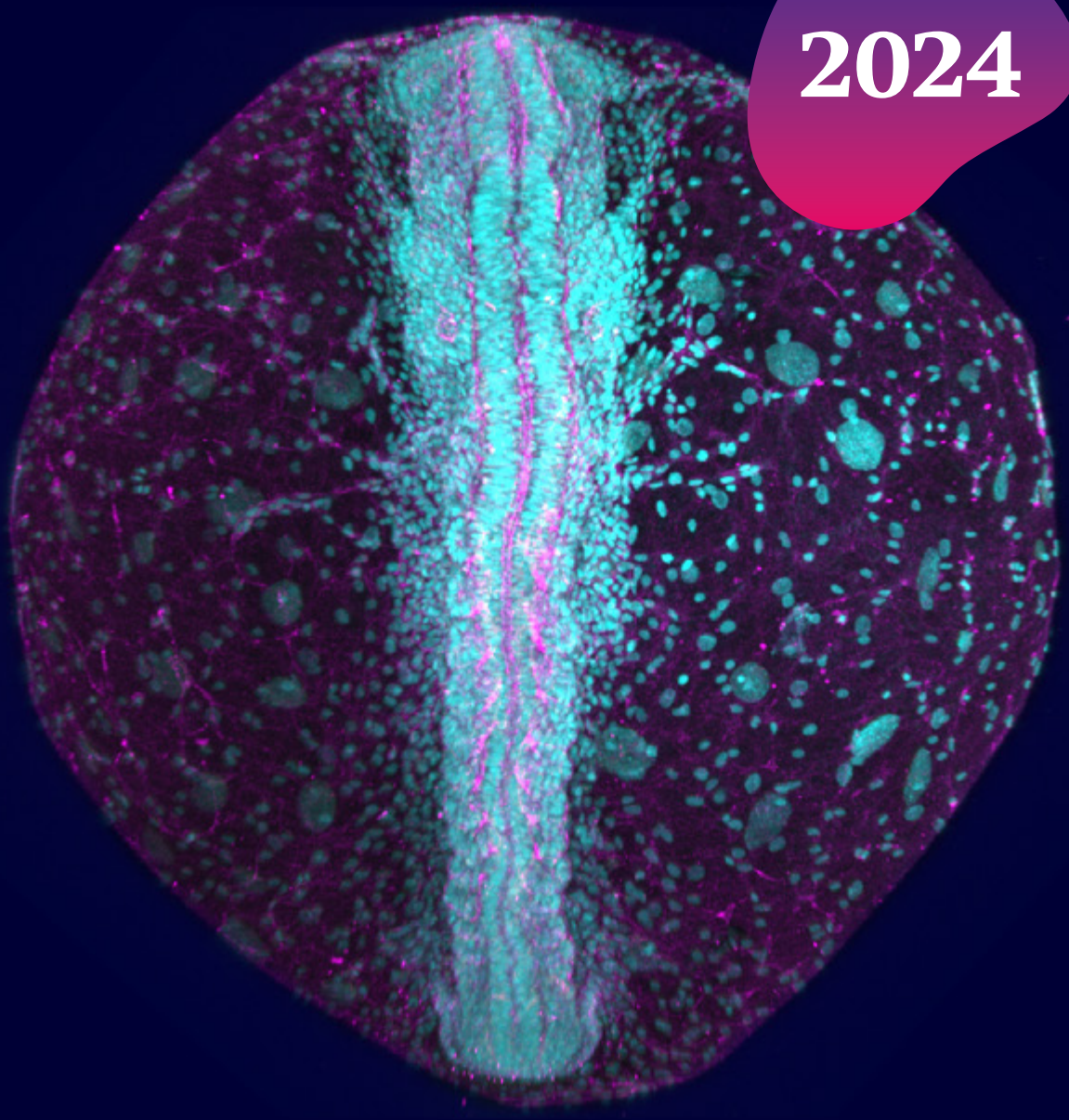
University of Basel

BIOZENTRUM
The Center for Molecular Life Sciences

2024



Biozentrum Highlights

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Prof. Alex Schier,
Director of the Biozentrum,
University of Basel.

Dear Readers,

Would you ask me to fix your car? I hope not – I lack the training and would likely make matters worse. Likewise, asking your car mechanic to analyze your mutants might not yield the best results. She might excel at her craft, but she doesn't have the specialized knowledge or skills for this task. While it seems obvious to seek help from experts, recent political trends suggest that expertise is no longer universally valued – and is sometimes even viewed with suspicion.

The roots of distrust in expertise are complex: expert findings often challenge entrenched beliefs or political agendas, such as in the case of climate change. Additionally, experts are frequently associated with institutions and elites that have failed to address critical issues, like income disparities. Historical abuses of "expertise", such as eugenics, and high-profile failures, including economic crises, have further eroded public confidence. In addition, "post-truth" ideologies, the rapid spread of misinformation via social media, and AI systems masquerading as experts have undermined the very foundation of expertise.

Yet, as you will read in the following pages, expertise is the lifeblood of the Biozentrum. Our collective knowledge and skills have led to groundbreaking discoveries and have helped train the next generation of life scientists. Crucially, our success relies not only on scientific expertise but also on the many experts who support the Biozentrum – from administration and building maintenance to core facilities and the cafeteria. Without this network of expertise, there would not be a Biozentrum.

How, then, can we navigate the tension between the importance of expertise and the distrust it faces? To regain and maintain public trust, we must communicate not only what we know but also what we do not know. There is a difference in being 99.9% certain that a fact is well established as compared to mostly speculative. We need to engage with the public to foster critical thinking, improve scientific literacy, and demonstrate accountability. These themes of outreach, transparency and inclusion are also highlighted in the pages ahead, from public lectures to meetings with policymakers.

Scientific expertise is needed now more than ever. We Biozentrics are uniquely positioned to create and transmit knowledge and serve as honest brokers that offer evidence-based policy options. Let us continue to hone our skills, take pride in our expertise, share it with the world, and inspire others to become experts like us.

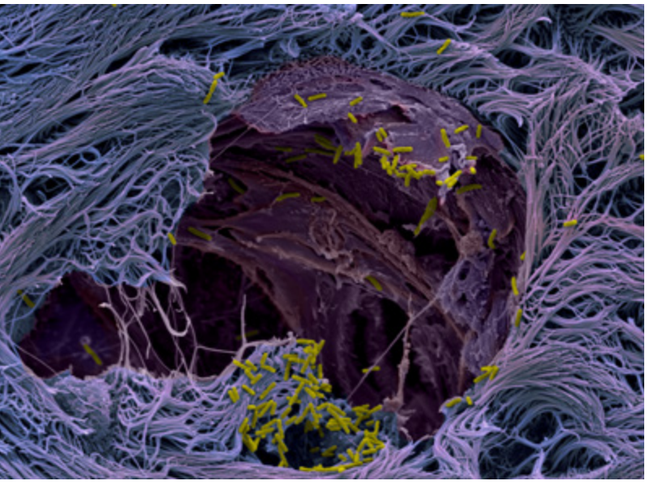
Prof. Dr. Alex Schier
Director of the Biozentrum, University of Basel

2024 at a glance.

How pathogens infect human lung tissue

Researchers led by Prof. Urs Jenal uncovered the strategy used by *Pseudomonas aeruginosa*, a dangerous nosocomial pathogen, to invade human lungs. Using lab-grown lung organoids, they have found that the bacterium uses mucus-producing goblet cells as "Trojan horses" to breach and cross the lung barrier. With an arsenal of virulence factors, the pathogen specifically invades and kills the goblet cells enabling them to spread into deeper tissue regions. This study provides insights into how this pathogen behave in human tissue. Furthermore, such organ models will be indispensable for developing new and effective strategies to combat pathogens.

Swart et al., Nature Microbiology



New SNSF Ambizione Fellows

The Swiss National Science Foundation (SNSF) has awarded two young scientists from the Biozentrum a prestigious Ambizione Grant. In her project, Dr. Janani Durairaj will explore variations in viral proteomes and the evolution of viruses. Dr. Fengjie Wu aims to gain new insights into the dynamics of an important family of cell receptors, known as G protein-coupled receptors (GPCRs). The Ambizione Fellowships give young scientists the opportunity to carry out their own research project.

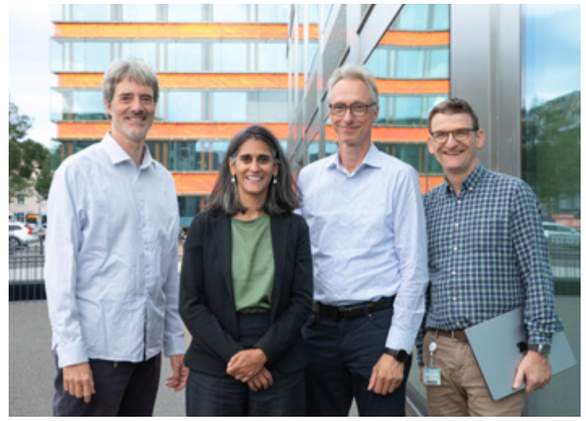
Boost for Biozentrum spin-offs

Two Biozentrum spin-offs achieved significant milestones. Translation-X, founded by Dr. Özgür Genç and Prof. Peter Scheiffele, received an investment of 150,000 Swiss francs from Venture Kick to advance its precision medicine approach to treat autism spectrum disorders (ASD). The startup develops small molecules targeting dysregulated protein synthesis to restore neural function and thus mitigating the core ASD symptoms. The startup NXI Therapeutics, founded by Dr. Rajesh Jayachandran, raised 3.5 million Swiss francs in pre-seed funding to develop selective immunosuppressive therapies. The company is working on safer immunotherapies for autoimmune diseases, aiming to improve quality of life without compromising immune function.

The Biozentrum PhD Fellowships, launched in 2007, is a prestigious program aimed at attracting exceptional young scientists to pursue their PhD at the Biozentrum. 103 PhD fellows from 30 countries – 54 of them women – have successfully graduated from this program, emphasizing scientific excellence and diversity. Currently, the Biozentrum is home to 43 fellows. Each year, up to ten fellowships are awarded through a highly competitive selection process. This year, about 1,500 applications were received across two calls. A unique feature of the program is its rotation system, enabling fellows to explore different research groups before committing to a lab.

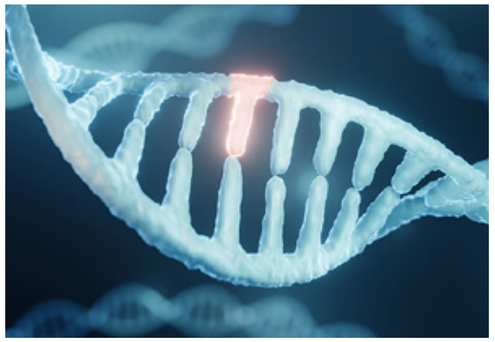
Second round for NCCR “AntiResist”

The Research Council of the Swiss National Science Foundation (SNSF) approved the continuation of the National Center of Competence in Research "AntiResist", and increased its contributions by 20 percent. For the second phase, which runs from 2024 to 2028, the NCCR received 20.4 million Swiss francs. As part of its commitment to cutting-edge research, the University of Basel decided to increase its financial support to 4.8 million Swiss francs. The NCCR "AntiResist" focuses on discovering new antibiotics and developing alternative strategies to combat antibiotic-resistant pathogens. Furthermore, the NCCR "AntiResist" won a Lighthouse Award for INCATE, an entrepreneurial incubator combating antibiotic resistance. This first edition of the SNSF Lighthouse Awards recognized five NCCRs for their innovation and societal impact.



National Future Day

On this year’s National Future Day, the Biozentrum was filled again with excitement. Many children stepped into the role of a researcher for a day, engaging in hands-on science, microscopy, and 3D printing. They explored the microscopic world – from blood cells to adorable tardigrades – and conducted some magical experiments.



New CRISPR method enables efficient DNA modification

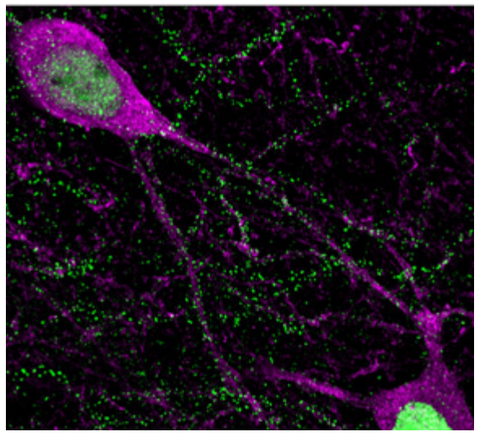
The research group led by Prof. Markus Affolter developed a new method that further improves the existing CRISPR/Cas technologies: it allows a more precise and seamless introduction of tags into proteins at the gene level. This technology could significantly improve research on proteins in living organisms and opens up new possibilities for medical research.

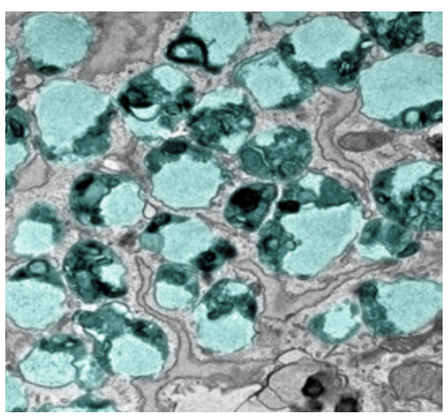
Aguilar et al., Developmental Cell

Perfect balance: How the brain fine-tunes its sensitivity

A sensitive perception of the environment is crucial for guiding our behavior. However, an overly sensitive response of the brain's neural circuits to stimuli can lead to neurodevelopmental disorders such as epilepsy. Prof. Peter Scheiffele's lab revealed in mice how the brain fine-tunes its sensitivity to respond adequately to sensory stimuli. In their study, the researchers discovered that the BMP2 signaling pathway, previously known for its role in early brain development, is re-purposed to stabilize neuronal circuits in the adult brain. The findings shed light on the mechanisms that regulate neuronal network sensitivity.

Okur et al., Nature





New target to treat severe autoimmune disease

LRBA deficiency is a rare and severe autoimmune disorder caused by a genetic defect. Prof. Anne Spang's team made a significant breakthrough in understanding the cellular processes underlying this disease. The researchers uncovered that two distinct cellular recycling steps are disrupted in patients with LRBA deficiency. The findings provide novel insights into the cellular mechanisms of LRBA deficiency and open up new avenues for potential therapies.

Szentgyörgyi et al., Journal of Cell Biology

High distinctions for Michael N. Hall

Prof. Michael N. Hall was honored with two prestigious distinctions: the 2024 Balzan Prize for Biological Mechanisms of Ageing and the Grande Médaille of the French Academy of Sciences. The Balzan Prize recognizes Hall's groundbreaking discovery of the protein TOR (Target of Rapamycin), a key regulator of cell growth and metabolism. His pioneering research has significantly advanced our understanding of cell growth, ageing, and the development of age-related diseases such as cancer, diabetes, and cardiovascular diseases. The prize, endowed with 750,000 Swiss francs, supports ongoing research, with half designated to fund projects involving a new generation of young researchers. The award ceremony took place on November 21, 2024, at the Palazzo del Quirinale in Rome, in the presence of Italian President Sergio Mattarella. The Grande Médaille, awarded by the French Academy of Sciences, honors Hall's groundbreaking contributions to molecular biology. Established in 1997, this distinction is awarded annually to a researcher who has contributed decisively to the development of science.

Biozentrum Research Summer

The Biozentrum Research Summer program offers Bachelor students a unique opportunity to immerse themselves in cutting-edge research for seven to nine weeks. Open to students from the life sciences and related fields, the program combines hands-on lab experience with engaging scientific and social activities. This year, 14 participants from around the world explored diverse research topics and experienced first-hand what it means to be a researcher.

How tiny diatoms efficiently capture CO_2

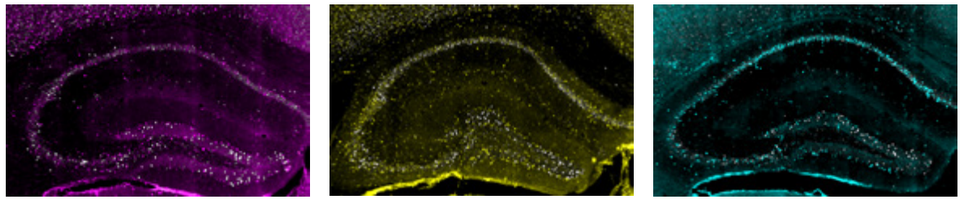
Tiny diatoms in the ocean are masters at capturing carbon dioxide (CO_2) from the environment, fixing up to 20 percent of the Earth's CO_2. Prof. Ben Engel's team discovered a protein shell in these algae, essential for efficient CO_2 fixation. Using cryo-electron tomography, the researchers revealed the molecular architecture of the so-called PyShell and elucidated its function. Removing the PyShell impairs CO_2 fixation and diatom growth. This study underscores the PyShell's critical role in efficient carbon capture – a process crucial for ocean ecosystems and the global climate. This discovery can provide ideas for bioengineering approaches to reduce CO_2 in the atmosphere.

Shimakawa et al., Cell

Torsten Schwede among the world's most cited

Prof. Torsten Schwede is among the most frequently cited scientists worldwide. To identify Highly Cited Researchers, the US company Clarivate conducts an annual evaluation of its Web of Science database, which records scientific publications across various fields. For the current list, publications from 2013 to 2023 were assessed, resulting in the recognition of 6,636 researchers from 59 countries.

On May 27, 2024, the Biozentrum hosted the event "AGE-LESS: Why We Die" as part of the End of Aging exhibition at the Kulturstiftung Basel H. Geiger (KBH.G). Nobel laureate Prof. Venki Ramakrishnan presented excerpts from his new book "Why We Die: The New Science of Aging and the Quest for Immortality". Subsequently, he engaged in a conversation with Prof. Michael Hall, exploring current stances on longevity research. The event was moderated by Michael Schindhelm, curator of the exhibition, and introduced by Prof. Alex Schier.



The brain creates three copies for a single memory

The ability to turn experiences into memories allows us to learn from the past and use what we learned as a model to respond appropriately to new situations. Researchers led by Prof. Flavio Donato revealed that the memory for a specific experience is stored in multiple parallel "copies", which are preserved for varying durations, modified to certain degrees, and sometimes deleted over time. These copies are stored by three different groups of neurons in the brain, which emerge at different stages during embryonic development. This study demonstrates that the activation of specific memory copies and their timing could have significant consequences for how we remember, change, and use our memories.

Kveim et al., Science

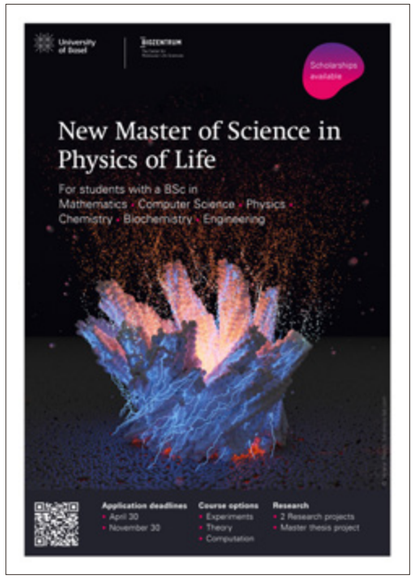
Biozentrum Retreat

In August, the Biozentrum scientists left their labs for a three-day retreat at the Campus Sursee. Around 250 researchers from a wide variety of disciplines took the time to get to know each other and make new connections, to discuss scientific issues and broaden their knowledge. The event offers young scientists in particular a platform to network and to present their research findings.

40 Years of the Homeobox

The “40 Years of the Homeobox @Biozentrum” symposium took place on October 1, 2024, celebrating four decades since the groundbreaking discovery of the homeobox, a specific DNA sequence found in genes that regulate the development of organisms. The conservation of the homeobox from invertebrates to vertebrates was identified by the labs of Prof. Walter Gehring and Prof. Eddy De Robertis at the Biozentrum in 1984.

New Master's degree program



Awards and honors for Biozentrum professors

Two Biozentrum professors were selected as fellows of the International Society for Computational Biology (ISCB). Prof. Torsten Schwede was honored for his contributions to computational biology through SWISS-MODEL, the first automated protein homology-modeling server, advancing our understanding of protein structure and fostering the use of computational models in research. Prof. Mihaela Zavolan was recognized for her pioneering work in computational research into microRNAs, revealing their broad expression and quantitatively predicting their interactions with target mRNAs. The ISCB Fellows program is a prestigious recognition within the field of computational biology. In addition, Prof. Peter Scheiffele was awarded the 2024 FENS-Kavli Network of Excellence Mentoring Prize for his leadership in fostering the careers of neuroscientists. Finally, Pathoplexus, a project involving Prof. Richard Neher's team, won the 2024 National Prize for Open Research Data, awarded by the Swiss Academies of Arts and Sciences. Pathoplexus ensures open access and provides state-of-the-art infrastructure for interactive and programmable data exploration.

Women in Science Day

On the occasion of the Women in Science Day, young Biozentrum researchers shared insights into their perspectives and highlighted the day's importance for promoting diversity and gender parity in science.

“I hope that soon it will not matter if you are a man or a woman in science. You are a person in science, a scientist, and this should be enough.”

Daria Smolyarova, PhD student

“The majority of my teachers, supervisors and role models are female. Imagine, a few decades ago without gender equality this would never have happened.”

Ahmed Mahmoud, PhD student

“We can only do great science with equality in opportunities and access to resources regardless of gender.”

Hugo Gillet, Master student

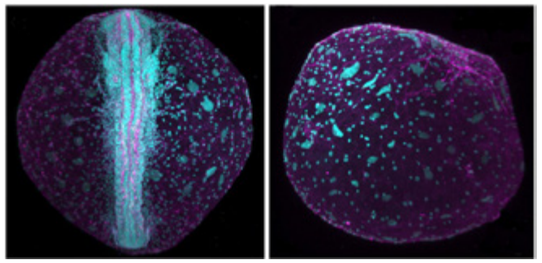
“In order to achieve gender parity, we need systemic changes and also challenge stereotypes.”

Cindy Reinger, PhD student

Neighboring synapses shape learning and memory

The ability of our brain to modify the connections between neurons is fundamental for learning and memory. Dr. Everton Agnes, an independent research group leader at the Biozentrum, has developed a new mathematical model that provides a holistic view on how our brain manages to learn rapidly and forms stable, long-lasting memories. This study sheds light on the dynamics and optimization of neural networks at the microscale, and highlights the crucial role of interactions among neighboring contact sites of nerve cells for brain plasticity – the brain's ability to adapt to new experiences.

Agnes et al., Nature Neuroscience



How killifish embryos adapted their development

The annual killifish lives in regions with extreme drought. The team led by Prof. Alex Schier discovered that the early embryogenesis of killifish diverges from that of other species. Normally, the dorsal-ventral body axis, i.e. the back and the belly of the fish embryo, is already determined by maternal factors. However, the researchers demonstrated that embryonic cells of killifish are not maternally pre-patterned, but self-organize to form the body axis. The absence of maternal pre-patterning in killifish embryos might offer a survival advantage during dry seasons.

Abitua et al., Science

Basel Summer Science Academy at the Biozentrum

In the 2024 summer course, 24 local high school students explored the fascinating world of phages. They collected water samples from the Rhine and Birs rivers and analyzed the isolated bacteriophages. Beyond their lab work, participants enjoyed a diverse program of social and cultural activities. Notably, a former Summer Science Academy student was recognized by "Schweizer Jugend forscht" for her "Maturaarbeit", in which she discovered new phages that may help fight antibiotic-resistant bacteria.

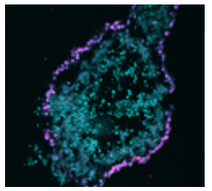
"Einblicke Biozentrum"

The lecture series "Einblicke Biozentrum" for the general public was a resounding success, attracting over 200 attendees to its monthly sessions. These events offer fascinating insights into the scientific endeavors at the Biozentrum and strengthen the dialogue between scientists and the public, making complex research topics accessible and sparking curiosity about our work and institute.

Ribosomal component helps cells find their identity

The "protein factories" of the cell, the ribosomes, consist of up to eighty components. Prof. Mihaela Zavolan and Prof. Anne Spang's teams discovered that a specific ribosomal component is crucial for embryonic stem cells to differentiate into diverse cell types. This component increases the accuracy with which ribosomes produce certain proteins. Its presence in various tumor cells suggests that it may also play a role in cancer development.

Banerjee et al., Nucleic Acids Research



The enemy within

Some pathogens hide inside human cells to enhance their survival. Researchers led by Prof. Marek Basler uncovered a unique tactic of the intracellular pathogen *Burkholderia thailandensis* to spread undetected in the body. The bacteria use a nano-sized speargun called the Type VI secretion system (T6SS)to infect new host cells without alarming the immune system. Equipped with the T6SS nanomachine, the pathogen can pursue a dual strategy: cell fusion and directly moving from one cell to another.

Plum et al., Cell Host & Microbe

New professors

The University Council appointed Yuping Li, David Brückner and Claudia Keller Valsecchi as new Assistant Professors at the Biozentrum. Yuping Li studies the interactions between bacteria and large viruses, known as jumbophages. She was recently awarded a highly coveted SNSF Starting Grant. David Brückner investigates the role of biophysical mechanisms in cell fate decisions and tissue patterning during embryonic development. Claudia Keller Valsecchi focuses on the evolution of sex chromosomes, sex differences, and the biology of gene dosage alterations. The molecular biologist was also selected to join the EMBO Young Investigator Program.

New insights into blood vessel formation

The formation of blood vessels is a complex process involving the interplay of proteins and mechanic forces. Prof. Markus Affolter's team uncovered new mechanisms in blood vessel formation. The researchers demonstrated how cells interact during vascular lumen formation and the critical role of dynamic forces in this process. These new insights into blood vessel formation may provide potential approaches in the treatment of vascular diseases.

Yin et al., Nature Communications

Dirk Bumann elected to Leopoldina

Prof. Dirk Bumann was elected a member of the prestigious German National Academy of Sciences Leopoldina. The infection biologist and Biozentrum research group leader is also one of the NCCR "AntiResist" directors. Membership in the Leopoldina is an award for outstanding scientific achievements. The election of new members is based on strict criteria of scientific excellence.

Biozentrum Discovery Seminar series

Launched in 2018, the Discovery Seminars feature talks from in-house PhD students and postdocs, as well as internationally renowned guest speakers. Held regularly throughout the year, the seminar series fosters scientific exchange, strengthens our community, and provides a valuable platform for networking and collaboration.

Bachelor Info Day 2024

Important guests @Biozentrum

Throughout the year, the Biozentrum welcomed delegations from politics, business, and culture, providing them with first-hand insights into scientific advancements. Among the distinguished visitors were representatives from the Swedish Foundation for Strategic Research, officials from the governments of Stuttgart (Germany) and Bellinzona (Switzerland), the Austrian Ambassador, and an economic delegation from the Czech Republic, accompanying President Petr Pavel during his state visit to Bern.

Biozentrum in brief.

People

529
Members of staff in total

32
Research groups and professors

›40
Nationalities

282
Junior researchers
103 Postdocs, 137 PhD students, 42 Master students

215
Staff
47 Scientific staff, 129 Lab staff, 39 Administration

Finances

74.9
Million Swiss francs total expenditure

67.7 %
University of Basel

18.7 %
Swiss National Science Foundation

2.1 %
Swiss Institute of Bioinformatics

11.5 %
Misc. third party grants

Awards, Grants & Fellowships for PhD students and Postdocs

Aude Andriollo, Swiss-wide 3MT Competition Audience Award
Alexey Baldin, SNSF Spark Grant
Kevin Baumann, Research Fund of the University of Basel for Excellent Junior Researchers and Propelling Grant of the University of Basel
Emily Bayer, Research Fund of the University of Basel for Excellent Junior Researchers
Lukas Beckert, Propelling Grant of the University of Basel
Don Gary Benjamin, Propelling Grant of the University of Basel
Mitchell Brüderlin, Propelling Grant of the University of Basel
Gabriela Casanova, EMBO Fellowship
Mireia Codina, Boehringer Ingelheim Fellowship
Kristin Dahl, Human Frontier Science Program Postdoctoral Fellowship
Laura de Smalen, Propelling Grant of the University of Basel
Janani Durairaj, SNSF Ambizione Fellowship
Carlos Flores, Novartis Foundation for Medical-Biological Research and SNSF Spark Grant
Özgür Genç, Venture Kick Funding for Translation-X
Caitlyn McCafferty, SNSF Postdoctoral Fellowship
Nemanja Milicevic, SNSF Postdoctoral Fellowship
Debdatto Mookherjee, Research Funding by the Swiss Life Foundation
Christoph Müller, Fellowship of the Peter und Traudl Engelhorn Foundation
Cornelius Roemer, National Prize for Open Research Data (ORD), Swiss Academies of Arts and Sciences
Zeynep Okur, Gottfried Schatz PhD Student Prize and Faculty Prize of the University of Basel
Hanae Omiya, Fellowship of the Astellas Foundation for Research on Metabolic Disorders and of The Uehara Memorial Foundation
Ivana Petrovic, J. C. W. Shepherd PhD Student Prize for Scientific Excellence
Madalena Pinto, Research Fund of the University of Basel for Excellent Junior Researchers and Winner of LS2 "PIs of Tomorrow" Competition
Marco Thürkauf, J. C. W. Shepherd PhD Student Prize for Scientific Excellence
Cristina Tocchini, Research Fund of the University of Basel for Excellent Junior Researchers and SNSF Spark Grant
Marc van Oostrum, Synapsis Foundation Career Development Award
Fengjie Wu, SNSF Ambizione Fellowship

Research groups 2024

Prof. Jan Pieter Abrahams
Prof. Markus Affolter
Prof. Silvia Arber
Prof. Marek Basler
Prof. Attila Becskei
Prof. Dirk Bumann
Prof. Christoph Dehio
Prof. Médéric Diard
Prof. Fiona Doetsch
Prof. Flavio Donato
Prof. Knut Drescher
Prof. Ben Engel
Prof. Stephan Grzesiek
Prof. Michael N. Hall
Prof. Christoph Handschin
Prof. Sebastian Hiller
Prof. Maria Hondele
Prof. Urs Jenal
Prof. Anissa Kempf
Prof. Yuping Li
Prof. Roderick Lim
Prof. Timm Maier
Prof. Susan Mango
Prof. Richard Neher
Prof. Jean Pieters
Prof. Markus Rüegg
Prof. Peter Scheiffele
Prof. Alex Schier
Prof. Torsten Schwede
Prof. Anne Spang
Prof. Erik van Nimwegen
Prof. Mihaela Zavolan