High Throughput Microscopy for Systems Biology

Euro-Biolmaging: Biomedical Imaging Infrastructure for the Future of European Research



EMBL

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European Molecular Biology Laboratory

Europe's flagship Institute in Life Science

www.embl.org



The Five Branches of EMBL

Heidelberg Headquarter



Molecular Biology Research Laboratory Central Administration *EMBO*

>1550 staff
>60 nationalities

Hamburg



Structural Biology DESY/PETRA3



Structural Biology ILL, ESRF, IBS, UVHCI

Hinxton



European Bioinformatics Institute (EBI) *Sanger Centre*

Monterotondo



Mousebiology EMMA, CNR



EMBL is funded by 21 Member States

Austria 1974 Denmark 1974 France 1974 Germany 1974 Israel 1974 Italy 1974 Netherlands 1974 Sweden 1974 Switzerland 1974 United Kingdom 1974 Finland 1984 Greece 1984 Norway 1985 Spain 1986 Belgium 1990 Portugal 1998 Ireland 2003 Iceland 2005 Croatia 2006 Luxembourg 2007

Australia 2008 (1st Associate Member)





Europe's Flagship Institution in Life Science

EMBL ranks as top European institute and fourth worldwide 1999-2009 in Molecular Biology and Genetics*

	Institution	Papers	Citations	Citations per paper
1	Cold Spring Harbor Lab	669	63,570	95.02
2	MIT	1,995	163,596	82.00
3	Salk Institute for Biological Studies	707	49,996	70.72
4	European Molecular Biology Lab	1,435	94,736	66.02
5	Memorial Sloan-Kettering Cancer Centre	1,099	71,250	64.83
6	Wellcome Trust Sanger Institute	790	50,997	64.55
7	Rockefeller University	1,332	83,307	62.54
8	Dana Farber Cancer Institute	673	41,627	61.85
9	Massachusetts General Hospital	1,447	86,773	59.97
10	Cancer Research UK	752	44,343	58.97

* Thompson ISI essential Science Indicators



EMBL's Five Missions





Molecular Biology from Molecules to Organisms









Fruitfly

Mouse

Human



Cells carry out many functions in the organism



















Mitosis is rare and transient in cultured human cells



Control



HeLa(Kyoto)_{H2B-GFP} reporter cell line

Plk1 RNAi





Microscopy-based genome-wide RNAi screening



the human genome on siRNA microarrays



51 108 siRNAs (2-3 siRNAs/gene) knock down hit rate: 97%*

siRNAs/cellarray	384
cellarrays/genome:	149

* qRT-PCR (Ambion) of **1031** genes. 97% knocked down to less than 30% remaining mRNA.

High throughput microscopy



s): 1536
30 min
48 h
400 GByte
260 000 movies = 34 Tbyte

MITO^CHECK *

260 000 movies of cell division after RNAi







Automatic analysis of the movies







2 Billion Nuclei / 20 Million Mitosis

EMBL





Defining mitosis hits









EMBL





www.mitocheck.org





EMBL's Five Missions











Euro-Biolmaging

European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences

A project coordinated by EMBL

Jan Ellenberg Scientific Coordinator EMBL Heidelberg, Germany





Meeting NEuro-BioImaging Poland May 30th, 2011

European Strategy Forum on Research Infrastructures (ESFRI)

- represents the Member States' research ministries and the European Commission.
- established in April 2002 to produce the "European Roadmap on Research Infrastructures"



- RIs are facilities, resources or services used by the scientific community to conduct top-level research
- Single-sited, distributed, or virtual
- Offer unique research service, stimulate knowledge transfer, open access policy



The Roadmaps

Research Infrastructures on the European Roadmap



2010: 48 RI projects (13 BMS)

2006: 35 RI projects (6 BMS)

2008: 44 RI projects (10 BMS)

BBMRI	Biobanking and Biomolecular Resources Research Infrastructure	
EATRIS	European Advanced Translational Research Infrastructure in Medicine	
ECRIN	European Clinical Research Infrastructures Network	
ELIXIR	European Life Science Infrastructure for Biological Information	
EMBRC 🤤	European Marine Biological Resource Centre	
EU-OPENSCREEN	European Infrastructure of Open Screening Platforms for Chemical Biology	
Euro-Biolmaging	European Biomedical Imaging Infrastructure	
ERINHA	European Research Infrastructure on Highly Pathogenic Agents	
Infrafrontier	European Infrastructure for Phenotyping and Archiving of Model Mammalian Genomes	
INSTRUCT 💰	Integrated Structural Biology Infrastructure for Europe	
ISBE	Infrastructure for Systems Biology - Europe	
ANAEE -	Infrastructure for Analysis and Experimentation on Ecosystems	
MIRRI	Microbial Resource Research Infrastructure	



Bioimaging Technologies









Partners

26 countries, 39 Partners, > 180 Associated Partners, ~ 200 Letters of Intent_

Austria Belgium Bulgaria Croatia Czech Republic Denmark Estland Finland France Germany Greece Hungary Ireland Israel Italy Netherlands Norway Poland Portugal Romania Slovenia Spain Sweden Switzerland Turkey United Kingdom

+ Australia





Timeline & Funding

2010 - 2013	2013 - 2017		
Preparatory Phase	Construction Phase	Operation Phase	
Plan for contruction and operation	Construction or major upgrades of existing facilities	Access and training. Technology updates to maintain best service	
5.2 Mio € funded by EC	>100 Mio € funded by Member States	20% of construction/year funded by EC + Member States	
	1		



Working Groups





<u>Aims</u>

- Survey European biomedical imaging resources & define user needs
- Plan for construction and operation
- Standardized access and training models for imaging technologies
- Standardized image data storage and analysis tools
- Define the legal and governmental framework for implementation phases
- Develop sustainable funding concept and overall business plan
- Integrate Euro-BioImaging into the European and global research infrastructure landscape



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Survey

- establish European inventory of existing imaging research infrastructure
- assess the needs and requirements of RI users, providers, industry and funders
- consult all Euro-BioImaging Stakeholders to define criteria for future nodes







- Interlinked & distributed research infrastructure nodes
- Focused on complementary imaging technologies
- Newly constructed or major upgrades
- Distributed across Member States
- Devote significant part of capacity to external users

INTEGRATION

SURVEY

DATA

LEGAL FRAMEWORK BUSINESS PLAN





SURVEY

ACCESS

PLAN

DATA

LEGAL FRAMEWORK BUSINESS PLAN



Euro-Biolmaging Nodes



SURVEY

ACCESS

PLAN

DATA

LEGAL FRAMEWORK BUSINESS PLAN



Access to Innovative Technologies



Pepperkok and Ellenberg, 2006, Nat Rev Mol Cell Biol 7:690

SURVEY

PLAN

ACCESS

S DATA

LEGAL FRAMEWORK BUSINESS PLAN



Distribution of Users in 51 HTM Projects (2008 – present)



- Transnational Users
- Regional Users
- Internal Users

29 projects completed; Usage: 28,000h / year

Technology commercialized with:



SURVEY

PLAN AC

ACCESS

DATA

LEGAL FRAMEWORK BUSINESS PLAN



Integrating National Biolmaging Initiatives



PLAN

DATA

LEGAL FRAMEWORK BUSINESS PLAN





Level of national involvement in Euro-BioImaging + Letter of Intent from Funders + Biolmaging on National Roadmap + Constituating Meeting of National Imaging Communities + National Coordinating Person



Swedish Biolmaging

- **BioImagingUK**
- German Bioimaging
- Swiss-Biolmaging
- France-Biolmaging
- Greece-Biolmaging
- NorBioImaging
- **Italian Bioimaging**
- Imaging Plattform Ireland
- Finnish National Imaging Infrastructure Network
- **Czech Biolmaging**
- (N)Euro-BioImaging Poland



LEGAL FRAMEWORK **BUSINESS** PLAN



Euro-Biolmaging Partners in Poland

Beneficiaries Nencki Institute of Experimental Biology, Warsaw in WP2 Legal, Governance and Ethical Issues WP4 Finance Planning

Associated Partners Jagiellonian University, Krakow University of Warsaw Medical University of Warsaw International Institute of Molecular and Cell Biology in Warsaw M. Mossakowski Medical Research Center Warsaw Adam Mickiewicz University, Poznan University of Wroclaw Institute of Biochemistry and Biophysics

Stakeholders

LifeScience Park, Krakow





The Euro-Biolmaging Vision

"To provide a clear path of access to imaging technologies for every biomedical scientist in Europe."



Website

www.eurobioimaging.eu



EMBL

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