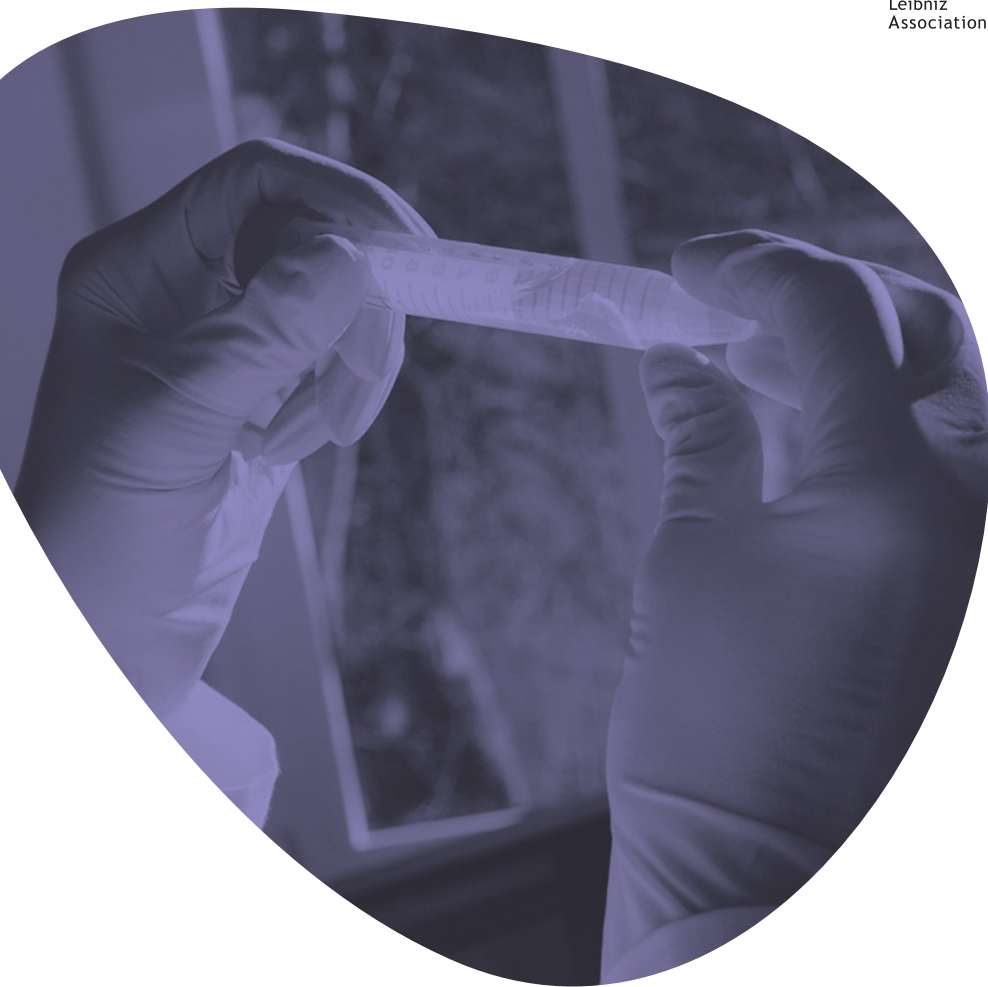




Biodiversity and Health

Section “Life Sciences”

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Introduction

How will we live in the future? What challenges and opportunities will our society face? Humanity is massively altering its environment – its own habitat, and that of millions and millions of other species. Ecosystems are being profoundly affected. Global change and an ageing and changing society require new solutions to altered living conditions: professional challenges, physical and mental fitness, health, nutrition and resilience. Globalisation is spreading organisms around the world at great speed – including pathogens.

The institutes within the section „Life Sciences“ conduct research into physical and mental health and behaviour of humans, environmental influences and the living conditions of plants and animals. They make a pioneering contribution to our understanding of current societal challenges, and highlight potential solutions to tackling negative developments.

The research topics pursued by the institutes of section “Life Sciences” focus on the following four key areas:

- **Biodiversity:** Which species exist or have existed on our planet? How did this biodiversity come about, and what are its characteristic processes? Why is diversity important, and how adaptable are the planet’s ecosystems? What are the risks of biodiversity loss? How can biodiversity be preserved and sustainably utilised? How can a growing global population be supplied with healthy and sustainably produced food?

- **Infection and inflammation:** How can pathogens – i.e. viruses, bacteria, fungi and parasites – be effectively controlled in humans, animals and plants? How do pathogens adapt through resistance and how can that be prevented? How do we deal with new pathogens, new pandemics? What causes the increase in chronic inflammatory diseases, and how can these be cured? How can people be treated better on an individual basis (personalized medicine)? And how can artificial intelligence help us find answers?

- **Lifestyle, the environment and healthy ageing:** What effects do nutrition, work conditions, stress and other environmental factors have on our health? How can we stay mentally and physically healthy and resilient our entire lives? What is the best way to prevent illness?

- **Bioactive compounds and biotechnology:** Which bioactive compounds can be found in nature, and how do we develop new ones? How can bioactive compounds and biomedical drugs be improved and bio-

technologically produced so they can be used for new therapies in medicine, food production or agriculture?

Alongside their research and high-security laboratories, the institutes operate important research infrastructures such as special clinics, technology and information platforms, collections, reference and study centers as well as field stations and laboratories in partner regions worldwide, including various African countries. By setting up research data infrastructures, the data obtained in this way becomes available and usable in the long term. Research museums make complex research topics accessible to the general public. The social involvement of the Leibniz institutes and their research topics is reflected in the diverse transfer activities such as infrastructure services, the translation of results from basic research into clinical application, cooperation with industry, public relations work, political and social consulting and active citizen participation (citizen science).



Section “Life Sciences” – Key Research Areas

Biodiversity

Research objectives

Studying biodiversity, its abiotic and biotic origins as well as its links and interactions with the social, economic and political sphere, requires an integrative approach. There are eight Leibniz institutes conducting research into the diversity of life at all levels: genes, species and ecosystems. They record and document, analyse and model biodiversity.

In doing so, they address the following questions:

- What are the key factors for the interrelations within and between ecosystems, what is the role of biodiversity and what are the consequences of anthropogenic changes and interventions? What interactions exist between biodiversity and climate change, health and food security for a growing global population?
- How can we record the diversity of species, as well as the genetic and (bio)chemical diversity of natural and selected populations? How do we pool, expand and utilise this knowledge in order to breed improved crop plants?

The institutes of section “Life Sciences” conduct research on, and document, biodiversity and processes of evolution, selection and extinction events of the past, present and future. Their work also encompasses



modelling future biodiversity scenarios, assessing biodiversity goods and ecosystem services, and developing methods for sustainably utilising and managing biodiversity.

The aim of the research is to be able to preserve, protect and sustainably utilise a functioning biosphere and the resources necessary to human existence.

Initiatives for the future

In the Leibniz Research Network *Biodiversity*, the Leibniz Association pools expertise in the field of biodiversity research in a unique way. State-of-the-art technologies (metabarcoding, environmental DNA, artificial intelligence) are used in basic and applied research and internationally leading collections are maintained. Leibniz Biodiversity is equally committed to scientific excellence and the transfer of biodiversity information for politics and society. It offers spaces for reflection, analysis and advice in the areas of „recognizing, preserving, using and predicting diversity“ in order to raise public awareness of the ongoing loss of biodiversity and to strengthen the appreciation of biodiversity in society. With the „10 Must Knows from Biodiversity Science“, the research network has been actively contributing to the scientific, public and political discourse in ten key areas of the Earth-Human system since 2022.

The institutes of the section “Life Sciences” contribute their expertise to national and international committees and programs, in particular to the United Nations Convention on Biological Diversity (CBD), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Nagoya Protocol on Access and Benefit-sharing (ABS). In the Leibniz Lab Systemic Sustainability, the institutes can contribute to transformative change through a more systematic and action-oriented approach and an in-depth dialog with society. Another important goal is to strengthen biodiversity research infrastructures, in particular the digitization and integration of collections and improved biodiversity monitoring using the latest molecular and data science methods. Finally, biodiversity research cooperates closely with research into new and emerging infectious diseases as part of the holistic One Health concept and is playing a key role in the establishment of the Leibniz Lab *Pandemic Preparedness*.

Infection and Inflammation

Research objectives

The key challenges in health research include acute, chronic, persistent and latent infections, as well as chronic inflammatory diseases resulting from infections or occurring independently due to dysregulated immune reactions in the course of the ageing process. The Leibniz Association brings together excellent research institutes working in this area, 17 of which are part of section “Life Sciences”. Their aim is to conduct comparative research into infections caused by various pathogens, as well as chronic inflammatory diseases affecting various organs, and to thereby gain a fundamental understanding of these illnesses. Drawing on their findings, the institutes can develop new ways of preventing infections, for example prevention strategies and vaccinations, as well as new, efficient treatment methods for infectious diseases and chronic inflammatory diseases, for example immunotherapies.

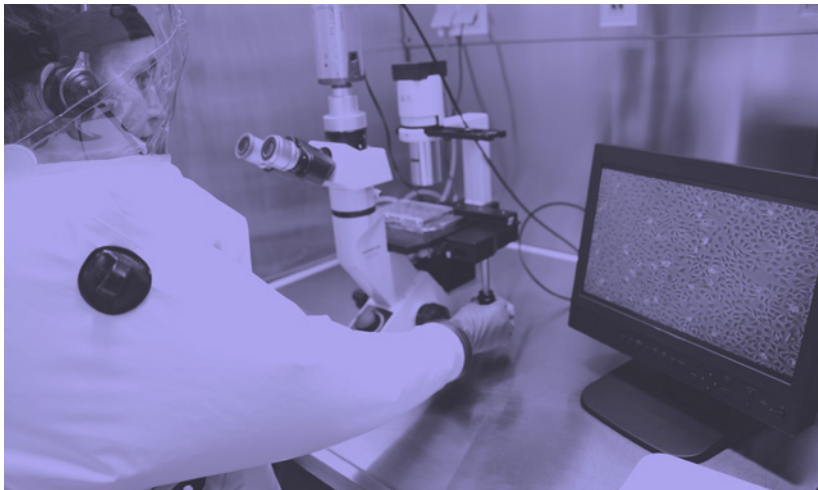
The following questions are at the heart of the research:

- Which molecular and structural characteristics of pathogens and their vectors are important for infection processes? What are the interactions between pathogen, host and vector and which reactions of our immune system play a role? How can these findings, also in combination with social science findings, be used to develop targeted preventive and therapeutic measures, such as modern pathogen surveillance, new hygiene concepts and innovative vaccination procedures, improved antibiotics and advanced immunotherapies for the personalised treatment of infectious diseases and their long-term consequences?
- How do the various components of the *One Health* concept – humans, animals, plants, the environment, food and agriculture – interact in relation to infectious agent? How can transmission routes be sustainably blocked?
- How can epidemics be recognized and stopped at an early stage? What are the best methods of preparing for (Preparedness), preventing (Prevention) and responding to (Response) pathogen outbreaks?
- Why do allergies and chronic inflammation arise in some people following an infection? How can these diseases be prevented, treated or even cured in the long term?

Comparative studies are important to understanding infectious and inflammatory diseases. The expertise of the participating Leibniz ins-

titutes makes precisely these comparisons possible. Section “Life Sciences” encompasses institutes that study and globally record viral, bacterial parasitic and fungal diseases in humans and animals, and collect and characterise their pathogens. The section brings this expertise together with that of institutes researching immune reactions, immunity and inflammation in humans but also in animals and plants. Interdisciplinary approaches to analysing and preventing infections are brought together in particular in the Leibniz Research Alliance *INFECTIONS in an Urbanizing World – Humans, Animals, Environments*. This involves analysing how drug-resistant pathogens in particular spread and how this can be better controlled. The focus is on the environment, agriculture and health systems, including socio-anthropological, psychological and economic aspects, as well as the optimisation of communication in society.

The close links between Leibniz institutes and university medicine in Germany and worldwide are also crucial in this respect. They enable research to be aligned with clinical realities and the therapeutic concepts of Leibniz researchers to be rapidly implemented in clinical practice. Leibniz institutes study allergies, diabetes, neurodegenerative diseases, rheumatism, chronic lung and bowel inflammation, as well as infectious diseases such as influenza, malaria, Ebola and tuberculosis. In this area, the Leibniz Association pools an impressive wealth of expertise which makes it possible to discover commonalities and distinctive characteristics within the diversity of diseases, and to use these insights to develop entirely new therapeutic approaches.



Initiatives for the future

The institutes further expand their dialogue with academic medicine and their collaborations with clinics, so that new treatment concepts can be rapidly transferred into clinical practice. These collaborations are also to be intensified because the Leibniz institutes' technical expertise can further push the direct study of diseased tissue. Furthermore, section "Life Sciences" wants to set new trends in the combination of evidence-based medicine and personalised patient care. Artificial intelligence and machine learning methods are to be developed and used to improve diagnostics, epidemiology, outbreak detection and patient care under different conditions. Important initiatives include the Leibniz Research Alliance *INFECTIONS in an Urbanizing Wold – Humans, Animals, Environments*, the participation of Leibniz institutes in the German Centers for Health Research and in the Excellence Initiative, as well as the successfully established Leibniz ScienceCampi. In the Leibniz Lab *Pandemic Preparedness*, scientists from all sections work together to prepare for future pandemics using an interdisciplinary and transdisciplinary approach.



Lifestyle, the Environment and Healthy Ageing

Research objectives

Rapid progress and fundamental changes to the world of work, demographic change, an increase in age-related diseases together with their co-morbidities and multi-morbidities, as well as the concomitant costs to society and healthcare systems, represent major challenges of our era. 15 institutes of section “Life Sciences” contribute to tackling these challenges with their research into human and animal health. Their key research focus is the preservation and restoration of mental and physical fitness as well as resilience and increasing the healthy human life-span through the sustainable prevention of illness.

This research centres on three questions:

- How do environmental influences, nutrition, working conditions, pollution exposure and biological factors influence physical and cognitive performance, mental health and resilience?
- How do pathologies such as obesity, diabetes mellitus, depression, dementia and rheumatism develop? What interrelations exist, and how can methods of diagnosis, treatment and, above all, prevention be improved?
- What are the necessary framework conditions for healthy ageing? How can life-long learning help in mentally and physically healthy ageing and prevent age-related memory loss?

In order to answer these questions, the institutes study large population-based cohorts. They also use model organisms, cell cultures and other in vitro systems. With cutting-edge molecular-genetic and spectroscopic procedures, together with high-resolution imaging techniques at the micro and macro scale, they are able to identify relevant biological factors, depict changes in tissue, and describe these processes in terms of systems biology.

In the key research area of lifestyle, the environment and healthy ageing, the Leibniz Association offers a pool of expertise that is unique throughout Germany. Its strength lies in the diversity of approaches and in the close collaboration between the institutes within the section and within Leibniz Research Alliances and Leibniz Research Networks across the different sections. Transdisciplinary approaches to understanding and promoting resilient ageing are bundled in the Leibniz Research Alliance Resilient Aging. In the Leibniz Research Network Green Nutrition – Healthy Society,

aspects of sustainable nutrition are developed in the context of health behavior, social impacts and political instruments. In the networks and in large project consortia, health researchers work together with colleagues from the human, environmental, technical and economic sciences as well as with industry. The great potential of health research within the Leibniz Association is, for example, revealed in the German National Cohort (“NAKO Gesundheitsstudie”), involving four Leibniz institutes acting as recruitment centres, and in the involvement of 13 Leibniz institutes with the German Centers for Health Research.

Whether it is healthy nutrition, pollution exposure or an environmentally conscious and sustainable lifestyle: the topics within this key research area are the subject of public debate, and the demand for expert knowledge is great. The health research institutes of the Leibniz Association have recognised this demand, and participate in the public discourse in order to find solutions together with citizens and policy-makers. The decentralised organisation of the institutes within the Leibniz Association hereby provides the necessary flexibility to react rapidly, expertly and effectively to society’s requirements.



Initiatives for the future

The institutes are planning to extend their expertise, particularly in the field of the systems biology of ageing and in personalised prevention and resilience promotion, and work even more closely with the key research area bioactive compounds and biotechnology. Sustainable prevention and health promotion is only possible when those factors which cause diseases and those which are responsible for health and remaining healthy are known. This is why the institutes will, among other things, use funding from the internal Leibniz Competition in order to initiate new collaborations between health researchers and members of other-professional groups, such as analysts, biostatisticians and sociologists.



Bioactive Compounds and Biotechnology

Research objectives

Without suitable bioactive compounds, medical progress, safeguarding agricultural production and healthy nutrition become impossible. Bioactive compounds are molecules that effect defined changes in target organisms. As the active components in medicine, they help to cure or prevent diseases. In food, they influence enjoyment and health. In agriculture, they represent the foundation of our food production thanks to their use as crop protection or veterinary medication. No matter what form they take or whether they are natural or synthetic in origin: bioactive compounds are essential to our daily lives.

In this key research area, 18 Leibniz institutes dedicate themselves to the following research questions:

- How can the chemical, molecular-biological and biotechnological methods available today be used effectively in order to discover and manufacture new bioactive compounds?
- How can bioactive compounds be improved in order, for example, to switch off undesired side-effects? How can the drug delivery be improved?
- In the face of new challenges, how can we utilise existing bioactive compounds and discover new ones?



- What are the opportunities offered by biomedical drugs and novel therapies? How can findings from basic research be quickly translated into clinical application?

The development of innovative medications, for example as antibiotics, immuno-suppressants, cancer therapies or treatments for neurological and mental disorders, is of great social relevance. The current antibiotics crisis is ample evidence of this. The number of multi-resistant bacteria that can no longer be treated with approved bioactive compounds is growing. Developing new active compounds is also of great importance in the prevention, early diagnosis and treatment of cancer, autoimmune diseases, diabetes, neurodegenerative diseases such as Alzheimer's, mental disorders such as depression and for neglected and poverty-related diseases as well as emerging infectious pathogens. The Leibniz institutes of the section "Life Sciences" cover the entire translational chain for the development of innovative drugs and can therefore make a significant contribution to overcoming the innovation crisis in drug development. The Leibniz institutes work closely with partners at universities, university hospitals and industry.

In the area of *Food and Agriculture*, the institutes' researchers focus on bioactive compounds for crop protection, but also on natural bioactive compounds which we ingest with our food. The latter are also contained in lifestyle products, such as cosmetics and hygiene products. The bottleneck developments in biotechnology make it possible to use synthetic biology and molecular cultivation to create innovative production processes, for health- and flavour-enhancing components, for example. The Leibniz Association's institutes are world-leaders in this area. The Leibniz Research Network *Bioactive Compounds* works across different sections and encompasses 12 institutes within section "Life Sciences". As the search for new bioactive compounds is predominantly based on natural substances, research into bioactive compounds combines areas of biodiversity research with the area of *One Health* and the key research areas *Infection and Inflammation* and *Lifestyle, the Environment & Healthy Ageing*.

Initiatives for the future

The Leibniz Research Network *Bioactive Compounds* is pressing on with further pooling research into bioactive compounds, especially those based on natural substances, and their biotechnological production. There is an emphasis here on developing supporting infrastructures.

The Leibniz Research Network *Stem Cells and Organoids* focuses on the exchange of innovative methods based on stem cells and/or organoids, which are used in areas such as disease modeling, drug development and biotechnology. In addition, the participation of several Leibniz institutes in the German Centers for Health Research and in the Excellence Initiative as well as several successfully established Leibniz ScienceCampi contribute to the development of new bioactive compounds for the prevention and treatment of diseases.



Prospects for the Future

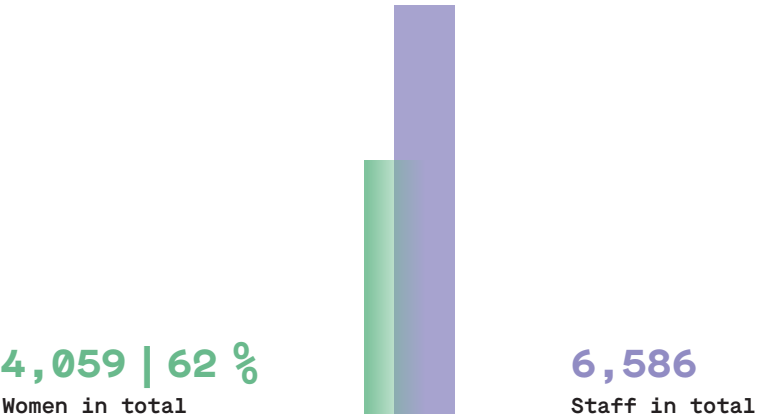
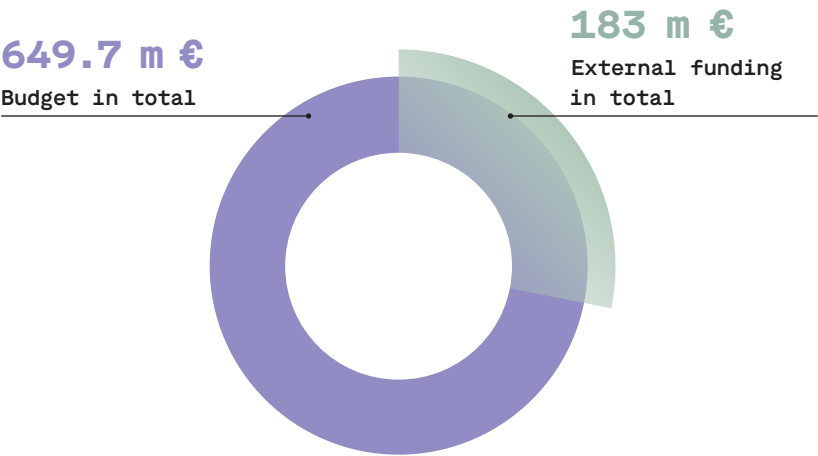
The institutes within section “Life Sciences” are helping to determine the direction in which the research encompassed by the *One Health* concept develops. This concept takes a holistic, interdisciplinary approach to examining the complex interrelations between humans, animals, plants, the environment and their health. The institutes have begun to analyse and model these interrelations in the context of global change and will gain even more insights in the future thanks to computer-based science. In order to better combat infectious diseases and chronic inflammatory diseases and prevent future pandemics, the institutes of the section “Life Science” will further develop and utilise individualised approaches within evidence-based medicine. It remains a major challenge to individually adapt prevention strategies and shape the work environment in line with research. Further specific therapeutic approaches and diagnostic tools are to be developed for targeted treatment, to which end new bioactive compounds need to be isolated, characterised and transferred into clinical practice.

To meet these challenges, the institutes have created suitable structures for creating synergies in the form of research infrastructures, Leibniz Research Alliances, Leibniz Research Networks, Leibniz Science Campi and Leibniz Labs. In future, these forms of collaboration will be further consolidated, bringing together researchers from different disciplines. The funding programmes of the Leibniz Competition offer an important instrument for developing the necessary interdisciplinary collaborations and actively participating in shaping a global research area. The Leibniz Association offers excellent conditions for attracting the best junior researchers to life science research.

Alongside the partnership networks between the Leibniz institutes, the section actively contributes to systematic profile building. The portfolio of section “Life Sciences” will thereby be further developed, and the international standing of the Leibniz Association enhanced through excellent research, infrastructure, services and transfer of knowledge.

Section “Life Sciences” in Figures

Last Update: December 2024



Section “Life Sciences” in Figures

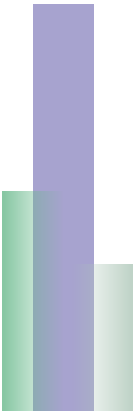
Last Update: December 2024

3,361

Researchers in total

1,826 | 54 %

Female researchers



1,205 | 36 %

International researchers

882

Doctoral researchers in total

518 | 59 %

Female doctoral researchers



565

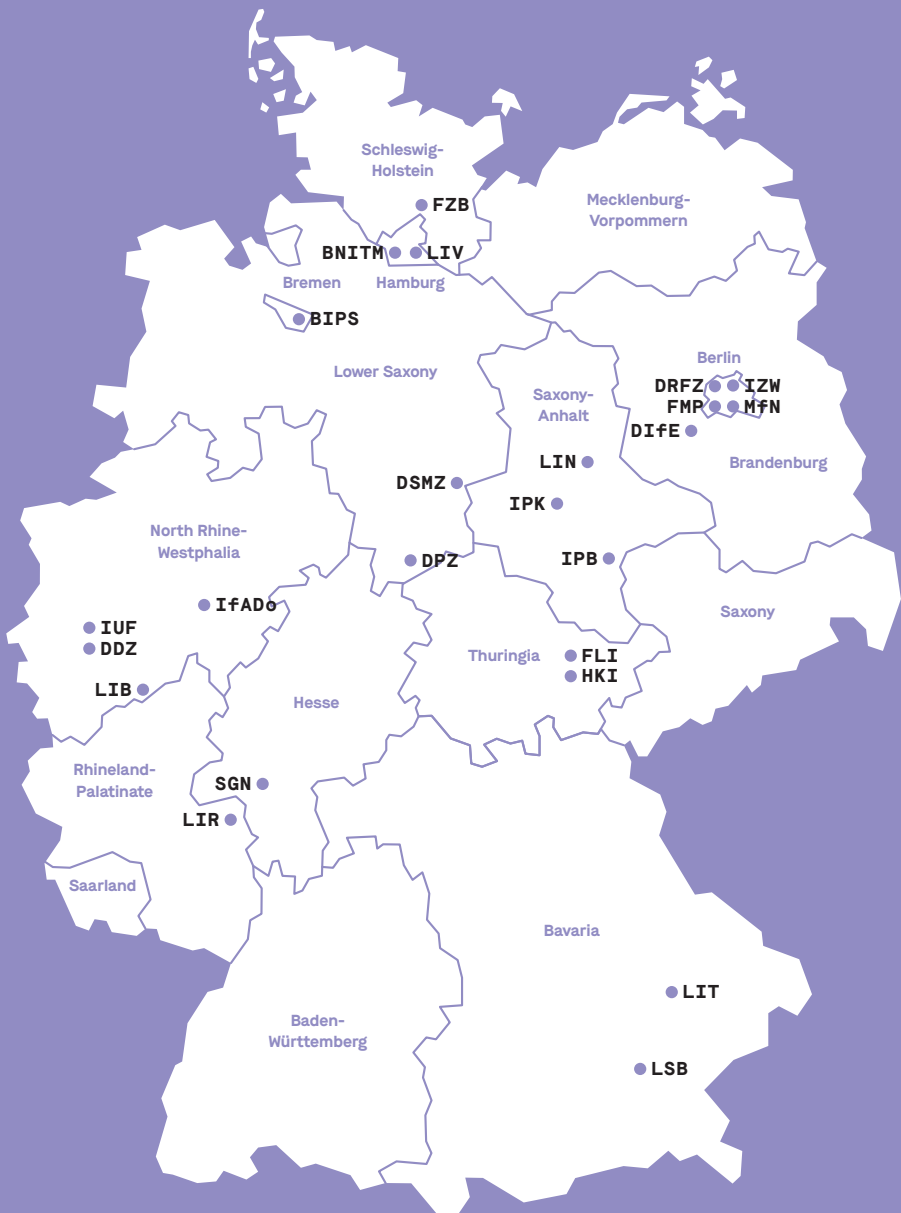
Researchers in executive positions in total

231 | 41 %

Female researchers in executive positions



24 Leibniz Institutes of the Section “Life Sciences”



BAVARIA

- **LIT** Leibniz Institute for Immunotherapy, Regensburg
- **LSB** Leibniz Institute for Food Systems Biology at the Technical University of Munich, Freising

BERLIN

- **DRFZ** German Rheumatism Research Centre Berlin
- **FMP** Leibniz-Forschungsinstitut für Molekulare Pharmakologie, Berlin
- **IZW** Leibniz Institute for Zoo and Wildlife Research, Berlin
- **MfN** Museum für Naturkunde - Leibniz Institute for Evolution and Biodiversity Science, Berlin

BRANDENBURG

- **DIfE** German Institute of Human Nutrition Potsdam-Rehbruecke

BREMEN

- **BIPS** Leibniz Institute for Prevention Research and Epidemiology, Bremen

HAMBURG

- **BNITM** Bernhard Nocht Institute for Tropical Medicine, Hamburg
- **LIV** Leibniz Institute of Virology, Hamburg

HESSE

- **SGN** Senckenberg Society for Nature Research – Leibniz Institution for Biodiversity and Earth System Research, Frankfurt am Main

LOWER SAXONY

- **DPZ** German Primate Center (DPZ) – Leibniz Institute for Primate Research, Göttingen
- **DSMZ** Leibniz-Institute DSMZ–German Collection of Microorganisms and Cell Cultures, Braunschweig

NORTH RHINE-WESTPHALIA

- **DDZ** German Diabetes Center – Leibniz Institute for Diabetes Research at Heinrich Heine University Düsseldorf
- **IfADo** Leibniz Research Centre for Working Environment and Human Factors, Dortmund
- **IUF** IUF – Leibniz Research Institute for Environmental Medicine, Düsseldorf
- **LIB** Leibniz Institute for the Analysis of Biodiversity Change, Museum Alexander Koenig Bonn and Museum der Natur Hamburg

RHINELAND-PALATINATE

- **LIR** Leibniz Institute for Resilience Research, Mainz

SAXONY-ANHALT

- **IPB** Leibniz Institute of Plant Biochemistry, Halle
- **IPK** Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben
- **LIN** Leibniz Institute for Neurobiology, Magdeburg

SCHLESWIG-HOLSTEIN

- **FZB** Research Center Borstel - Leibniz Lung Center

THURINGIA

- **FLI** Leibniz Institute on Aging - Fritz Lipmann Institute, Jena
- **HKI** Leibniz Institute for Natural Product Research and Infection Biology – Hans Knöll Institute, Jena

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