



WP2 RESEARCH INFRASTRUCTURES

Task 2.3 Unlocking the collaborative potential of EDUC Research Infrastructures

Advancing healthcare using the Research Infrastructure
CeSAR of UniCa: Nutrition during the first two years of
life

Cagliari, 23th and 24th November 2023



This project has received funding
from the European Union's Horizon
2020 research and innovation
programme under grant agreement
No 101017526

BRNO

city for life



history



culture



architecture



science



Mgr. Hana Seličová

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Teaming for a healthy future

Mission

Building a healthy future with environmental, economic and social sustainability and improved well-being.



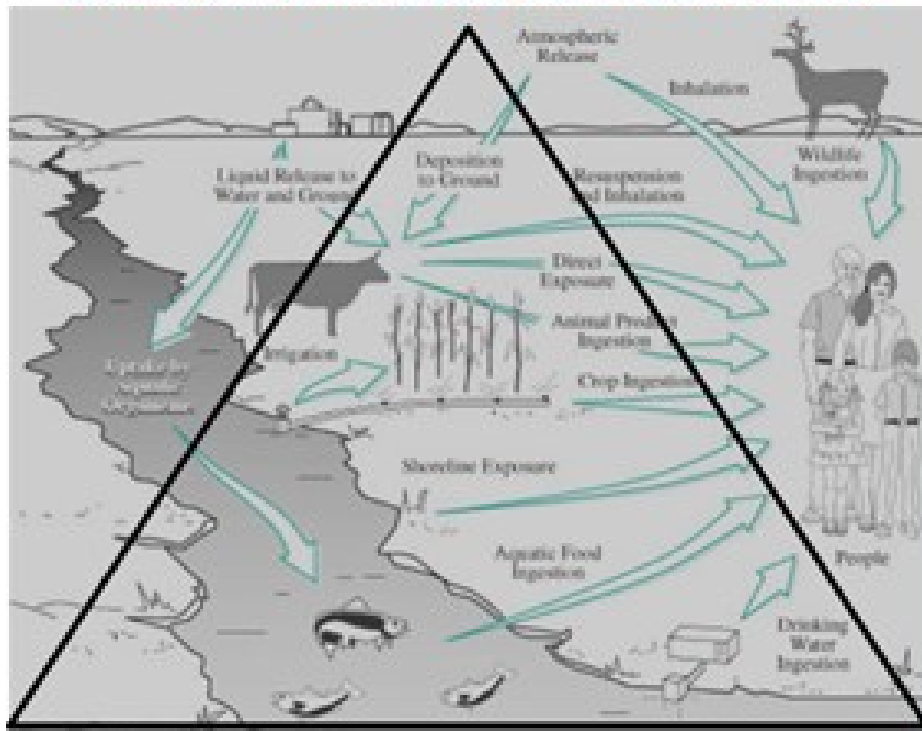
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857560

Challenge of Assessing Human Exposome

2005: Wild proposed a non-genetic complement to the genome - the exposome - to encompass all environmental exposures shaping phenotype. <https://doi.org/10.1158/1055-9965.EPI-05-0456>

Bottom-up Exposomics

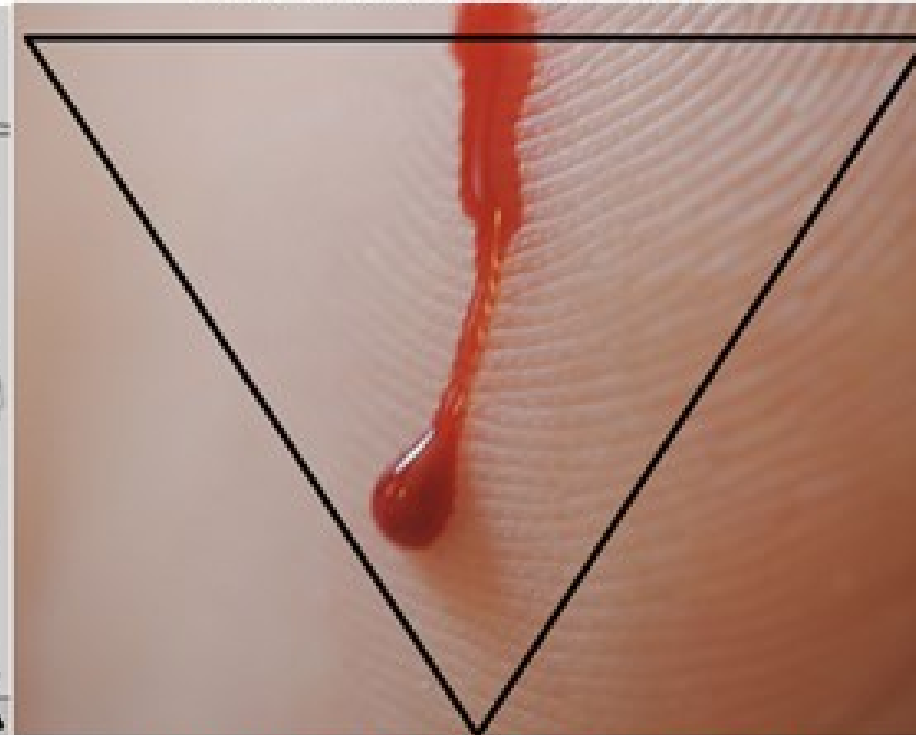
Identify important exogenous exposures



Measure chemicals in air, water & food

Top-down Exposomics

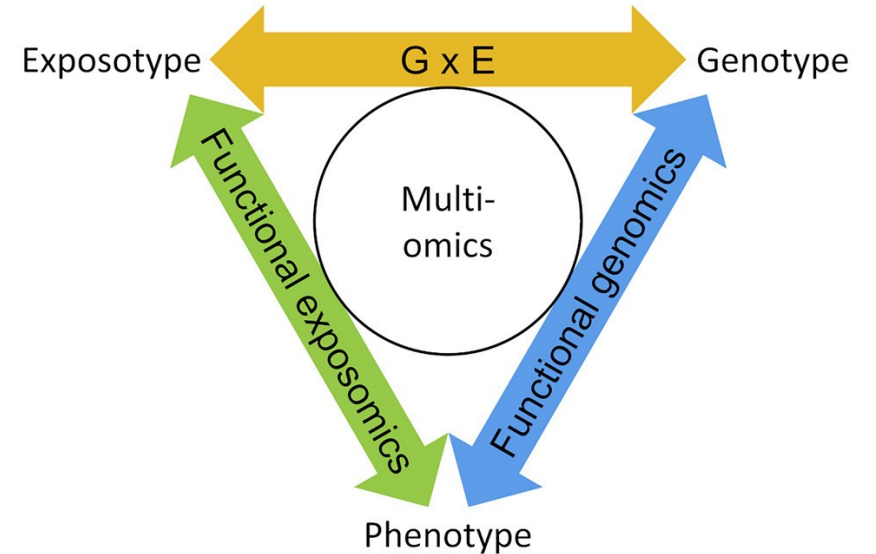
Measure chemicals in blood



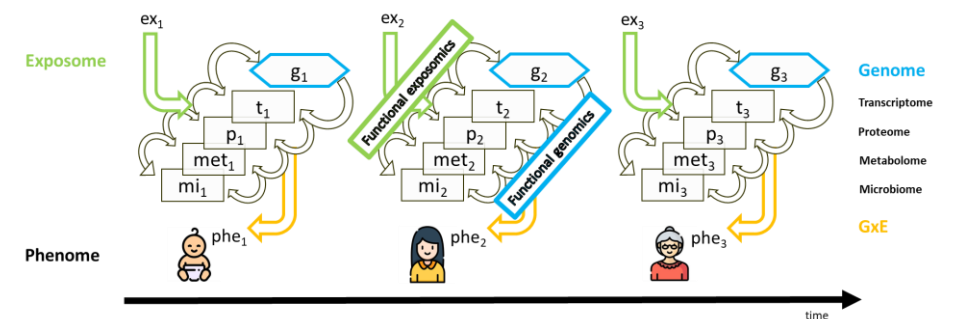
Identify all important exposures

Human exposome redefined (2022)

- **Exposome:** the totality of environmental exposures, i.e. the totality of contact between external factors (agents) and a biological entity.
- **Functional exposomics:** the systematic and comprehensive study of environmental exposure-phenotype interaction over a defined time-period.
- Operational definition for studies to **consider the environmental exposures** (contact with external factors) that **influence phenotype and health**



<https://doi.org/10.1016/j.isci.2022.103976>



RECETOX Research Infrastructure



Acronym: RECETOX
 Hosting Institution: Masaryk University
 Phase: construction
 Character: single-site
 Responsible person: Prof. Jana Kůrková, Ph.D.
 kmasova@recetox.muni.cz
 Website: old.recetox.muni.cz/index-en.php
 Year of inclusion on the Czech Roadmap: 2010

Motto: Science for a healthy future

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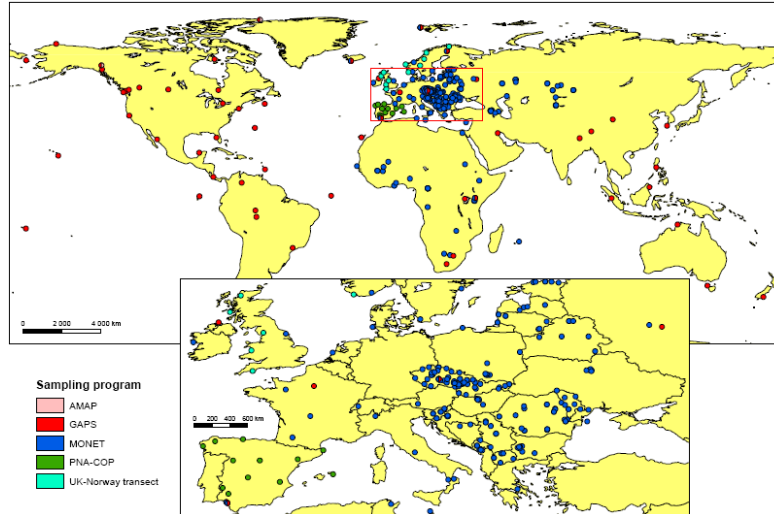
Characteristics

RECETOX RI enables research on both environmental and human health risks related to environmental contamination, and supports the safe management of chemicals. The existing and newly built capacities of the RECETOX RI core facilities offer a wide range of expertise needed for making environmental impact assessments for a variety of users. They provide access to analytical, chemical, biological, and toxicological laboratories, the environmental monitoring network (EMN) (Monitoring Network), population studies (GENESIS) (Global European Longitudinal Study of Genetic Susceptibility), and related data sources. They allow for the presentation of real-time data through the GENESIS (Global Environmental Assessment and Information System) information platform. The capacities for data analysis, interpretation and modeling are also available together with advanced biostatistics and bioinformatics offering a portfolio of services to users from both the academic and private sectors in the Czech Republic and abroad. The comprehensive interdisciplinary approach taken by RECETOX RI is unique in the European context. RECETOX RI offers capacities for the assessment of innovative impacts on human health, a platform for the development of innovative methods, know-how and technology transfer, teaching and consulting. The education and training activities of RECETOX RI at all levels of higher education improve the quality and professional readiness of its graduates. The training courses, workshops, and the international summer schools are also organized for attendees from universities, research institutes, health facilities, industrial enterprises, regional and state authorities, ministries, governments and international organizations. RECETOX RI is associated with the Czech nodes of the ECDC (European Centre for Disease Prevention), GENESIS (Global European Longitudinal Study of Genetic Susceptibility), GENESIS (Global Environmental Assessment and Information System), and GENESIS (Global Environmental Assessment and Information System) European research infrastructures. It coordinates the GENESIS (Global Environmental Exposure Assessment Network) project for the updated ESPRI Roadmap, and the GENESIS (Global Genetic Observations) initiative (GENESIS) (Global Observation System for Persistent Organic Pollutants). It also contributes to the implementation and management of past European programmes such as HUMAN (Human Dimensionality for Europe) and DNA (European Network for Observing our Changing Planet).

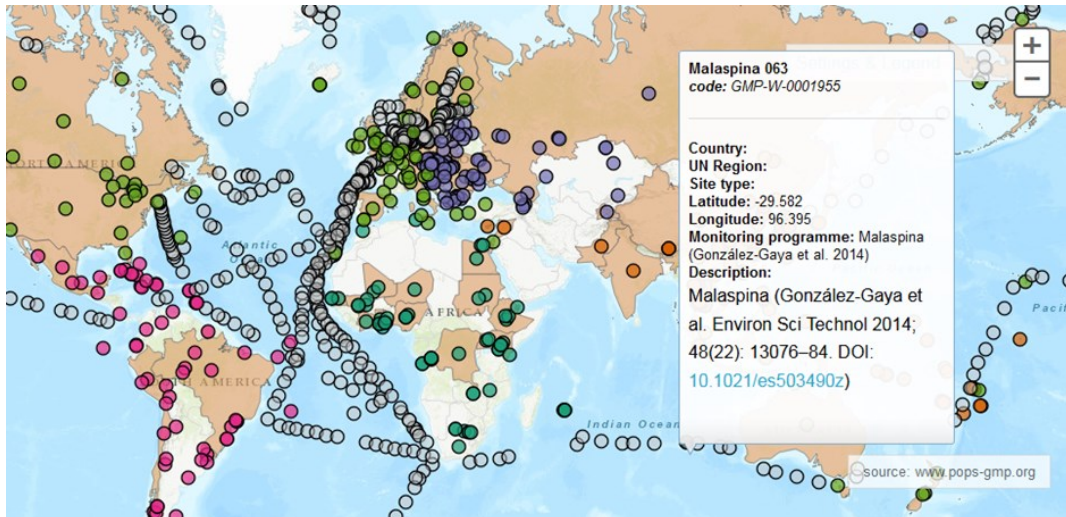
Socio-economic benefits

RECETOX RI develops new approaches to assess the causal links between human exposure to toxic substances and the development of chronic diseases, and improves our understanding of the mechanisms of such interactions. It identifies toxic mixtures in the environmental samples, consumer products and human tissues, as well as sources of biochemical mixtures, their health effects and most vulnerable populations. It explores the links between environmental exposure and social and economic factors that affect human health, and allows for the prioritization and better targeting of the relevant legislation. It contributes to the better management of toxic chemicals, the safe production of food and consumer products, and safe waste processing. It influences the protection of human health, the development of preventive measures, and sustainability of healthcare. It collaborates with WHO (World Health Organization) and supports the implementation of the concepts of a circular economy and healthy practices. It also provides university education and builds international capacities for assessing environmental exposures.

RECETOX RI – in the Czech Roadmap since 2011



RECETOX accredited laboratories
 MONET monitoring networks
 GENESIS information platforms
 CELSPAC population studies



Trace analysis of exposure markers – services of accredited laboratories

- Development of sampling devices and sensors
- Environmental sampling and monitoring
- Development of analytical (GC/HR-MS, LC/HR-MS, ICP-MS) methods
- Analysis of anthropogenic compounds in environmental matrices
 - organochlorines including dioxins
 - perfluorinated surfactant
 - brominated and organophosphate flame retardants
 - pesticides
 - plasticizers, UV filters
 - polyaromatic hydrocarbons
 - musks
 - mycotoxins, cyanotoxins
 - toxic metals, micronutrients
- Analysis of target compounds and their metabolites in human tissues
- Target analysis of other exogenous and endogenous chemicals.



Analysis of endogenous chemicals / biological markers

Target protein and metabolite analysis

- Quantification of inflammatory proteins (i.e. SAA1, SAA2, SAA4, CRP, A1AT, A1AG) including corresponding proteoforms (i.e. SAA2alpha, SAA2beta, A1AT1, A1AG1, A1AG2) and adaptive immunity effector IGHA1 in dried blood spots
- Quantification of adaptive immunity effectors (i.e. IGHA1, IGHA2) and immune protein markers (i.e. A1AT, ECP, EDN, MPO, CAL1, CAL2) in neonatal meconium and fecal swabs
- Quantification of adipophilin and perilipin-3 in breast milk
- Quantification of tryptophan-derived microbiome co-metabolites (5-hydroxyindolacetate, 5-hydroxy-L-tryptophan, 5-methoxy-3-indolacetic acid, anthranilate, indole-3-acetamide, indole-3-acetate, indole-3-aldehyde, indole-3-butyric acid, indole-3-lactic acid, indole-3-propionic acid, L-kynurenine, L-tryptophan, melatonin, methyl indole-3-acetate, methyl indole-3-propionic acid, N-acetyl tryptophan, serotonin, tryptamine) in dried blood spots, urine, meconium & nasopharyngeal swabs

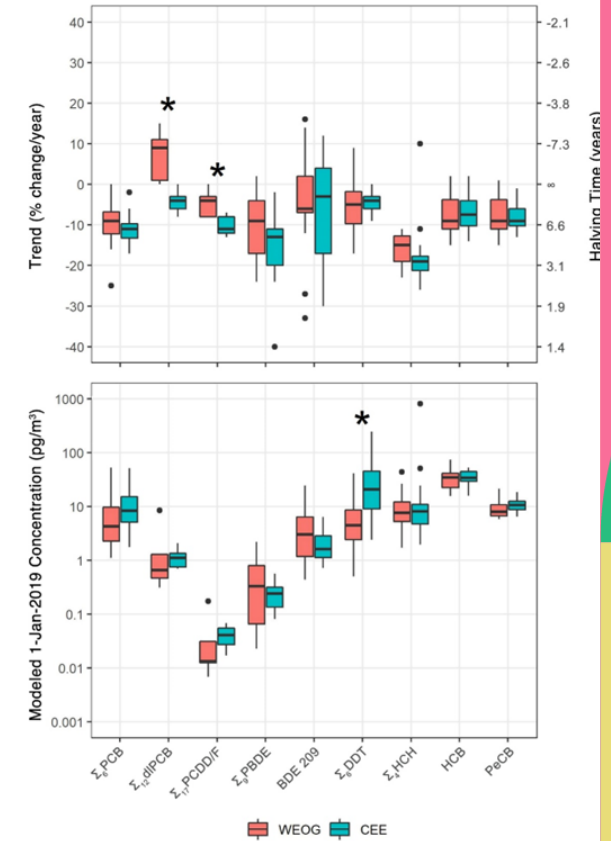
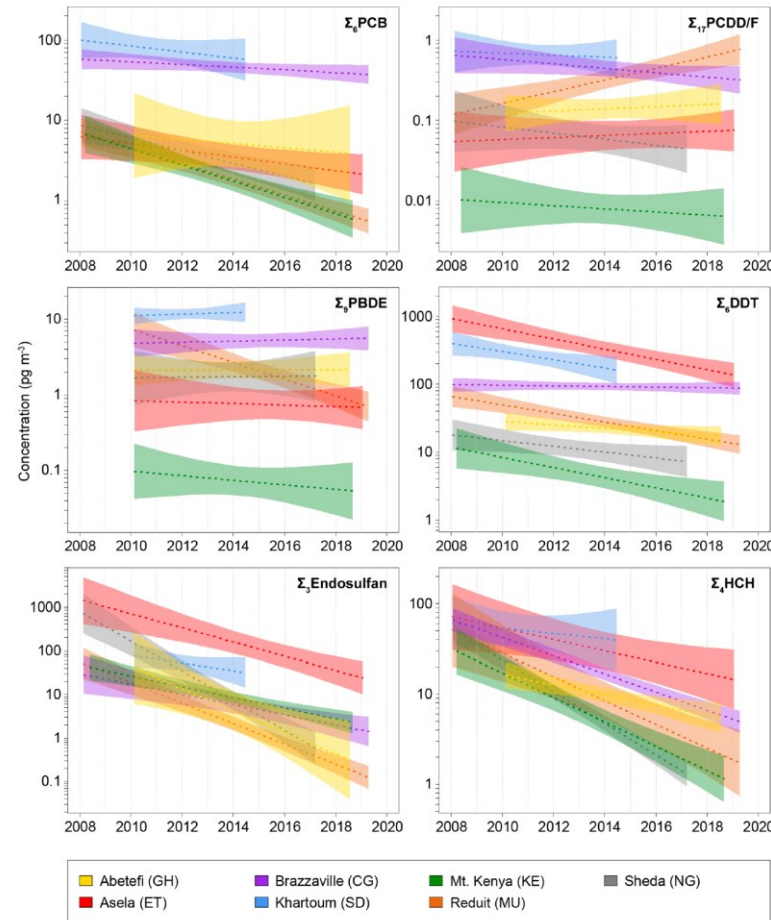
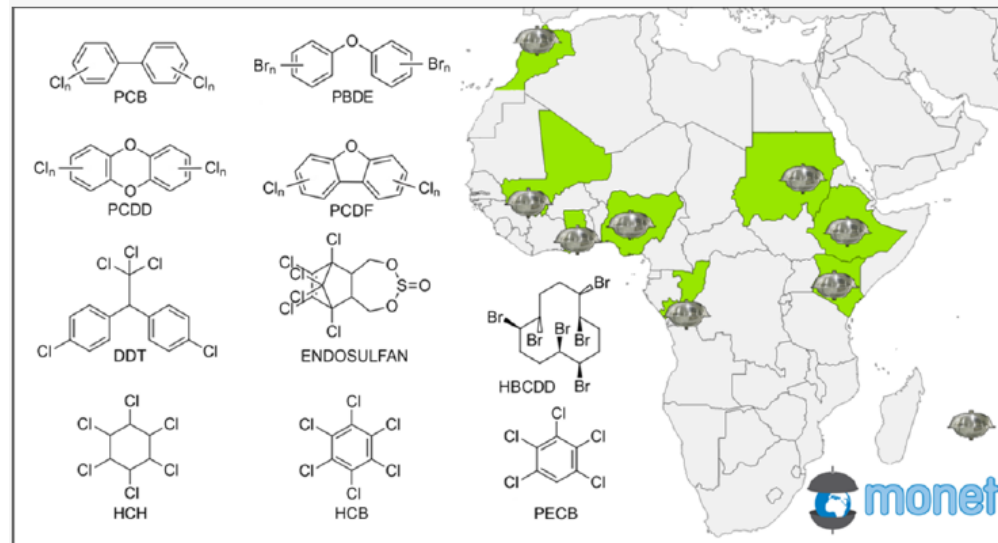
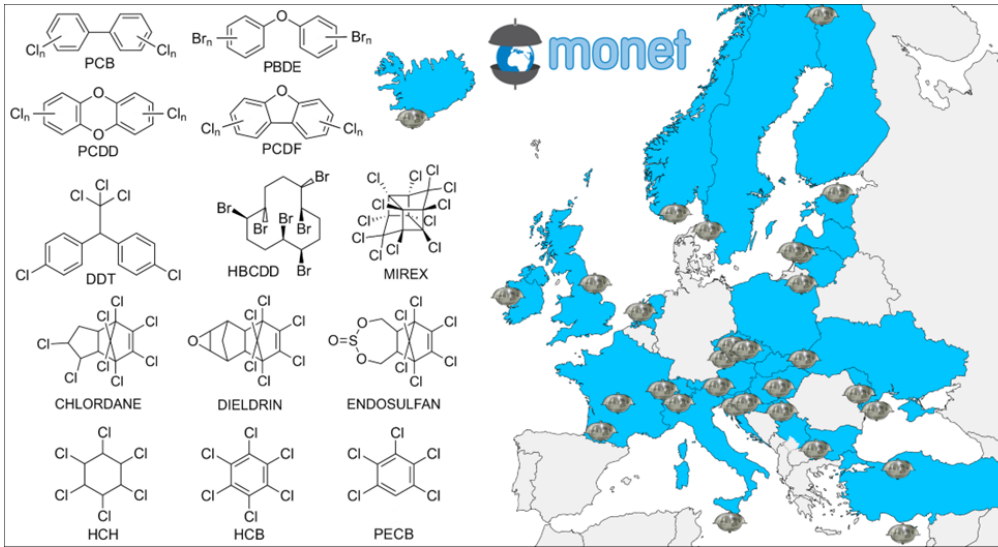
Metabolomics & Exposomics

- Chemical and biological profiling via high resolution/accurate mass (HRAM) mass spectrometry
- Q Exactive GC Orbitrap GC-MS/MS
- UHPLC-Orbitrap Fusion Tribrid MS

Microbiome analysis

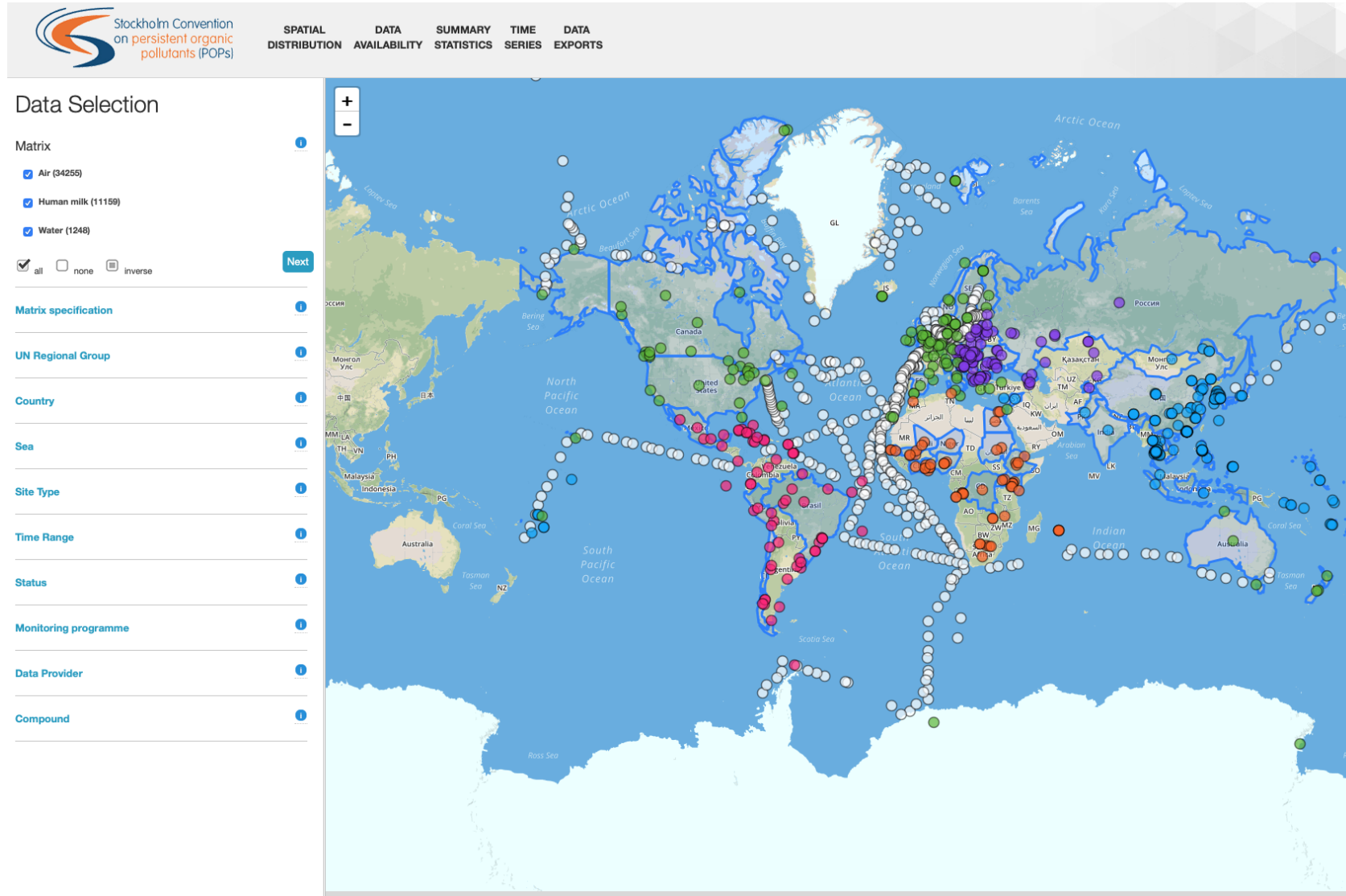
- isolation of NA from microbial cultures, environmental, animal, and human samples
- preparation of the library for 16S/ITS rRNA amplicon sequencing* for the bacteriome/mycobiome analysis in microbial DNA high/low-abundant matrices
- preparation of the library for the sequencing analysis of bacterial/fungal cultures (whole genome sequencing, WGS)*
- preparation of the library for Shotgun metagenomic sequencing (whole metagenome sequencing, WMGS)*
- detection of DNA from selected oral and gut bacteria and their DNA quantification by qPCR method (single/multiplex qPCR analysis)
- methodology development of a specific plex according to customer's demand Analyses of human/animal genome/transcriptome/proteins
- SNP genotyping by methods based on PCR
- gene expression analysis by methods based on PCR
- single/multiplex ELISA

MONET: temporal trends in atmospheric and water levels of organic pollutants



- New sensors development (including personal)
- Setting monitoring studies
- Data provision (also ACTRIS)

GENASIS information systems



- Data collection and harmonisation
- Data hosting and visualisation
- Data integration and analysis
- Transport, fate, pharmacokinetic modelling
- Services to UNEP, WHO, government and authorities

CELSPAC Population cohorts



- 1960s: > 500 mother-child pairs



- 1990s: ELSPAC parents



- 2020s: ELSPAC follow up



- 2020s: CELSPAC_TNG, >1000 mother-child pairs



- 2010s: KARDIOVIZE, >2000 individuals

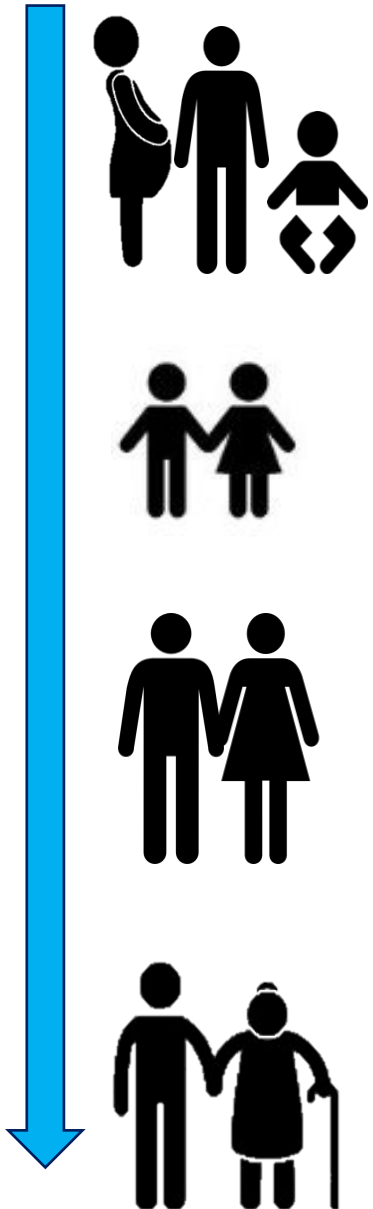


- 2000s: HAPIEE



Samples and data available

- **CELSPAC: TNG**
- CELSPAC: Teenagers
- CELSPAC: School Children
- **CELSPAC: Young Adults**
- VULDE a Health Brain Age
- CELSPAC: PsyCap
- WHO Breast Milk
- **PROSECO STUDY (COVID-19 Seroprevalence)**
- **HAPIEE**
 - FireExpo
 - Icarus
 - Specimen



> 5,500 of active participants plus 30,000 of PROSECO study's participants

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CELSPAC platform services

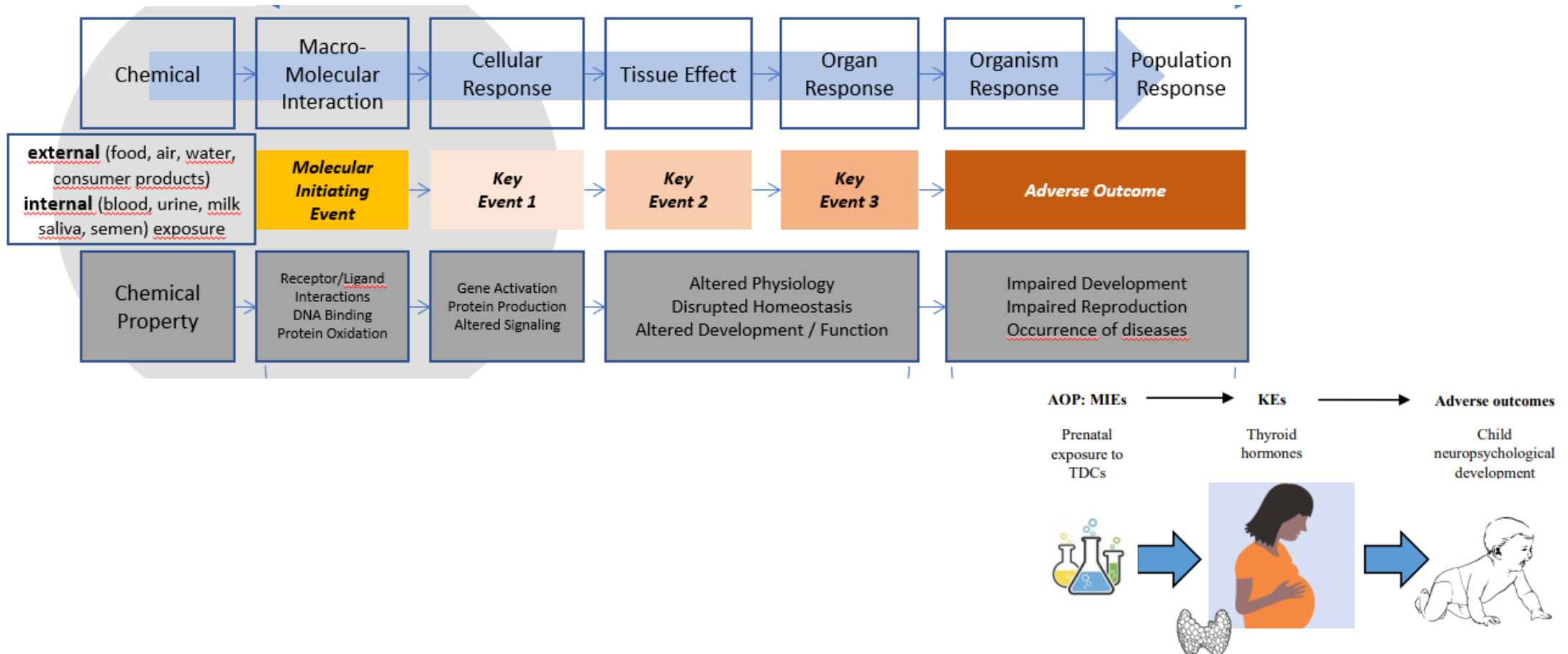
- Study design, protocol, SOP, ethical clearance
- Sample collection, preparation, analysis and long-term biobanking according to validated SOPs and QA/QC
- Analysis of basic biomarkers (creatinine, albumin, thyroid hormones, blood lipids - cholesterol, triglycerides, HDL, LDL), and immunomarkers (IgG; IgM; IgE; interleukins)



- Biobanking of in-house and external samples and harmonisation of data
- Longitudinal follow up
- Access to samples and data (also via BBMRI)

Linking AOP framework and Epidemiology

- Epi studies: Identifying links between chemicals exposures and adverse outcomes **at the population level**
- Experimental studies: Identifying specific **mechanisms** leading to the adverse outcomes = strengthening the evidence



EIRENE RI: Prioritised in the 2021 ESFRI Roadmap

EIRENE RI

Research Infrastructure for Environmental Exposure assessment in Europe

Website
pending

Headquarters
Masaryk University
Brno, Czech Republic

Legal status
pending

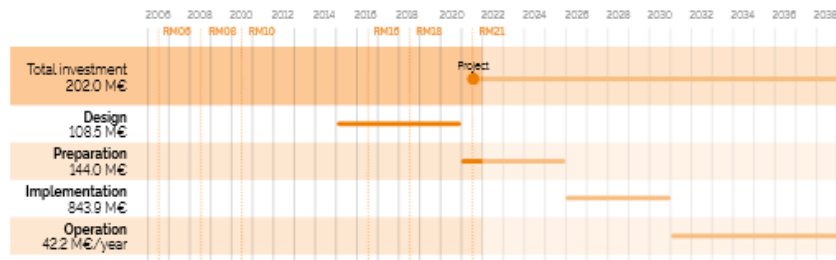
Type
distributed

DESCRIPTION

The Research Infrastructure for Environmental Exposure assessment in Europe (EIRENE RI) pioneers the first European Research Infrastructure on environmental determinants of human health, the Human Exposome. EIRENE RI intends to support large-scale research for the interdisciplinary assessment of environmental determinants of health, including indoor and outdoor environment factors, lifestyle, socioeconomic, and the individual's ability to cope with various stressors such as infection or disease. EIRENE RI will provide harmonised workflows and integrated services for data and sample collection, as well as knowledge and tools that will be made accessible to academic researchers, private companies, public authorities and citizens through the EIRENE open-access system and the EIRENE knowledge hub.

The concept of a pan-European Infrastructure supporting research on the effects of long-term exposures to various types of stressors on population health and the roles these exposures play in the development of chronic diseases is based on ten-year experience of Czech national RECETOX RI. Entered in the ESFRI Roadmap 2021, EIRENE RI already connects 60 research institutions from 17 countries. It builds on the legacy of the European environmental monitoring networks and their databases (EMEP, GMP, GMOS), GEO Initiatives (GOS4POP and GOS4M) and related H2020 projects (ERA PLANET, e-SHAPE), EU biomonitoring initiatives (DEMOCOPHES, HBM4EU), UNEP/WHO global biomonitoring efforts, EU exposome (HELIX, EXPOSOMICS, HEALS and EHEN cluster) and other related projects (HERA, EURION cluster).

TIMELINE & ESTIMATED COSTS



INTERCONNECTIONS



POLITICAL SUPPORT

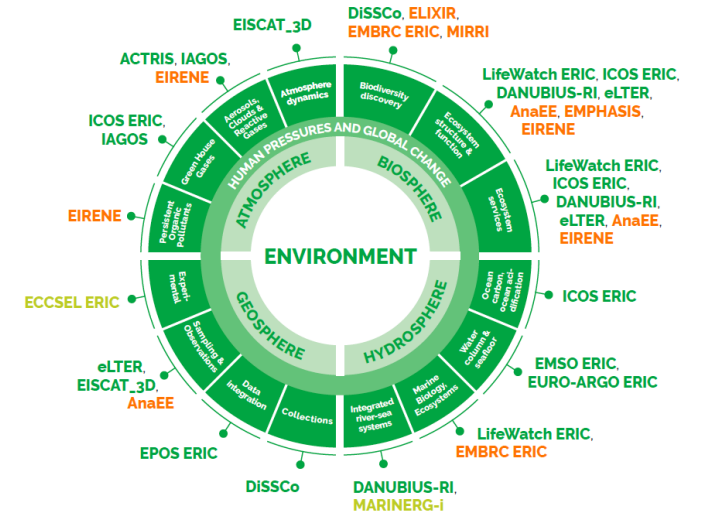
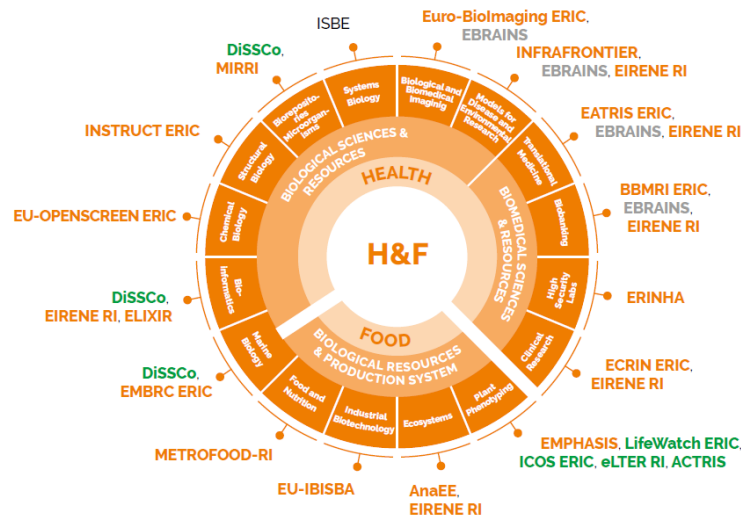


Lead
CZ

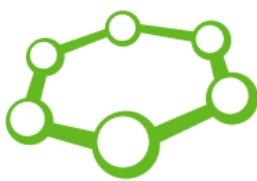
Prospective member
AT, BE, DE, EL, ES, IS, IT, NL, SK

Austria
Belgium
Czechia
Finland
France
Germany
Greece
Island

Italy
Netherlands
Norway
Slovakia
Slovenia
Spain
Sweden
UK
US

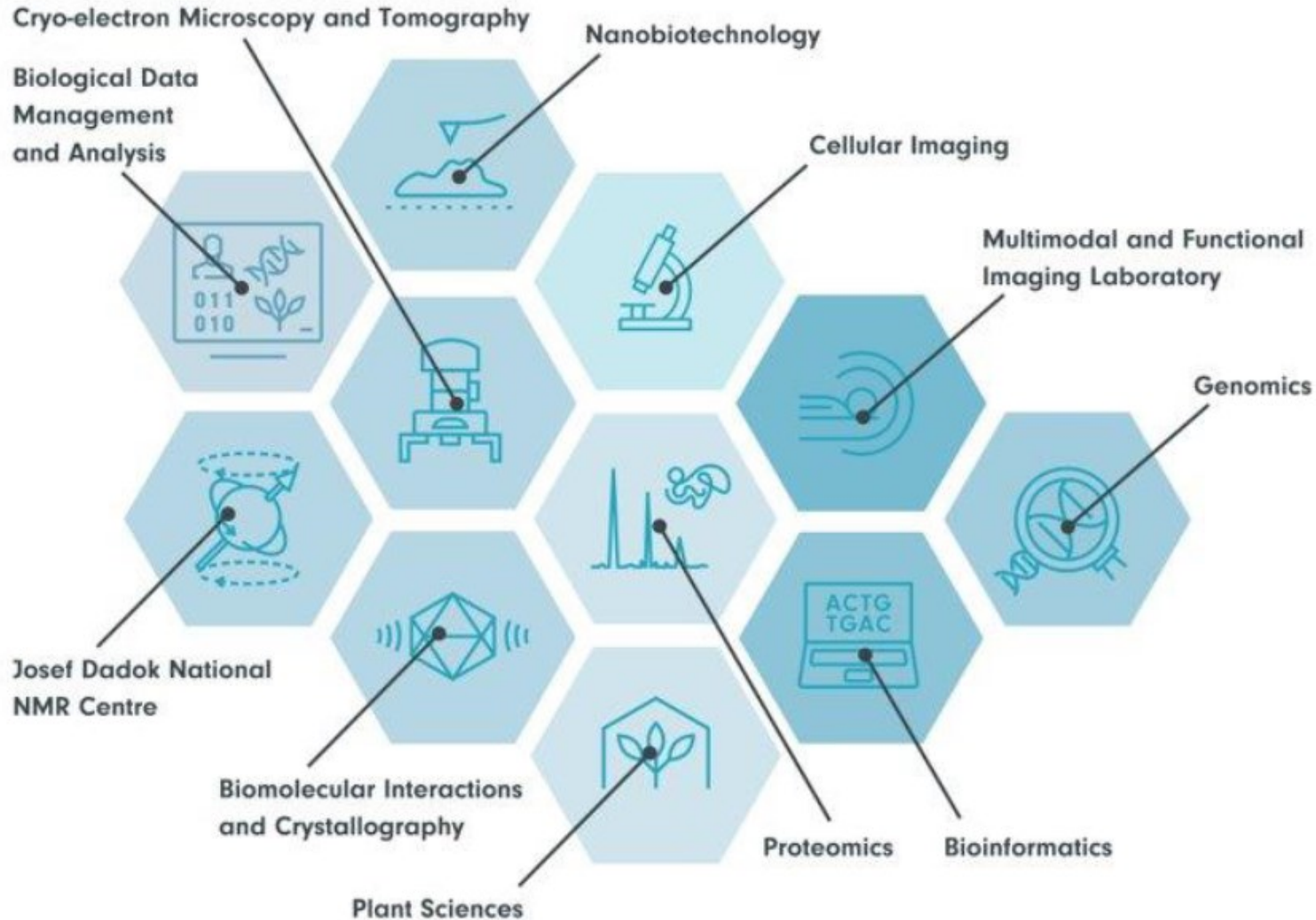


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CEITEC

CEITEC MUNI core facilities



• WHO?:

- technological (service) units
- state-of-the-art instrumentation

• WHAT?:

- access to instrumentation
- training
- complete service
- expertise & consultations

• HOW?:

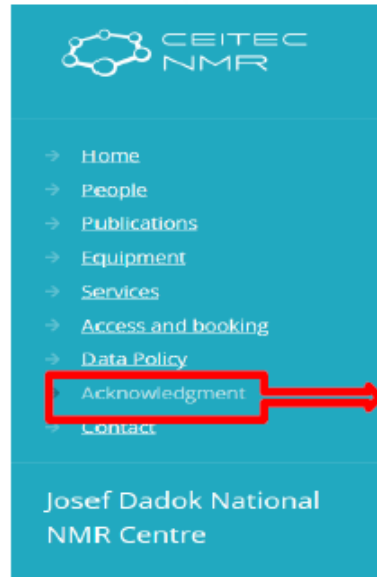
- open-access
- domestic & foreign users
- academia & industry

Basic rules of access

- CEITEC Core Facilities are accessible for domestic and foreign users at the **OPEN ACCESS** principle.
- **CONTACT CF HEAD** prior the first measurement.
- It is possible to reserve **INSTRUMENT TIME** or to order a **COMPLETE SERVICE**, including consultations and training from **CF EXPERTS**.
- It is necessary to book the instrument/service via the **BOOKING SYSTEM**, which is accessible via the CF website <https://www.ceitec.eu/core-facilities/>. Registration is required.
- Services are **NOT FOR FREE** = send request to core.facility@ceitec.muni.cz to get the prices.
- Academic users have the possibility to fill out the **OPEN ACCESS PROJECT** to get discounted access to the **RESEARCH INFRASTRUCTURE**.

Acknowledgment matters!

- If any data obtained in the CF resulted in the publication, you have to **ACKNOWLEDGE CF** in the publication.
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- You can contact us at core.facility@ceitec.muni.cz



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Josef Dadok National
NMR Centre

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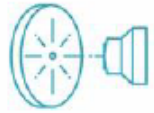
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Thank you for your attention! 😊