Fraunhofer Group for Life Sciences

Applied Science Dedicated to Life

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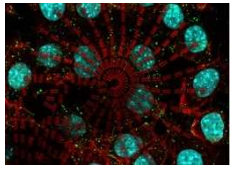
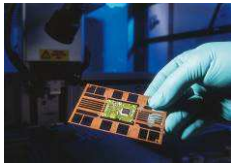
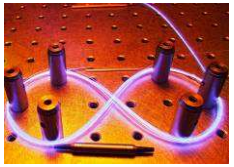
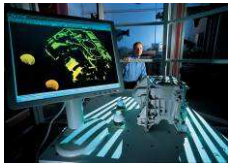
Profile of Fraunhofer-Gesellschaft

- 72 institutes
- 25 000 employees
- Budget of 2,3 billion euros

Seven Fraunhofer Groups

- Information and Communication Technology ICT
- Life Sciences
- Microelectronics
- Light & Surfaces
- Production
- Materials and Components – MATERIALS
- Defense and Security VVS

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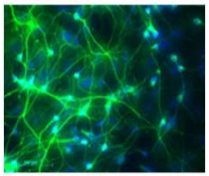
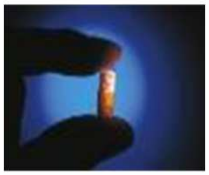
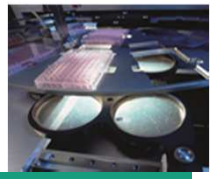
Fraunhofer Group for Life Sciences

Facts and figures

Established in the year 2000

6 Member institutes, 1 research institution

Chairman since April 1, 2017: Prof. Horst-Christian Langowski

Co-Chairman: Prof. Norbert Krug

Office: Hannover

Head of Central Office: Dr. Claus-Dieter Kroggel

Business units under development

Diagnostics and therapeutics – from target screening to clinical studies

Medical technology – with biology and engineering to the approved product

Food – healthy and safe on the plate

Bio-based economy – sustainable value-adding from resources

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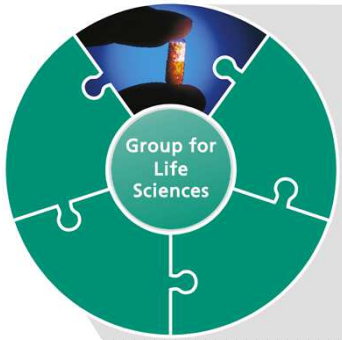
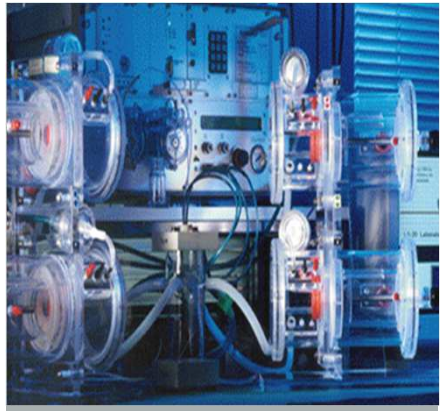
Medical Translational Research and Biomedical Technology: The Challenge of Innovative Diagnostics and Personalized Therapy

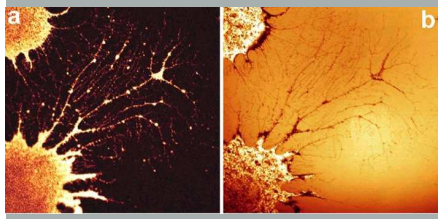


Our responses

- innovative biomarkers for prognosis and therapy control, e.g. RNA biomarker
- isolation and analysis of CTCs and DTCs for individualized tumor diagnostics
- insects and their microbiota as new source for therapeutics, e.g. highly effective antibiotic substances
- GMP platform with a wide range of expression systems, i.a. plant cell culture and plants (vertical farm)
- cell-free protein synthesis

Successful treatment through innovative diagnostics and optimally tailored, personalized therapy





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Translational Medicine: From Molecule to Patient

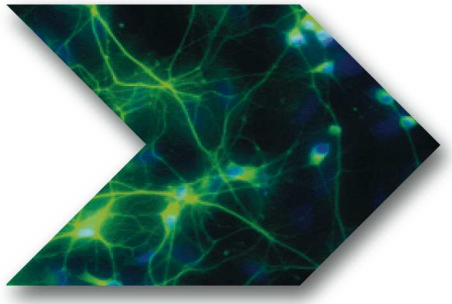
Bio-Hybrid and Cell-Based Tests – Early Go/No-Go Decisions

Target and drug discovery

- Databases: gene expression profiles
- High-throughput screening
- Array technologies
- Biochips: DNA chips, protein chips
- Cell-based assays and chips

Target validation

- Animal transgenic and in-vitro 3-D human disease models
- Large-animal models
- Behavioral animal models
- Cardiovascular and neuronal organotypic models and disease models



Lead optimization

- Structure optimization and humanization
- Aerosol generation
- High-content screening
- Human cell models
- Organotypic cell culture models

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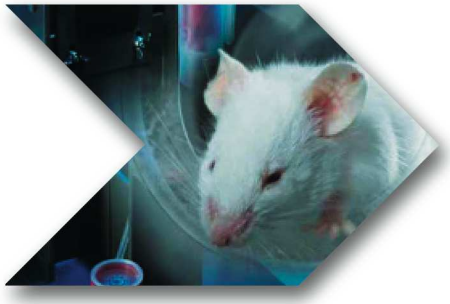
GXP Platform: GLP – GMP – GCP

APIs/Vaccines/Cell Therapeutics – System-independent Solutions – Clinical Studies Airways

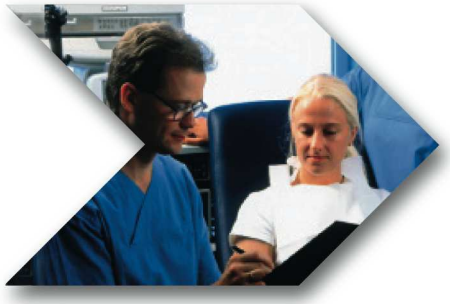


Safety pharmacology and toxicology

- GLP
- In-silico prediction ADME
- Molecular and functional imaging
- Nano- and microparticle systems
- Biomarkers of disease

Manufacture of clinical investigational products

- Consulting on regulatory and economic aspects
- Evaluation of customer processes
- GMP facilities
- Compound libraries and high-throughput systems
- Expression systems



Clinical trials of phases I and II

- GCP-compliant protocol development
- Toxicology and pharmacology
- Dose escalation studies in patients with malignant diseases
- Segmental lung challenge

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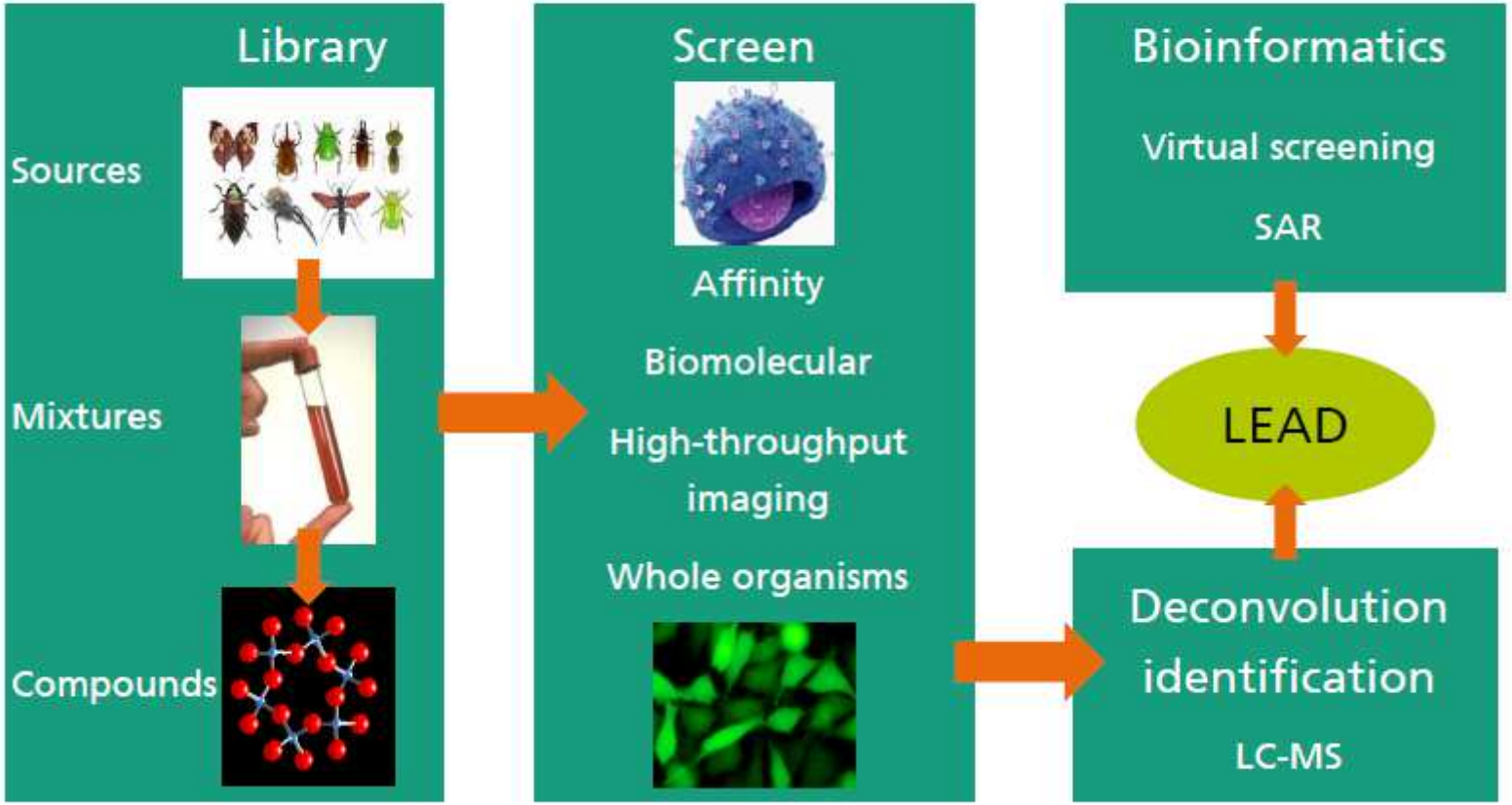
The Fraunhofer IME Knowledge-based Screening Portal



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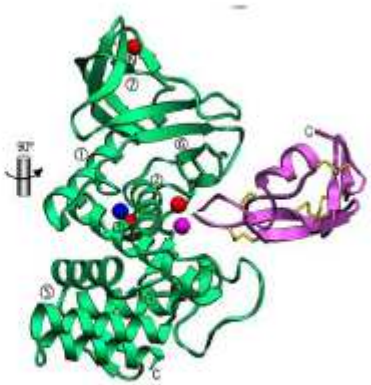
Insects as Resources for New Therapeutics

Wound-healing promoting molecules

Metallo-proteinase-inhibitor

Biofilm-degrading enzymes

Antimicrobial compounds



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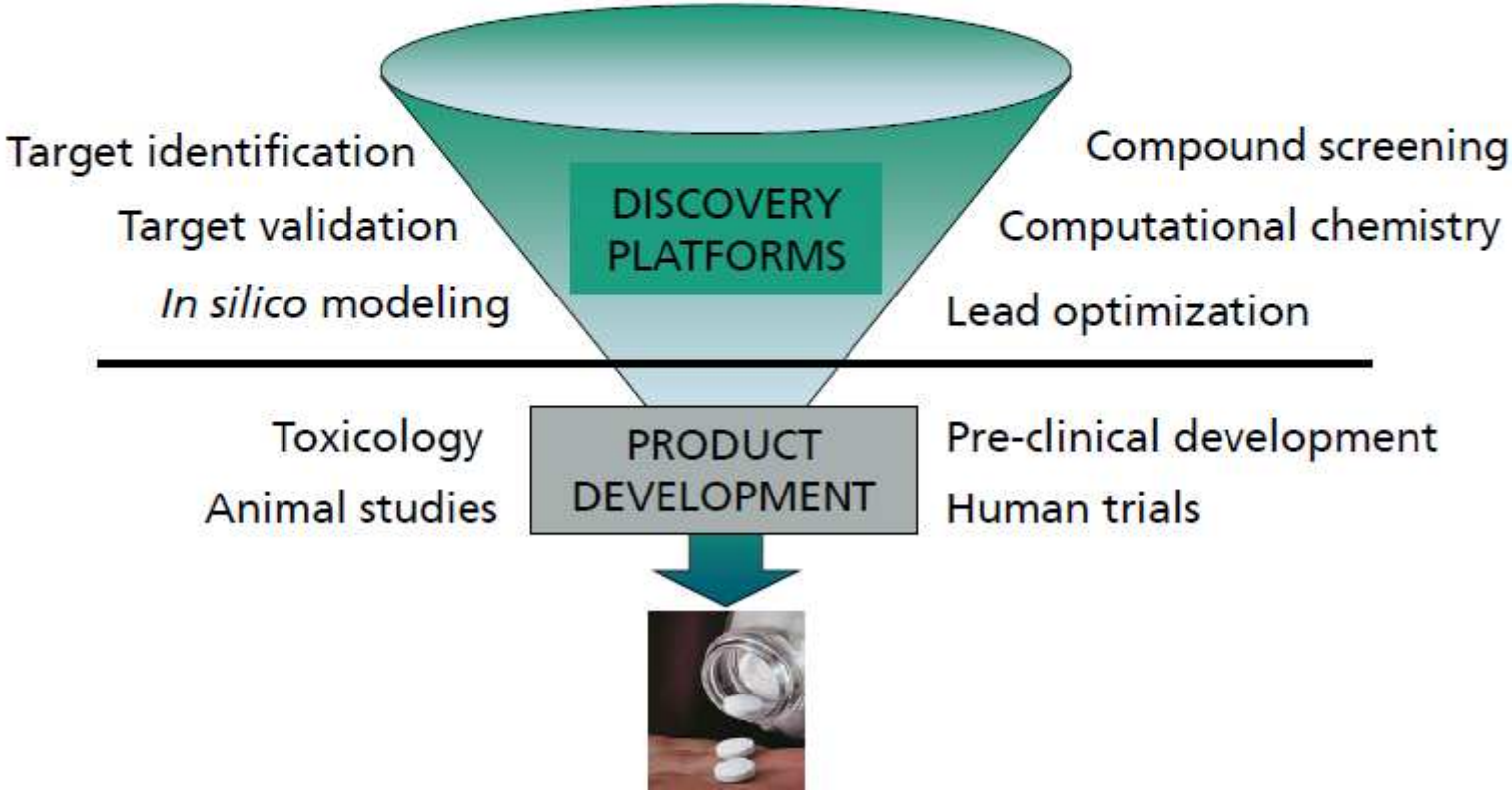
IME Insect Biotechnology Tool Box



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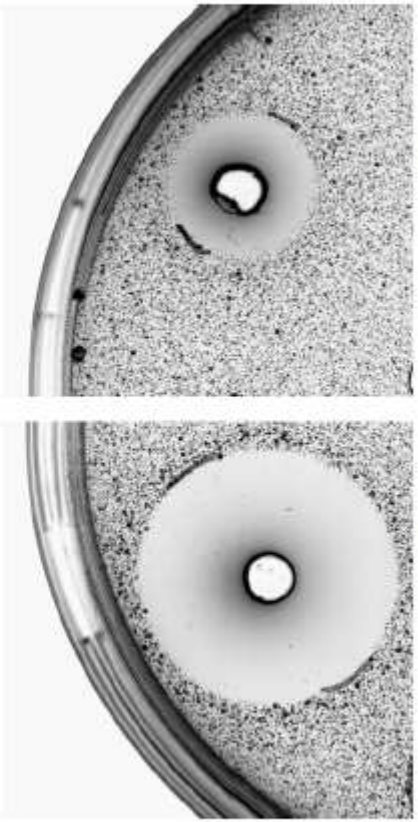
Biofilm* Degrading Enzymes



- Detection of high antimicrobial activity in hemolymph of untreated *Eristalis* larvae (= standing army costs)
- Antimicrobial activity increases remarkably upon injection of bacterial lipopolysaccharides (= war costs)

*IUPAC definition: Aggregate of microorganisms in which cells that are frequently embedded within a self-produced matrix of extracellular polymeric substance (EPS) adhere to each other and/or to a surface.

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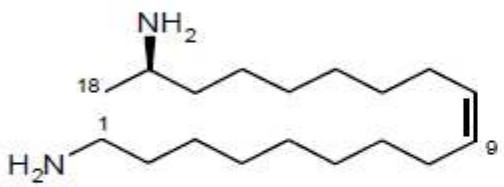
Drugs from Bugs

- Harlequin ladybird (Asian lady beetle) shows enduring resistance against diverse pathogens, which allows it to outperform and therefore dominate the most abundant native European ladybirds.
- Resistance due to chemical defense compounds in hemolymph
- ➢ Identification of **harmonine** with promising activity against *Mycobacterium tuberculosis* (tuberculosis) and *Plasmodium falciparum* (malaria)



Vilcinskas, A., Stoecker, K., Schmidtberg, H., Röhrich, C., Vogel, H. (2013). *Invasive harlequin ladybird carries biological weapons against native competitors.* SCIENCE.

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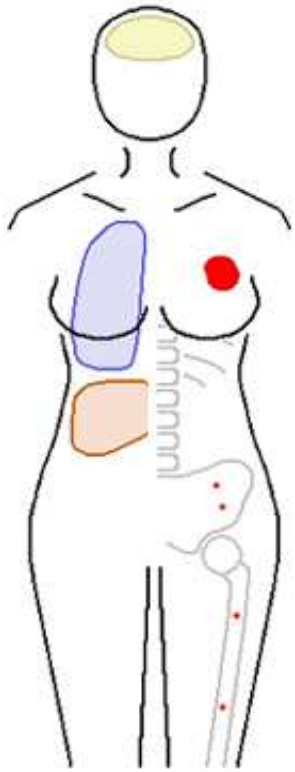
Personalized Approaches in Translational Medicine Isolation and Discovery of Circulating and Disseminating Tumor Cells



Circulating (CTC) and disseminating (DTC) tumor cells are isolated from:

- Bone marrow
- Blood
- Lymph nodes
- Cerebrospinal fluid

Detection of individual DTCs by e.g. cytokeratin staining

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Clinical Research Center Hannover (CRC Hannover)

State-of-the-Art Research Facility for Early-Phase and Proof-of-Concept Studies

- The CRC Hannover is a nationally unique medical research center.
- It is on its way to becoming the leading center for patient-oriented and translational medicine in Europe.
- CRC Hannover's sate-of-the-art infrastructure is jointly used by three leading research institutes: the Fraunhofer ITEM, the Hannover Medical School (MHH), and the Center for Infection Research (HZI).

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Clinical Research Center Hannover (CRC Hannover)
Numbers and Data

- 3 Partners: Fraunhofer ITEM, MHH, and HZI
- In the direct vicinity of Fraunhofer ITEM and MHH
- 6,000 square meter space
- 30 Intermediate care beds (for clinical trials phase I and IIa)
- 20 Beds for study participants with low monitoring needs
- 15 Rooms for specialized diagnostics
- Modern imaging methods (MRI)
- Biomarker laboratory
- Biobank

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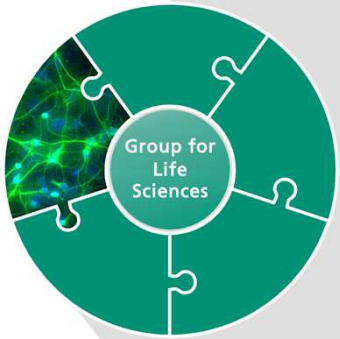
Regenerative Medicine: The Challenge of Qualified Biobanking and Controlled Self-Healing



Our responses

- Fraunhofer Bioarchive as an unrivaled source of live cell samples
- iPSCs
  innovative approaches to adult stem cell differentiation
  advanced technologies for genetic characterization and quality control procedures
- Development of patient-specific cell therapeutics
- small- and large-animal models as well as cell culture techniques, e.g. for stroke research
- 3D in vitro and ex vivo test systems for long-term and multiple exposition

Healthy aging

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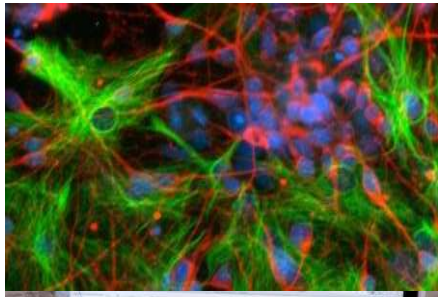
Cell-therapeutic Approaches – All Development Steps for Cell-therapeutic Agents from One Source

- Development and testing of cell-based therapeutic approaches
- Focus: Ischemic diseases (stroke, heart attack), neurodegenerative diseases (Alzheimer's), joint diseases, oncology
- Feasibility studies – study design and proof of concept in in-vitro and in-vivo (small-animal) models
- Pre-clinical development – safety, efficacy and, efficiency testing in different in-vivo models (small and large animals) with unrivaled predictivity for use in man
- GLP-compliant safety and efficacy testing
- Clinical trials – GMP-compliant manufacture of investigational medicinal products for clinical trials



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Healthy Foods: The Challenge of High Consumer Acceptance and Disease Prevention

Our responses

- innovative screening and rapid tests to analyze single components and substance patterns
- gentle disinfection and sterilization methods
- safe and high-grade foods as a result of intelligent packaging
- Aroma and texture research for maximum eating pleasure
- tasty recipes for calorie-reduced and functional foods
- new ingredients for bioactive foods
- In-vitro and in-vivo proof of efficacy of bioactive food components

Health through a specific diet

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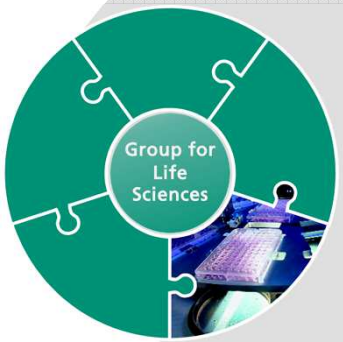
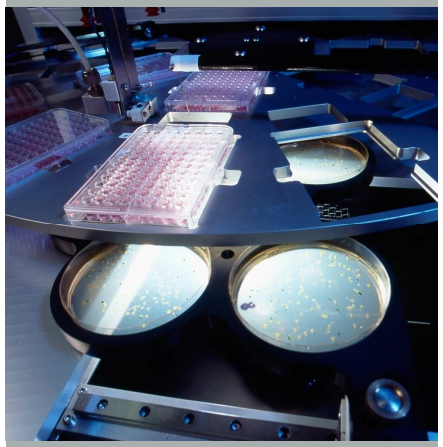
The New Potential of Biotechnology:
The Challenge to Learn from Nature for Industrial Exploitation



Our responses

- innovative methods to use renewable raw materials and also waste
- Supply of alternative, inexpensive fermentation raw materials, for example from lignocellulose
- Isolation of new and optimized biocatalyzers by metagenomics
- Exploitation of the wide range of insect enzymes for industrial use
- Transfer of process steps to plant production systems
  Fraunhofer Center for Chemical-Biotechnological Processes, Leuna

New raw materials for the future



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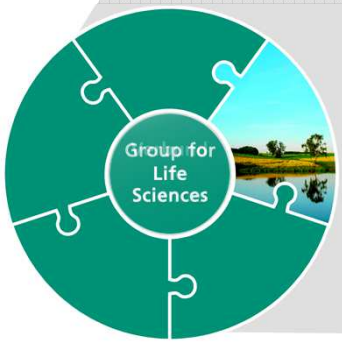
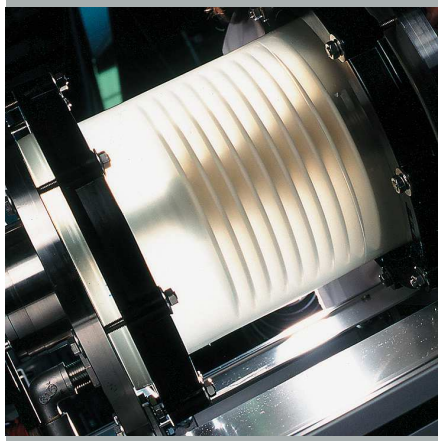
Process, Chemical, and Herbicide Safety:
The Challenge of Environmental and Consumer Protection



Our responses

- substance-specific strategies for chemical evaluation
- Inclusion of data pools and in-silico methods
- broad range of alternative in-vitro and in-vivo test methods
- comprehensive ecological evaluation of herbicides including complex environmental simulation
- semi-decentralized supply and disposal systems for safe and effective water management
- Broadband sensor for continuous monitoring of drinking water

New technologies create safety for man and the environment



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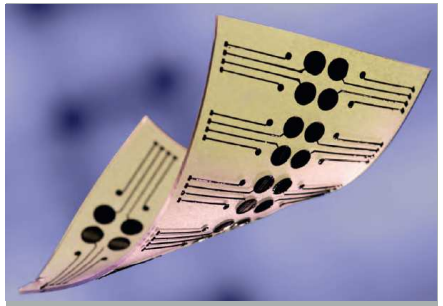
New BU within the Group – Result of Strategic Decisions

Medical Technology – From Idea to Approved Products

New BU

Our responses

- Neuroprosthetics, e.g. elastic nano-functionalized polysiloxane structures
- wireless energy and data transmission for highly sensitive actuation of prostheses
- combining therapeutic and diagnostic functions in a single medical device
- Biotelemetry
- biomedical ultrasound
- Plasma technologies for cleaning and disinfection as well as functionalization of surfaces
- broad range of 3D scaffold creation technologies



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6 Institutes, 1 Research Institution, 21 Locations

Main locations:

Hannover: Fraunhofer Institute for Toxicology and Experimental Medicine ITEM

Aachen: Fraunhofer Institute for Molecular Biology and Applied Ecology IME

St. Ingbert: Fraunhofer Institute for Biomedical Engineering IBMT

Stuttgart: Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB

Freising: Fraunhofer Institute for Process Engineering and Packaging IVV

Leipzig: Fraunhofer Institute for Cell Therapy and Immunology IZI

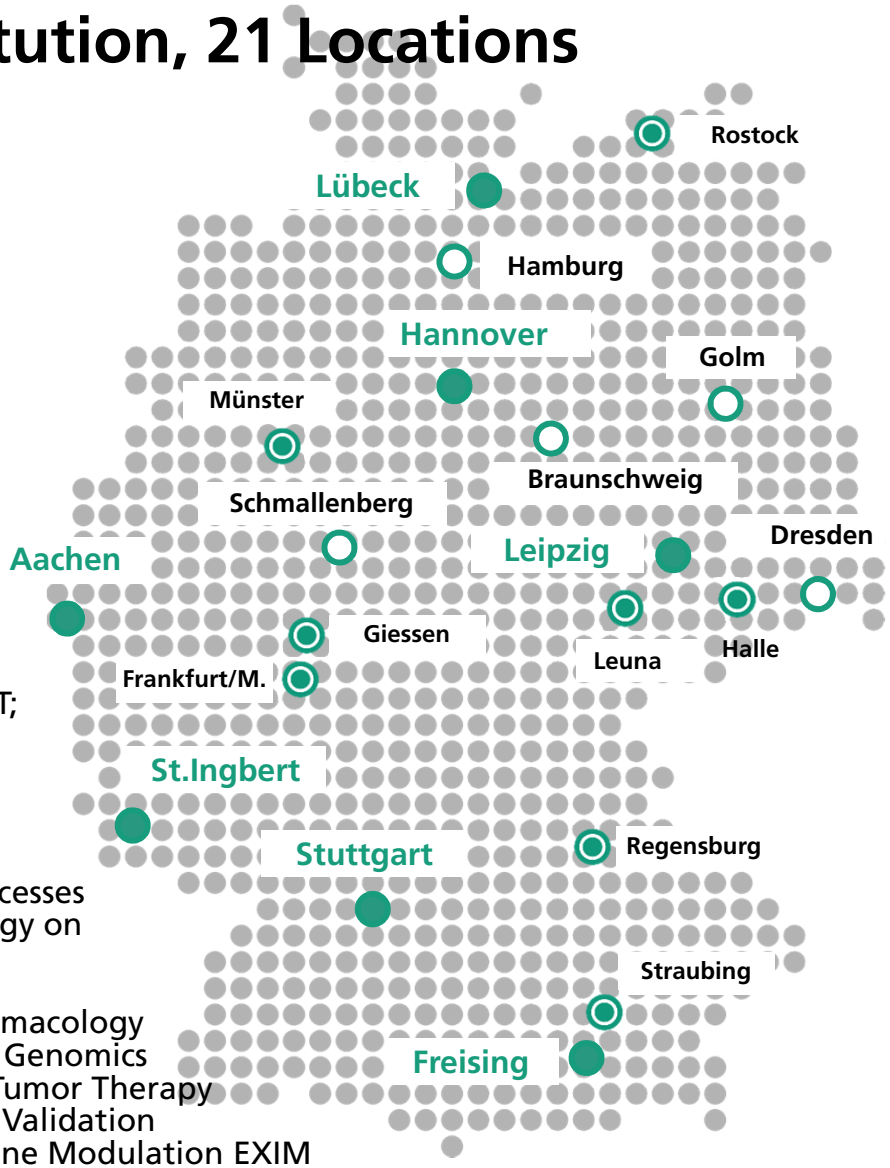
Lübeck: Fraunhofer Research Institution for Marine Biotechnology EMB

Branches:

Schmallenberg: IME; **Hamburg**: IME; **Sulzbach:** IBMT; **Braunschweig:** ITEM; **Dresden:** IVV; **Golm**: IZI

New project groups:

Leuna: IGB, Fraunhofer Center for Chemical-Biotechnological Processes CBP
Straubing: IGB, Project Group BioCat "Catalytic Processes for a Sustainable Supply of Raw Materials and Energy on the Basis of Renewable Resources"
Giessen: IME, Project Group on Bio-Resources
Frankfurt/Main: IME, Translational Medicine + Pharmacology
Münster: IME, Branch Lab for Functional + Applied Genomics
Regensburg: ITEM, Project Group on Personalized Tumor Therapy
Halle: IZI Project Group on Drug Design and Target Validation
Rostock: IZI, Project Group on Extracorporeal Immune Modulation EXIM



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Do not hesitate to contact us

We are pleased to help you find answers to any questions you might have or solutions you are looking for.

Please contact our Central Office:

Dr. Claus-Dieter Kroggel
Head of Central Office

Fraunhofer Group for Life Sciences
Nikolai-Fuchs-Str. 1
30625 Hannover
Germany

Phone +49 511 5350 - 449
claus.kroggel@vls.fraunhofer.de

Dr. Claus-Dieter Kroggel
Head of Central Office

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