

European Molecular
Biology Laboratory

Overview

About EMBL

The European Molecular Biology Laboratory, one of the world's top research institutions, is dedicated to basic research in the molecular life sciences.

EMBL is funded by 20 member states, including much of Europe and Israel, and one associate member, Australia. The current Director General is Professor Iain Mattaj, who was selected by the governing body, EMBL Council.

The main laboratory is in Heidelberg, Germany, and there are four outstations: Grenoble, France; Hamburg, Germany; Monterotondo, Italy; and the European Bioinformatics Institute (EMBL-EBI) in Hinxton, UK.


EMBL was founded in 1974 to create a central European laboratory in the new field of molecular biology. It has attracted many of Europe's most talented young research scientists by pursuing the following missions:

- to conduct **basic research** in molecular biology;
- to provide **essential services** and research infrastructures to European scientists;
- to provide **advanced training** to its staff, students and visitors at all career stages;
- to develop **new instrumentation** for biological research;
- to develop its discoveries to benefit society by **technology transfer**.

EMBL is international, innovative and interdisciplinary. Its 1,400 employees from 60 nations represent scientific disciplines including biology, physics, chemistry and computer science. Researchers pursue their interests in broad thematic units, which encourage the combination of methods and technologies from diverse disciplines. Exchange and collaboration between scientists is also supported by cross-departmental structures, the **EMBL Centres**.

Services provided by EMBL include the core biomolecular databases and bioinformatics tools, particularly at EMBL-EBI, and the provision of beamlines, instrumentation and high-throughput technology for structural biology at the Hamburg and Grenoble outstations. The **Core Facilities** provide cost-effective and efficient access to methods and technologies that are expensive to set up or maintain, or that require considerable expertise.

The **European Bioinformatics Institute (EMBL-EBI)** is located on the Wellcome Trust Genome Campus in Hinxton, near Cambridge. As a European hub for biomolecular data resources, the EBI offers the scientific community access to a variety of bioinformatics services, alongside which a number of active research groups work in areas that complement and extend these services. The EBI also provides advanced training and disseminates cutting-edge technologies to industry.



EMBL Hamburg develops novel, innovative technologies in structural biology, such as high-throughput crystallisation and data interpretation software. The unit, which shares a campus with the German Synchrotron Research Centre (DESY), operates seven synchrotron radiation beamlines and offers world-leading facilities and expertise to the research community. A new facility, PETRA III, is under construction, with user operation planned for 2010/2011.

EMBL Heidelberg, the main laboratory, is home to five research units, central scientific services, the administration and the laboratory's technology transfer arm, EMBL Enterprise Management (EMBLEM). Heidelberg is the largest centre for biomedical research in Germany and many bilateral links between EMBL scientists and local research institutions, including the Ruprecht-Karls-Universität and the German Cancer Research Centre (DKFZ), have been established.

EMBL Monterotondo, the Mouse Biology Unit, shares a campus with Italian national research groups (IBC-CNR) and the European Mouse Mutant Archive (EMMA) near Rome. EMBL Monterotondo's research focuses on mouse genetics and functional genomics, and offers expertise in mammalian physiology and production of mouse models of human disease.

EMBL Grenoble builds and operates beamlines for macromolecular crystallography, develops instrumentation and techniques and provides facilities and expertise to visitors in collaboration with its campus partners, the European Synchrotron Radiation Facility (ESRF) and the Institut Laue Langevin (ILL). Together with the Université Joseph Fourier and the National Center for Scientific Research (CNRS), EMBL Grenoble is also part of the Unit of Virus Host Cell Interactions (UVHCI), which pursues high quality research in this field of study.

Employees stay for a maximum of nine years at EMBL. This maintains the dynamic environment and encourages a flow of ideas. As a result, EMBL produces a constant stream of highly qualified researchers. Of these, 80% return to the member states, often in leading academic or industrial positions, feeding the exceptional experience of EMBL into the wider community.

The EMBL Alumni Association coordinates this worldwide network of people as a resource of experience and knowledge.

“ The most valuable resource EMBL provides to its member states is highly trained scientists ”

Iain Mattaj

Research

Mouse Biology

Mice and humans are genetically very alike, making the mouse an ideal model organism to study human disease. Researchers at EMBL study mice with conditions similar to depression, heart failure, multiple sclerosis and chronic anxiety to gain insight into human disorders. Using genetic and behavioural techniques they also assess important aspects of mammalian physiology, including muscle and nerve cell regeneration, blood stem cell differentiation and embryonic development, and complex behaviours like learning, memory and fear responses, asking such questions as:

- How does normal physiology change in disease?
- What are the genetic and molecular mechanisms underpinning a disorder?
- What do mouse behaviour and physiology tell us about humans?
- How can we cure diseases in mice and ultimately humans?

Developmental Biology

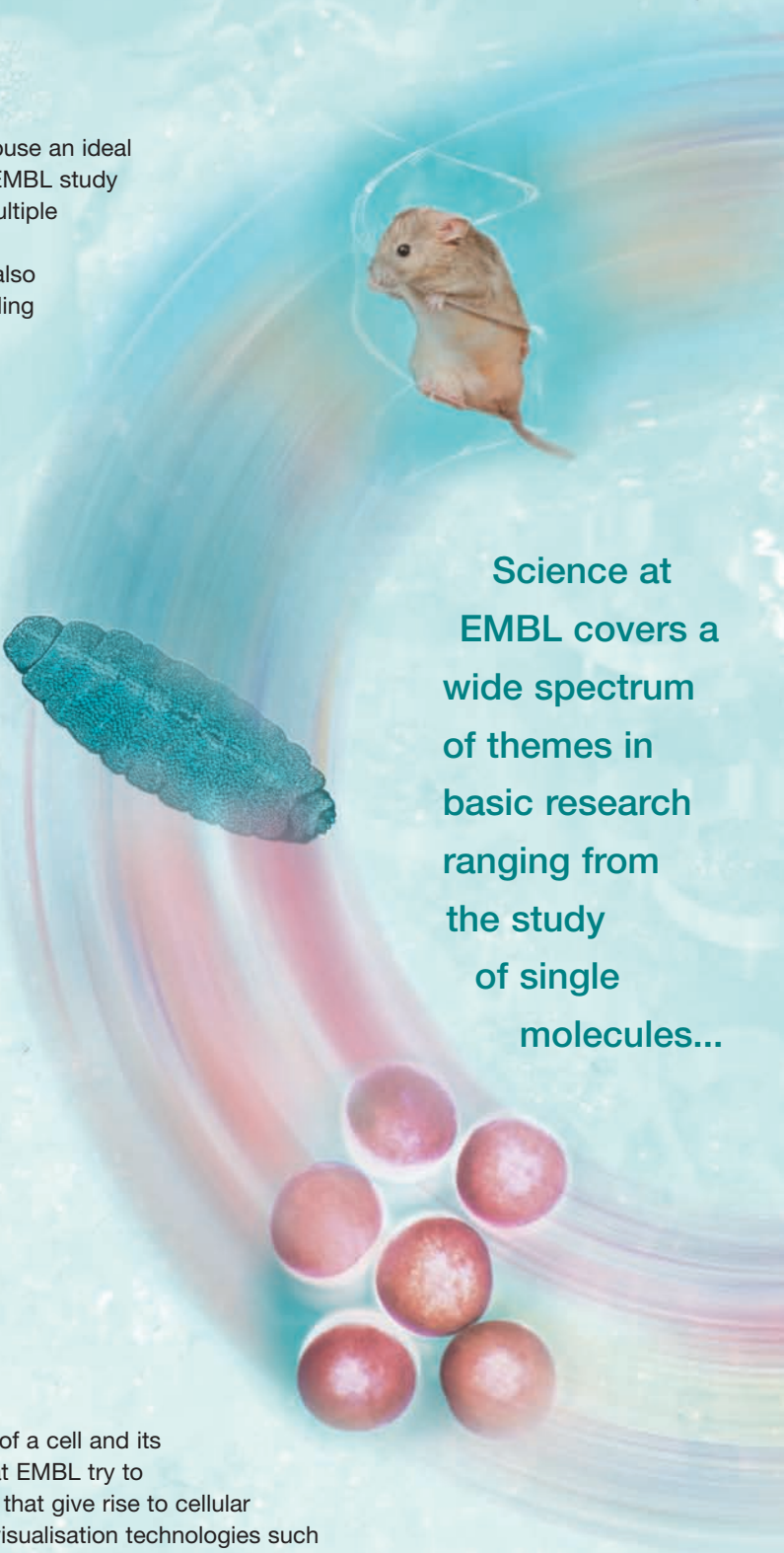
A single cell contains all the information needed to develop into a multicellular organism. Its instruction manual is DNA, identical copies of which are passed on to all the cells of the emerging body. So why does a brain cell differ from a heart cell, which in turn is different from a blood cell? EMBL scientists use microscopy, computer and microarray analysis and genetics to observe development from a single cell to a complex animal. They use different model organisms to find out what goes wrong when animals carry mutations in certain genes.

- How does an organism arise from a single cell?
- Which regulatory mechanisms give cells their unique identities?
- How are these processes disturbed in disease?
- How do organs and tissues develop?


Cell Biology and Biophysics

Cell biology comprises all aspects of the life and structure of a cell and its function in the context of a whole organism. Researchers at EMBL try to understand molecular mechanisms and physical principles that give rise to cellular organisation using computer simulation and cutting-edge visualisation technologies such as live imaging and fluorescence microscopy.

- How do structures arise inside the cell?
- What kind of machinery does a cell need to divide and how does it work?
- How do cellular systems combine to build an organism?
- How can complex cell behaviours be modelled by computers and what can we learn from computer models?



Science at
EMBL covers a
wide spectrum
of themes in
basic research
ranging from
the study
of single
molecules...



...to an
understanding of
how they work
together in
complex systems
to organise cells
and organisms

Bioinformatics and Computational Biology

Molecular biology produces an overwhelming amount of data, which has to be collected, organised and made available. Large databases are needed to store this information, which includes DNA and protein sequences, molecular structures, genome information and scientific literature. As a service, EMBL establishes, updates and curates such databases and makes them freely available worldwide. In addition, research groups focus on computational biology to develop programs and models that simulate dynamic processes. Others generate tools to extract information by analysis of data from diverse fields of biomedicine.

- What kind of information can we extract from DNA sequences and genomes?
- How can proteins and their interactions be classified and understood?
- What does biological data tell us about evolution and the relationship between species?
- How can computer models help us to understand complex physiological processes?

Gene Expression

The genome encodes the information that coordinates cellular processes, from RNA transcription to the regulation of protein machinery.

The gene expression programme takes a systems biology approach to unravel these complex processes at all scales, integrating global approaches at a genome level with detailed mechanistic investigation at a molecular level.

- How do molecules interact within networks to enable complex biological processes?
- How is gene expression regulated through the interplay of epigenetic modifications and transcriptional control?
 - How is protein function controlled through post-translational modifications and protein interactions?
 - How does variation in genomes lead to phenotypic diversity, including diseases?

Structural Biology

Proteins have unique three-dimensional structures, which enable them to interact and become part of the molecular machines that carry out almost all processes in a cell. One wrongly built protein can threaten the function of an entire cell. To understand protein structures and interactions, EMBL scientists employ tools including powerful X-ray sources, electron microscopes and methods relying on magnetic resonance.

- How do molecules interact in complexes?
- Through which molecular mechanisms do proteins function in the cell?
 - Can you predict a molecule's function from its 3D structure?
- How do viruses and bacteria infect human cells and cause diseases?

Systems Biology – The big picture of life

When scientists first started to explore molecular biology, they focused on the details. But how do all the single components interact in a system, such as a living cell, or even a whole organism? When interrelated elements work together they develop new properties that cannot be understood simply by studying their components. Systems biology links all levels of biological organisation, bridging the gaps between different scales from molecules to organisms and even entire ecosystems.

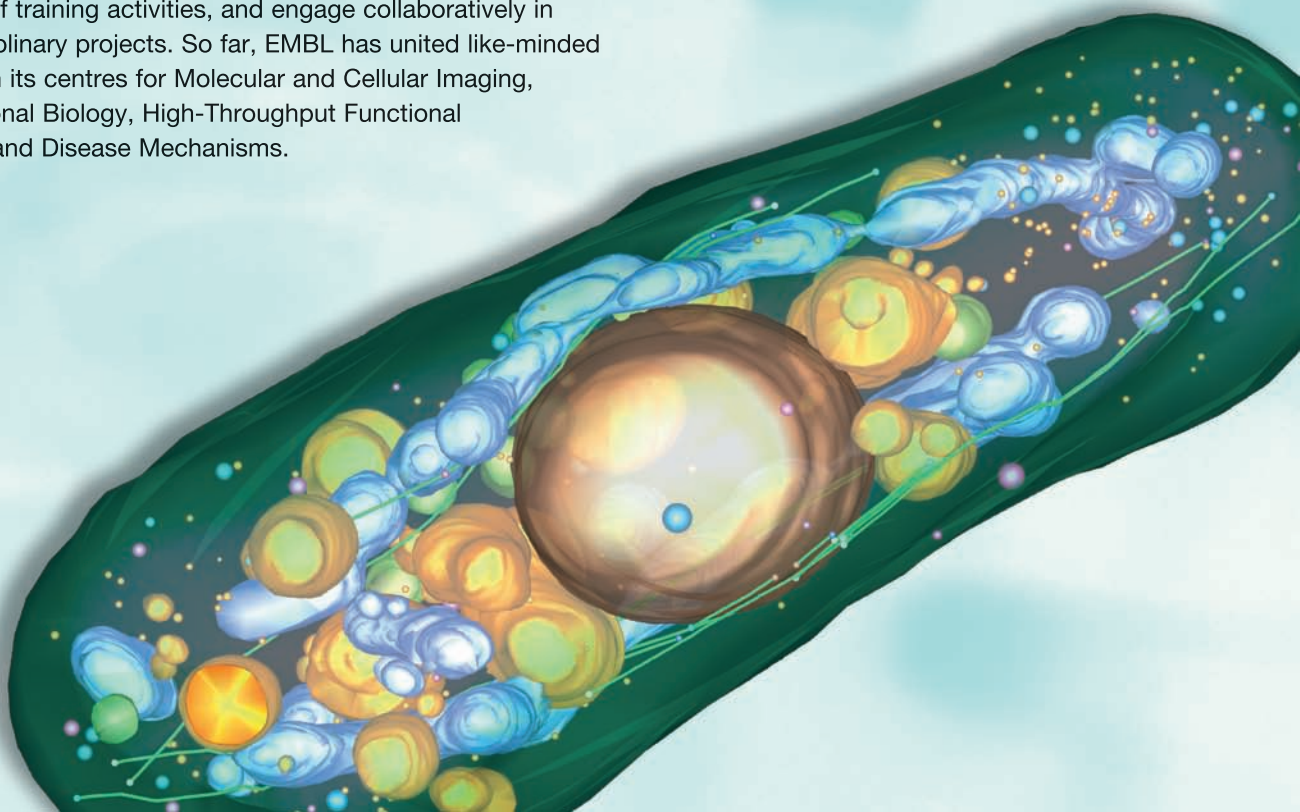
At EMBL, scientists from different disciplines bring together the complementary expertise needed for systems biology and apply it to investigate how molecules interact within the cell to form structures like the cytoskeleton, the cell's internal scaffold, and how it influences a cell's behaviour, or to observe how connections between brain cells help form memories. A combination of cutting-edge computational and structural techniques provide first-hand insights into the interactions of molecules and their self-organisation into cell complexes and entire cells.

EMBL Centres

Tackling systems biology and other interdisciplinary projects requires expertise from more than one scientific field. EMBL brings together researchers with different backgrounds and similar interests in thematic centres. Here they can exchange knowledge, ideas and experiences in seminars and conferences or as part of training activities, and engage collaboratively in cross-disciplinary projects. So far, EMBL has united like-minded scientists in its centres for Molecular and Cellular Imaging, Computational Biology, High-Throughput Functional Genomics and Disease Mechanisms.

“Scientific understanding is often beautiful, a profoundly aesthetic experience which gives pleasure not unlike the reading of a great poem”

Paul Nurse



Services



More than 300,000 unique hosts use the free bioinformatics data resources provided by EMBL-EBI at www.ebi.ac.uk every month. The best-known include EMBL-Bank, Europe's primary resource for DNA and RNA sequence information; UniProt, a comprehensive protein sequence database; PDBe, Europe's data resource for macromolecular structures; Ensembl, a database of genomes including the heavily annotated human genome; and ArrayExpress, a repository for gene expression data.



More than 2,000 users per year benefit from EMBL's facilities for powerful X-ray and neutron sources at the Hamburg and Grenoble outstations to study the structure and functions of proteins. Both sites also provide additional services to the user community. Examples of these include high-throughput facilities for protein expression and crystallisation, innovative diffraction instrumentation, automatic sample changers for rapid crystal screening and free access to data interpretation software.

PETRA III

EMBL Hamburg is building an integrated research facility for structural biology at the new PETRA III storage ring of the German Synchrotron Research Centre (DESY), soon to be one of the world's most powerful radiation sources. The new facility, EMBL@PETRA3, will comprise a complete and automated pipeline for structural investigations of proteins and other biological molecules. EMBL@PETRA3 and its services will be accessible to structural biologists from all around the world. This new addition to EMBL Hamburg's existing facilities will start operations in 2010/2011.

ELIXIR

EMBL coordinates the [ELIXIR \(European Life sciences Infrastructure for Biological Information\)](#) initiative within the European Strategy Forum on Research Infrastructures (ESFRI). Coordinated by EMBL-EBI, ELIXIR's objective is to secure funding commitments from government agencies, charities, industry and intergovernmental organisations throughout Europe to strengthen and sustain a world-class infrastructure for the management and integration of information in the life sciences.

Partnerships

Networking the scientific community

EMBL enters into partnerships with member state institutions of comparable standard, vision and international orientation. These partnerships, which can operate either locally or further afield, foster research collaborations at the institutional level in overlapping and complementary scientific areas. Their aim is to create an interlinked system of excellent institutions and thus enhance the development of the molecular life sciences across Europe and beyond.

The following partnerships have been established to date:

Unit of Virus Host Cell Interactions (UVHCI)

- University of Grenoble
- National Center for Scientific Research (CNRS), France

Nordic EMBL Partnership for Molecular Medicine

- University of Umeå, Sweden
- University of Helsinki, Finland
- University of Oslo, Norway

Partnership for Systems Biology

- Centre for Genomic Regulation (CRG), Barcelona, Spain

Partnership for Structural Biology

- European Synchrotron Radiation Facility (ESRF)
- Institut Laue Langevin (ILL)
- Institut de Biologie Structurale (IBS), Grenoble, France

Molecular Medicine Partnership Unit

- University of Heidelberg, Germany

Marine Molecular Biology Partnership

- SARS International Centre for Marine Molecular Biology, Bergen, Norway

Partnership with DESY

- German Synchrotron Research Centre (DESY), Hamburg

EIROforum

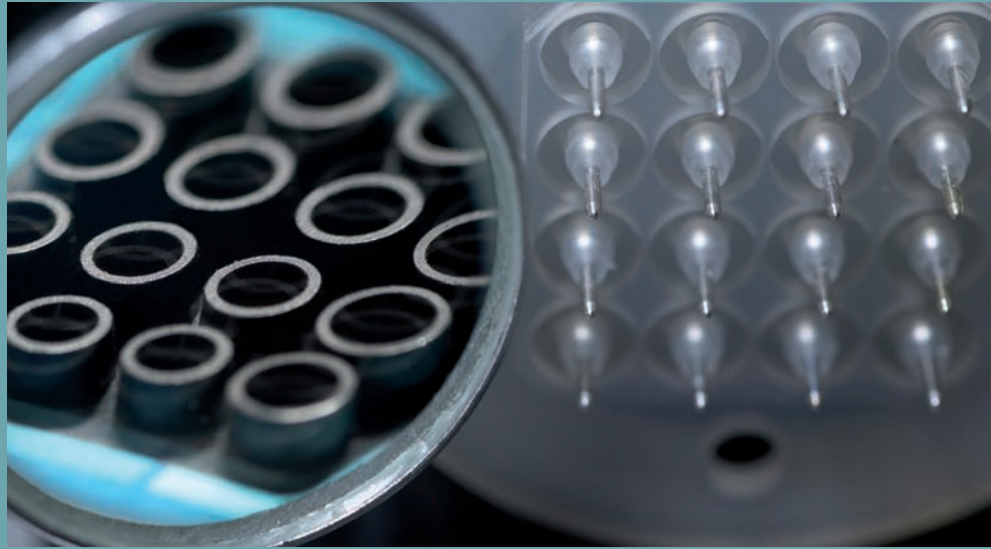
EIROforum brings together seven intergovernmental research organisations in Europe: CERN, EFDA-JET, EMBL, ESA, ESO, ESRF and ILL. These organisations serve European science and pursue joint initiatives, combine resources and share best practices.

EMBL and the EC

The relationship between EMBL and the European Commission is built on mutual recognition and reciprocity. EMBL's main role in the European research area is as a provider of major infrastructure in the biomedical sciences. It receives a significant part of its external funding from the EU Framework Programme (€17.1 million in 2007). In Framework Programme 6 (FP6), EMBL was responsible for the coordination of 18 EC-funded projects and participated in more than 80.

Instrumentation and technology

With its continuous development of innovative instruments and software, the provision of essential services by its core facilities and the transfer of new technologies, EMBL's discoveries and innovations are disseminated to the scientific community, industry and hence to society as a whole.

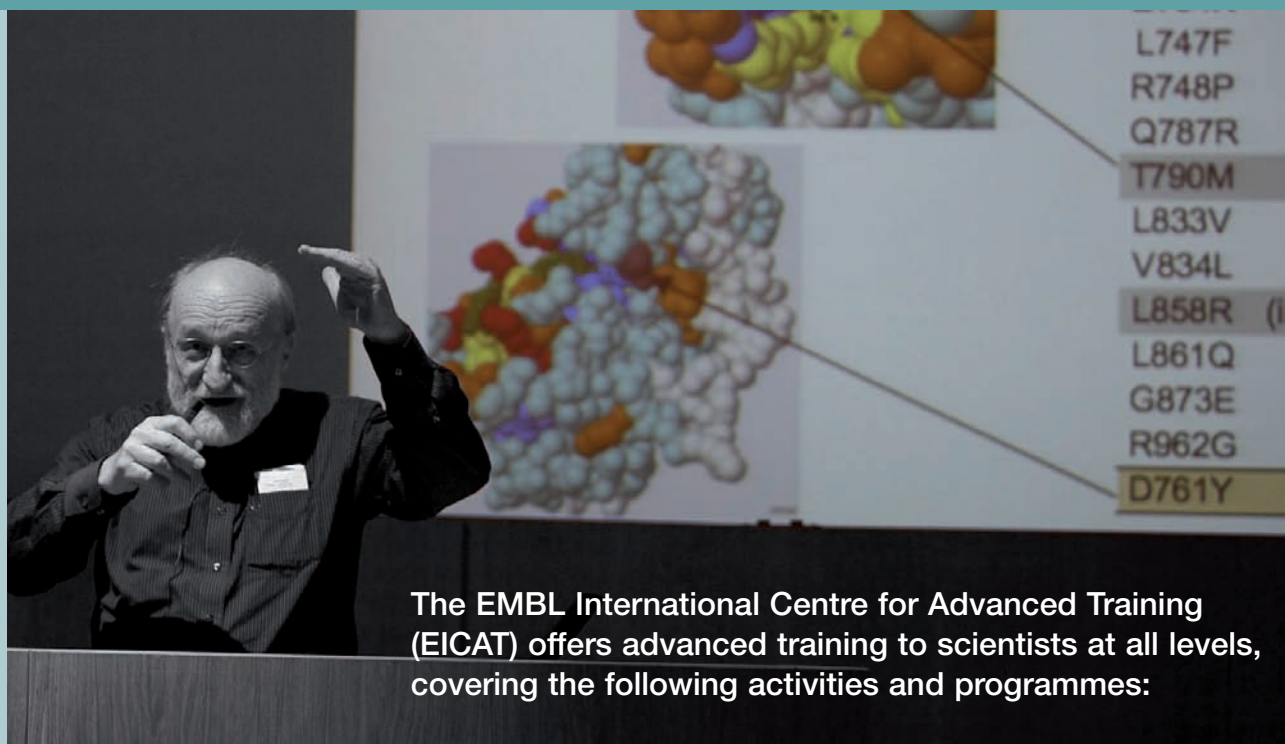


Instruments and techniques developed at EMBL include the use of synchrotron radiation for crystallography, mass spectrometry of proteins, and light and electron microscopy methods. In addition, EMBL's bioinformatics researchers develop and disseminate software that, used in conjunction with EMBL-EBI databases, allows life scientists to, for example, compare structures or predict molecular interactions. An area of prolific current activity is the generation of tools that enable quantitative image analysis and storage.

The core facilities (Advanced Light Microscopy, Genomics, Proteomics, Protein Expression and Purification, Electron Microscopy, Flow Cytometry, Monoclonal Antibodies and Chemical Biology) are dedicated to critical, widely used techniques and their provision to EMBL's research groups. This maximises the efficiency of researchers' time and minimises expenditure on costly equipment.

The technology transfer company EMBL Enterprise Management GmbH (EMBLEM), founded by EMBL in 1999, identifies, protects and commercialises the intellectual property developed by the EMBL community, by EMBL alumni and from non-EMBL third parties. EMBLEM facilitates and accelerates the transfer of innovative technology from basic research to industry by working closely with industrial partners spanning the biotech, IT and mechanical and electrical engineering markets. EMBLEM currently manages a portfolio of over 250 individual patents, patent applications, copyrights, trademarks and utility models. The technology portfolio spans the life sciences in the broadest sense and includes enabling technologies, molecular tools, techniques, instruments and software programs and databases.

Training at EMBL



The EMBL International Centre for Advanced Training (EICAT) offers advanced training to scientists at all levels, covering the following activities and programmes:

The EMBL International PhD Programme

welcomes about 50 graduates every year from all over the world to pursue a PhD within EMBL's interdisciplinary research projects. After 3-4 years at any one of the EMBL sites they are awarded degrees from EMBL and one of its 29 partner universities. The programme, one of Europe's most competitive PhD training schemes, fosters early independence by mentoring and training on an individual level.

The EMBL Postdoctoral Programme provides an exciting environment for postdoctoral fellows. They join EMBL for two years or more to work in world-class research facilities. They also benefit from high-quality seminars, a vibrant international atmosphere and academic mentoring, all of which guarantees excellent support at this important career stage.

The EMBL Interdisciplinary Postdoc (EIPOD) initiative promotes interdisciplinary research by combining scientific fields that are usually separate or by transferring techniques to a novel context. This project supports up to 20 postdocs per year working in at least two labs, spanning different research fields.

EMBL Courses and Conferences keep pace with the increasing complexity and interdisciplinarity of the life sciences and are organised by EMBL alone or jointly with the European Molecular Biology Organization (EMBO). To overcome capacity limitations and allow more scientists from all over the world to benefit, a new Advanced Training Centre (ATC, see opposite) is being built on the EMBL Heidelberg campus.

The EMBL Visitors' Programme welcomes more than 500 scientific visitors per year from all over the world, including collaborators, senior scientists, PhD students and undergraduates, at all the EMBL sites. They come to work in EMBL's top research facilities, develop collaborations and learn new techniques and methods.

The European Learning Laboratory for the Life Sciences (ELLS) aims to bridge the gap between research and schools. The education facility runs unique courses for high-school teachers which translate the cutting-edge research at EMBL into activities easily transferable to the classroom.

Communicating science

EMBL's Science and Society Programme promotes a broader understanding of the growing social and cultural relevance of the life sciences. It organises a variety of activities and events where members of the scientific community, scholars from other disciplines and members of the public meet to discuss and exchange ideas.

Lab visits: EMBL offers non-scientific visitors, such as school classes, visiting students or political delegates, the chance to get an insight into what goes on in the laboratory. Organised tours through EMBL laboratories, hands-on practicals and interesting talks about science give visitors a taste of life and work in a basic research institute like EMBL.

Science in School, a journal for science teaching supported by EIROforum, promotes inspiring teaching not only in the areas of biology, physics and chemistry, but also in maths, earth sciences, engineering and medicine. It features news about current scientific discoveries and topics, interviews with inspiring teachers and scientists and reviews of books, films and websites, and provides teaching materials and many other useful resources.

SET-Routes: One of the best ways to encourage young women to take up careers in science, engineering and technology (SET) is to present them with women scientists who have made it to the top. SET-Routes, an EU-funded project between EMBL, the European Molecular Biology Organization (EMBO) and the European Organization for Particle Physics (CERN), sends female scientists to schools and universities to share their enthusiasm for science.

Advanced Training Centre

The **EMBL Advanced Training Centre (ATC)**, which opens its doors in autumn 2009, will be a unique European centre combining cutting-edge facilities for education of scientists with the infrastructure required to host international conferences. The main building, in the structure of a double helix, will host state-of-the-art training facilities for practical courses and computer labs together with a 450-seat auditorium and a large display area for the presentation of scientific posters.



European Molecular Biology Laboratory

Heidelberg • Hinxton • Grenoble
Hamburg • Monterotondo

EMBL Heidelberg

Meyerhofstraße 1
69117 Heidelberg
Germany
Tel. +49 (0)6221 387 0
Fax +49 (0)6221 387 8306
info@embl.org

www.embl.org

EMBL's member states:

Austria, Belgium, Croatia, Denmark,
Finland, France, Germany, Greece,
Iceland, Ireland, Israel, Italy,
Luxembourg, the Netherlands, Norway,
Portugal, Spain, Sweden, Switzerland
and the United Kingdom.
Associate member state: Australia

