventing disease and increasing the healthy lifespan is the overreaching goal.

CECAD is supported equally by the Medical Faculty and the Faculty of Mathematics and Natural Sciences and promotes scientific research and academic education in the field of the biology and biomedicine of aging.

Key facts:

- CECAD is funded by the DFG as part of the federal and state Excellence Initiative since November 1, 2007
- Third seven-year funding period began in January 2019
- 54 Principal investigators (2021)
- Central office for scientific administration
- 6 Central technology facilities:
  - bioinformatics and data analysis, imaging, *in vivo* research, proteomics, lipidomics and metabolomics, systems neuroscience
- Translational Platform
- Cologne Graduate School of Ageing research (CGA) and platform for Career Development & Diversity
- 43 % international staff
- > 50 % female scientists



ImmunoSensation²
The Immune Sensory System

The ImmunoSensation² Cluster of Excellence is a joint collaborative project of the Medical Faculty and the Faculty of Mathematics and Natural Sciences of the University of Bonn and the German Center for Neurodegenerative Diseases (DZNE) of the Helmholtz-Society. Immune sensing receptors represent the core of innate immunity. These receptors detect foreign microbial molecules or altered self-molecules. Activation of immune sensing receptors initiates defense and repair mechanisms that protect the host. Dysregulation of these responses can cause a range of inflammatory diseases like atherosclerosis, metabolic syndrome and diabetes, neurodegeneration, autoimmune diseases and cancer. With the concept of an immune sensory system, which integrates the sensing functions of immune and non-immune cells, ImmunoSensation² has become one of the leading centers for immunological research. Seminal contributions include the identification of novel receptor ligands, a new second messenger, new paradigms of cell-to-cell communication, a new classification of macrophage activation, insights into immunopathogenesis of cancer, a new target to restore cognitive function, and the impact of Western diet on trained immunity.

To support the next generation of scientists, the Bonn International Graduate School (BIGS) Immunosciences and Infection provides world-class training in the life sciences. With the recruitment of excellent scientists and the establishment of cross-institutional technological platforms, ImmunoSensation² contributes to a better understanding of immune sensing receptors, their ligands, their regulation by the local and systemic environments, the integration of sensory input and its consequences for inflammation in vivo.

Participating institutions:
- Medical Faculty, University of Bonn
- Faculty of Mathematics and Natural Sciences, University of Bonn (LIMES Institute, Mathematics)
- German Center for Neurodegenerative Diseases (DZNE)

ImmunoSensation²
the immune sensory system Bonn cluster of excellence

KEYWORDS
Antibody, Immune Modulation, Neurodegenerative Diseases, Innate Immunity, Inflammation

Name	ImmunoSensation² Cluster of Excellence - EXC 2151
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E-Mail	immunosensation@uni-bonn.de
Internet	www.immunosensation.de
Funding Period	II. 01.2019 – 12.2025

www.immunosensation.de

PRODI
Center for Protein Diagnostics

KEYWORDS
Biomarker, Diagnostic Systems, Neurodegenerative Diseases, Oncology, Platform Technology

Name	Ruhr-University Bochum / Center for Protein Diagnostics (PRODI)
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Contact Person	Prof. Dr. Klaus Gerwert
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E-Mail	klaus.gerwert@rub.de
Internet	www.prodi.rub.de
Number of employees	120 (including PhD students)
	4 (administrative employees)
Founded	2019

www.prodi.rub.de

Ruhr-University Bochum / Center for Protein Diagnostics (PRODI)

In order to meet the challenges of an ageing society, the primary goal at the Centre for Protein Diagnostics (PRODI) is the development of new, minimally invasive methods for diagnostics and therapy prediction. The focus is on neurological and oncological diseases. In particular, innovative methods are being developed that provide precise information about diseases and individual therapy responses already at early stages of the disease.

Practically all oncological and neurodegenerative diseases are associated with protein alterations. Alterations in a single protein are often sufficient to trigger severe diseases. However, macroscopically visible, morphological changes in the tissue often only occur many years after the protein alterations have occurred. Therefore, in PRODI we analyse macroscopic changes in tissue, changes in cells as well as protein alterations on the molecular level across scales. The investigations of proteins on the molecular level complement the work at the Chair of Biophysics at the Ruhr-Universität Bochum.

The protein alterations mentioned can serve as biomarkers to detect diseases phenotypically in early, still symptomless disease stages (principle of secondary prevention). If certain proteins are identified as “key players”, it is possible to intervene specifically in the causative factors as well as in the disease process itself - in the sense of early therapy. Once these protein biomarkers have been validated, they can also be used to monitor the course of therapy and even predict the success of therapy. This enables personalised, precise medicine with new therapeutic approaches.

We have established a highly efficient workflow in PRODI, which ranges from sample collection and characterisation in the competence area Experimental Medicine and in cooperating clinics to detailed analyses in the competence areas Biospectroscopy and Medical Proteome Analysis to cross-platform evaluation of the data obtained in the competence area Bioinformatics.

The Fuel Center @ RWTH Aachen University

One of our greatest challenges today is the increasing demand for energy and the need to replace our current fossil energy supply. The Fuel Science Center therefore wants to replace today's static fossil fuel-based scenario with adaptive production and propulsion systems based on renewable energies and carbon resources.The aim is to integrate renewable electricity with the shared use of bio-based carbon raw materials and CO_2 to provide high-density liquid fuels ("bio-hybrid fuels") that enable innovative engine concepts for highly efficient and clean combustion. To do so, the FSC brings together researchers from different disciplines, especially from the natural sciences, engineering and social sciences as well as the participating institutes of RWTH Aachen University, Forschungszentrum Jülich, the Max Planck Institut für Kohlenfoschung and the MPI for Chemical Energy Conversion as cooperation partners.

FSC The Fuel Science Center | RWTH AACHEN UNIVERSITY

KEYWORDS
Bioeconomy, Circular Economy, Environmental Research, Fuel Science, Renewable Resources

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Internet	www.fuelcenter.rwth-aachen.de
Number of employees	100 (including PhD students) 10 (administrative employees)
Founded	2019

www.fuelcenter.rwth-aachen.de

west german
cancer center consortium

KEYWORDS
Biomarker, Drug Discovery/ Drug Delivery, Oncology, Personalized Medicine, Early Clinical Trials

Name	West German Cancer Center Network
Internet	www.wtz.nrw
Founded (year)	1967 (Essen Tumor Hospital)
Number of employees	University Hospital Essen: 8,000, University Hospital Münster: 11,500
Funding	State Government NRW 50% Federal Government (Germany) 20% Other 30% Deutsche Krebshilfe (Program "Oncology Centers of Excellence"), NRW, other peer reviewed funding org.

www.wtz.nrw

West German Cancer Center Consortium

Medical Excellence and Humanity

As Germany's first and one of its largest comprehensive cancer centers, the WTZ is based on the visionary concepts of C.G. Schmidt and E. Scherer, who created interdisciplinary facilities in Essen as early as 1967. Since then, the WTZ developed into one of the first European centers to combine cancer care and research. Today, it is one of 7 partner sites in the German Cancer Consortium and has recently taken the next step to evolve into a CCC Consortium connecting Essen and Münster. Funded by the German Cancer Aid, the WTZ fosters clinical translation and enhances access to highest quality cancer care for 40,000 patients per year. Early detection, precise diagnostics, individualized therapies and access to clinical trials that focus on patient need are hallmarks of care at the WTZ. Its mission - to progressively understand, control and cure cancer - and its continued efforts to develop innovative therapies, place it at the forefront of scientific research.

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West German Genome Center (WGGC)

The West German Genome Center (WGGC) is one of four national Next Generation Sequencing (NGS) Competence Centers funded by the DFG, the national research council. The WGGC takes a leading role in harmonizing standards to serve the scientific community by providing excellent NGS services.

The WGGC is a collaborative network of universities and institutes located in the west of Germany. Its activities started in January 2019. The WGGC unites three core facilities (Production Sites) where sequencing is performed. They are located in Cologne, Bonn and Düsseldorf. Together, their NGS portfolio includes nearly all applications currently known from genomics, epigenomics, transcriptomics to single-cell sequencing. Based on its long-lasting expertise in using NGS technologies, the CCG (Cologne Center for Genomics) has been selected as major production site of the WGGC. It offers a wide portfolio of all kinds of NGS applications, including single-cell genomics. The Life & Brain Center is the WGGC production site in Bonn and provides services for short-read based sequencing projects. The Genomics and Transcriptomics Lab in Düsseldorf specializes in long-read NGS technology. The production sites count on additional NGS expertise from Aachen, Duisburg/Essen and Saarbrücken. Centralized NGS services are complemented with existing decentralized NGS- and bioinformatics expertise of further partners. WGGC's expertise covers most aspects of NGS research, encompassing strong capabilities in human and medical genetics as well as onco- and plant genomics. Thus, you can connect with our network of WGGC experts working on a wide range of topics and with different organisms, from bacteria to plants to humans. To identify the expert you are looking for, please have a look at our profiles' page on our website (https://wggc.de). The WGGC experts work in five Special Interest Groups (SIGs) that focus on key topics relevant to NGS technology. Their goal is to tackle common and pressing issues and develop solutions that will benefit NGS users and service providers alike.

WEST GERMAN GENOME CENTER

KEYWORDS

Genomics, Microbial Genomics, mRNA, Platform Technology, Sequencing (Facility)

Name	West German Genome Center
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Fon	+49 221 478 96957
E-Mail	kontakt@wggc.de
Internet	www.wggc.de
Number of employees	56 (including PhD students)
	4 (administrative employees)
Founded	2019
Funding	50% DFG

www.wggc.de

WHGZ
Westdeutsches Herz- und Gefäßzentrum

West German Heart and Vascular Center University Duisburg-Essen

Name	West German Heart and Vascular Center University Duisburg-Essen
Address	Hufelandstraße 55
Postal Code/City	45122 Essen
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Fon	+49 201 723 4485
E-Mail	gerd.heusch@uk-essen.de
Internet	www.whgz.de
Founded (year)	2014
Number of employees	176 (including PhD students)
	77 (administrative employees)

www.whgz.de

The West German Heart and Vascular Center (WHGZ) was founded in 2014 and has evolved from the former West German Heart Center. The WHGZ comprises the Clinics of Cardiology and Vascular Medicine and Thoracic and Cardiovascular Surgery, the clinical units of Pediatric Cardiology, Nuclear Cardiology, and Emergency Care, the Herzzentrum Huttrop as well as the Institutes for Pathophysiology and for Pharmacology. The main purpose of the WHGZ is to provide the best possible patient care and to translate innovations as quickly as possible to patients´ benefit. Research at the WHGZ is supported by the German Research Foundation and several other funding agencies. Research focusses on arrhythmias, heart failure, myocardial ischemia and reperfusion injury, and protective interventions. In patients with structural heart diseases, interventional strategies to treat valve and congenital heart diseases are developed and evaluated. Aging ,including subclinical atherosclerosis and aortic diseases, but also atrial fibrillation is a clinical focus and research topic. Heart failure as the terminal state of most cardiac diseases is a focus of both basic research and clinical care, including biotechnical support and ultimately transplantation. At the WHGZ, researchers benefit from an excellent infrastructure, combining mechanistic basic research, interdisciplinary core facilities and an active university clinic, which offers maximum medical care for its patients. Close communication between research and clinical facilities enhances the interaction of scientists in all fields of the WHGZ, thus facilitating translational projects. Training of young scientists and continuous education are a key mission of the WHGZ, which is reflected by the high number of evolving highly productive working groups. By its interactive basic science and clinical research, the WHGZ will break new ground in cardiovascular medicine and improve patient care.

West German Center for Infectious Diseases

– excellent collaboration and bundled expertise –

Due to the advances in medicine in recent years, the number of patients with acquired immunodeficiency has increased significantly. These immune disorders can occur after immunosuppressive therapy for transplants or autoimmune diseases, chemotherapy for the treatment of tumor diseases, as well as in patients with HIV infections or severe diseases of kidney or liver. Infections pose a particularly serious threat to these patients. The research, prevention, diagnostic and therapy of infectious diseases in patients suffering from immunodeficiency therefore require special expertise and should be carried out in centers where interdisciplinary teams are active. For this purpose, the West German Center for Infectious Diseases (WZI) was founded in 2013 and bundles interdisciplinary expertise at the highest medical and scientific level. The interdisciplinary teams include infectious disease specialists, microbiologists, virologists, immunologists, internists, pediatricians and dermatologists. The focus is on the Department of Infectious Diseases (Prof. Dr. Oliver Witzke), the Institute for Medical Microbiology and Hygiene (Prof. Dr. Jan Buer), and the Institute for Virology (Prof. Dr. Ulf Dittmer). Further specialists, such as the HIV Institute, the HIV outpatient unit of the Department of Dermatology, the Department of Pneumology, the Department of Anesthesiology and Intensive Care Medicine and the Department of Gastroenterology are also significantly involved in fundamental understanding of the cause-and-effect interaction of infectious disorders. The research is practice-led and linked into international network and has the main goal to allow basic research findings to be adopted in clinical care settings as soon as possible. The WZI intensively supports highly motivated young scientists in these disciplines. The research work is currently devoted to a wide variety of topics, such as: the antiretroviral therapy of HIV infection or infective hepatitis, infectious diseases in immunosuppressed patients, vaccines or the importance of herpes virus infections.

wzi
West-German Center for Infectious Diseases

KEYWORDS
Anti-infective Research, Diagnostic Systems, Infectious Diseases, Therapeutics, Vaccines

Name	West-German Centre for Infectious Diseases (WZI)
Address Postal Code/City	Hufelandstraße 55 45147 Essen
Contact Person	Directors: Prof. Dr. med. Oliver Witzke, Prof. Dr. rer. nat. Ulf Dittmer Coordinator: Dr. rer. nat. Rabea J. Madel
Fon E-Mail	+49 201 723-82155 wzi@uk-essen.de
Internet	www.wzi-essen.de
Number of employees	more than 600 scientists (>30 PhD students) and 470 physicians distributed over 12 clinics and institutes of the WZI
Founded	2013

www.wzi-essen.de

Medical Faculties in NRW

Medical Faculties	Location	Webpage	Key Areas of Research*
Bielefeld University	Bielefeld	www.uni-bielefeld.de/fakultaeten/medizin/forschung/profil/	Medicine for People with Disabilities & Chronic Diseases; Brain - Impairment - Participation; Intelligent Systems - Assistance Interprofessional Networking; Microbial Diversity in the Human Habitat; Data Science for Medical Care
Heinrich Heine University Düsseldorf	Düsseldorf	www.medizin.hhu.de	Hepatology; Cardiovascular Diseases; Neuro and Behavioral Sciences; Infection Biology; Diabetology and Metabolic Research
Ruhr-University Bochum (RUB)	Bochum	www.medizin.ruhr-uni-bochum.de	Neuroscience; Protein Science; Oncology
RWTH Aachen University	Aachen	www.medizin.rwth-aachen.de	Organ Crosstalk; Phase Transition in Disease; Translational Neurosciences; Medical Technology and Digital Life Sciences
University of Bonn	Bonn	www.medfak.uni-bonn.de/de/forschung/forschungschwerpunkte	Immunosciences and Infection; Neurosciences; Cardiovascular Sciences; Oncology; Genetics and Epidemiology
University of Cologne	Cologne	www.medfak.uni-koeln.de	Tumor Biology, Infection and Immunity; Homeostatic Principles in Metabolism and Tissue Regeneration; Neuromodulation
University of Duisburg-Essen	Duisburg-Essen	www.uni-due.de/med/forschung/schwerpunkte/forschung.php	Cardiovascular Diseases; Oncology; Transplantation; Immunology and Infectiology; Translational Neuroscience and Behavioral Science
University of Münster	Münster	www.medizin.uni-muenster.de/en/faculty-of-medicine/research/research-emphases.html	Inflammation and Infection; Vascular System; Neural Systems; Cell differentiation, Regeneration and Neoplasia
Witten/Herdecke University (Private)	Witten/Herdecke	www.uni-wh.de/gesundheit/forschung-an-der-fakultaet-fuer-gesundheit/	Integrative and Personalized Health Care

Key Areas of Research*

- Neurosciences
- Cardiovascular Sciences
- Oncology Sciences
- Infection- & Immunosciences
- Others

* are based on information provided by the homepages of the medical faculties and partly by desk research of BIO.NRW.

Keywords

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International relations

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Key topics
Bioeconomy
Biotech Databases

BIO.NRW The Home of Biotech in North Rhine-Westphalia

North Rhine-Westphalia (NRW) is situated at Europe's geographic and economic center. It is the largest of Germany's 16 federal states and a leading exporter.

NRW's state government has established a number of technology networks to systematically improve NRW's strengths and talents in established industries and growing fields like biotechnology. NRW's biotechnology network BIO.NRW is a central catalyst for the sustainable development of the state's biotech sector. It activates cooperation between business, research, investors and policy-makers. BIO.NRW also promotes the strengths and achievements of biotechnology in the state.

To support young as well as already established biotech companies, BIO.NRW offers the following core competencies:

- Individual matchmaking for collaborations and partners
- Overview on all up-to-date R&D activities in industry and academia
- Profound knowledge on financing possibilities
- International promotion and marketing for NRW as biotech location
- Direct contacts to decision makers

Our services include

Technology Transfer

Tech transfer support is a key contribution from BIO.NRW. We organize events, working platforms and meetings to promote the dialogue between all stakeholders in the field of biotechnology and to encourage cooperation.

Biotech Business & Sciences

BIO.NRW compiles comprehensive and current online databases of the academic institutions and companies active in the life sciences in NRW. Free to access and easy-to-use, these resources are valuable tools for identifying prospective business partners. More information on www.bio.nrw.de

Fairs, Exhibitions and Conferences

Companies and academic institutions can generate awareness of their activities locally, nationally and internationally by being a part of the BIO.NRW common stands on fairs, exhibitions and conferences.

Support of Young Professionals

BIO.NRW takes a special interest in supporting young professionals in biotechnology. We participate in conventions and exhibitions to bring graduates in contact with representatives from industry and academic science. The 'Business Angel Network – BIO.NRW' helps financing and funding biotech start-ups. In addition, a forum that brings together investment institutions, private investors and business angels and developers provides information about the current NRW biotech scene. These meetings are a valuable opportunity for start-up companies to receive coaching and financing.

To learn more about BIO.NRW and to stay informed about the latest biotech developments in NRW please visit www.bio.nrw.de.

Further drivers in the field are dynamic local biotechnology initiatives and networks:

Gesellschaft für Bioanalytik Münster e.V.
www.bioanalytik-muenster.de

BioCologne
www.biocologne.de

BioIndustry e.V.
www.bioindustry.de

BioRiver - Life Science im Rheinland e.V.
www.bioriver.de

MedLife e.V.
www.medlife-ev.de

Cluster Industrielle Biotechnologie e.V.
www.clib-cluster.de

LifeScienceNet Düsseldorf
www.lifescience-dus.de

www.bio.nrw.de
scientific database

BIO.NRW
The Home of Biotech

Life science and biotechnology research entities and institutes in North Rhine-Westphalia. BIO.NRW offers free of charge a well-organized and comprehensive database of research institutions with focus on life science and biotechnology resident in North Rhine-Westphalia. The database currently includes more than 200 institutes and research entities with profile description and contact details.

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