11. Training: Learning for Life

Introduction

Training is a cornerstone of EMBL as one of its five missions. The ultimate aim is to stimulate and foster scientific inquiry and discovery among scientists, students, and visitors at all levels. Scientific training is coordinated by the **EMBL International Centre for Advanced Training (EICAT)**, a cross-cutting unit which drives initiatives, develops, and continuously evolves training programmes for the benefit of EMBL, its member states, and beyond. EICAT works hand in hand with EMBL's scientists at all EMBL sites, assisting and collaborating with them in achieving their ambitious plans.

EMBL prides itself on providing state-of-the-art scientific training for internal and external participants. The internal training arm of EICAT oversees the training and career development of all **EMBL fellows**, which includes predoctoral and postdoctoral researchers at EMBL. The external training arm coordinates EMBL's internationally renowned **Course and Conference Programme** and delivers training to the scientific community at large.

In this EMBL Programme, training at EMBL will embrace the new scientific themes of global importance, which are key to the Molecules to Ecosystems Programme, and continue to share best practice in scientific training.

EMBL's scientific training programmes aim to:

- Provide learning opportunities for researchers, empowering them to excel in their profession;
- Be at the forefront of training new types of scientists through a world-leading course and conference programme;
- Be leaders and models in scientific training in Europe;
- Exchange best practice in training with institutes in our member states and beyond.

Internal Training for EMBL

An Innovative Vision for EMBL Internal Training

EMBL's internal training programmes are central to the Laboratory's success as they provide training for tomorrow's leaders in multiple fields from academia to industry and other sectors. The training programmes are developed in order to foster scientific progress and to meet the needs of EMBL faculty. To ensure that EMBL continues to lead Europe in providing the highest quality training and career development for scientists, a number of new cross-cutting measures make up the core of EMBL's innovative vision for internal training.

Scientific Training of Fellows and Students

Through scientific training programmes which span both breadth and depth, EMBL provides fellows - predoctoral and postdoctoral - with outstanding training and career development opportunities such that they are able to realise their full potential. Training and inspiring the next generation of scientists are essential to drive science at EMBL and in its member states, where many EMBL alumni hold leading positions in academia, industry, and beyond. EMBL constantly develops its training programmes to reflect its ever-evolving scientific aims and to enable training across the scientific breadth of EMBL's faculty.

In line with the Molecules to Ecosystems Programme, EICAT aims to provide training and career development support to enable tomorrow's scientific leaders to tackle global challenges. State-of-the art training modules on the new research themes will be developed and integrated into the existing portfolio. Other initiatives include developing workshops that make scientists aware of their global responsibilities, including topics such as research integrity, open science, and citizen science. To help establish and strengthen EMBL's new transversal themes, dedicated activities for the pre- and postdoctoral programmes will be established. In addition, shifts in the scientific and overall career landscapes require that EMBL's training programmes evolve to remain at the forefront of graduate and postgraduate education. A steady increase in the number of research groups has also led to a growing number of EMBL fellows.

Embracing and Integrating New Themes into EMBL Training Programmes

The EMBL Programme seeks to expand into new areas of research such as planetary biology, human ecosystems, infection biology, microbial ecosystems, and theoretical biology. In addition, the increasing importance of data sciences in the life sciences calls for scientists who are able to fully exploit their own as well as publicly available data. To meet this need, training in data management and analysis will be developed in collaboration with the EMBL data science centre (Chapter 8: Data Sciences). A focus on open science, in line with EU objectives, will also be an important theme. These priorities need to be reflected in the training offered to EMBL fellows. Close links to centres of excellence and experts within the member states will be essential to fulfil this mission, particularly in areas where EMBL is still developing expertise. Collaborations with the École Normale Supérieure (Paris, France) and Biosphere 2 (Oracle, Arizona) will support EMBL's new initiatives in molecular-level ecosystems research. EMBL's links with the Tara Ocean Foundation research vessel and the European Marine Biological Resource Centre (EMBRC) will be essential for the development of its planetary biology research training plan. Furthermore, scientists with expertise in engineering, physics, mathematics, and artificial intelligence will be important to support EMBL's Programme. Collaborations with prominent national and international research organisations, including the Institute of Bioengineering of Catalonia (IBEC), the Italian Institute of Technology (IIT), the Institute for Theoretical Biology (Humboldt University), the Alan Turing Institute, and the European Laboratory for Learning and Intelligent Systems (ELLIS) will be invaluable. Through the new sabbatical programme, leading experts in the scientific areas EMBL plans to explore will spend time at EMBL. The engagement of these experts will contribute to high-quality training in the new research areas for EMBL fellows.

Attracting Fellows with Diverse Scientific Backgrounds to Drive Research in New Areas

One of the major challenges for EMBL will be to attract young researchers with educational backgrounds in EMBL's emerging areas. EMBL is well known amongst biologists but does not yet have the same recognition in other STEM fields such as chemistry, physics, mathematics, engineering, or computer science. It is therefore critical to raise the visibility of EMBL's training programmes at pertinent university departments through information sessions, targeted advertising campaigns, and other mechanisms. Current fellows and faculty who have educational backgrounds outside of biology will be encouraged to actively engage as EMBL ambassadors in their scientific communities.

Another, and perhaps the most effective, way to attract talented students with non-biology backgrounds is to offer them opportunities to experience EMBL's unique interdisciplinary work environment firsthand. The **EMBL Lautenschläger Summer School for Undergraduates**, which launched in 2019, is a two-week workshop exclusively targeted to students from STEM fields outside of biology. The first edition exceeded expectations, and further annual workshops with a focus on emerging research topics are planned. The

expansion of the **Scientific Visitor Programme**, the extended **EIPODs Inspire mentoring scheme**, and the potential establishment of a **Master's degree programme** will provide additional opportunities for non-biology STEM students to train at EMBL.

EMBL International PhD Programme (EIPP)

The **EIPP** is one of EMBL's flagship programmes. The programme was established in 1983 and continues to be a leader and model for graduate education in Europe. From the highly competitive pool of 1,800 applicants, between 50 and 60 students are admitted into the programme each year (Figure TR1). There are approximately 220 PhD students at EMBL at a given time, 70% of which come from EMBL's member states and study alongside talent from around the world. There is a diverse student body representing approximately 50 nationalities. The success of the EIPP and its students is illustrated by relevant key performance indicators (Figure TR1).

The EIPP strives to offer an ideal training environment for predoctoral fellows to develop into mature and independent scientists. This requires the right balance between theory and practice, individual mentoring and creative freedom, as well as teamwork and early independence. EIPP fellows enjoy close mentoring by their group leaders (the average student-supervisor ratio is 3:1) and benefit from the scientific and career guidance of their thesis advisory committees. In addition to the excellent scientific training the fellows receive in the laboratories, they benefit from the EIPP **complementary curriculum**, which consists of the compulsory **core course** and optional activities. The EMBL predoctoral course represents the core of the EIPP portfolio, providing broad interdisciplinary training (including theoretical and practical sessions), cohort-building, and networking across the EMBL sites. The course has three compulsory parts: a nine-week course in the first year taking place in Heidelberg; a one-week bioinformatics course in the second year at EMBL-EBI; and, from 2020 onwards, a two-day career development workshop which will be offered twice a year at different sites. EIPP students are free to choose additional training according to their individual needs and interests. They can take advantage of the course offerings from the **Complementary Scientific Skills Programme** or the Human Resources-based **Professional Development and Training Programme**, both of which are free of charge. There are also plenty of opportunities to develop hands-on transferable skills by participating in the organisation of PhD symposia and retreats or in public engagement and teaching activities. EMBL continues to place a stronger emphasis on helping students to reach their professional aims in the changing job market for life scientists. EIPP fellows are encouraged to seek guidance from the **EMBL-wide Fellows' Career Service**.

EMBL has been proactive in integrating the EIPP with its member states by establishing a network of partner universities and offering joint PhD degrees in 17 member states. This allows students to maintain scientific links to their home countries and fosters exchange with national higher education systems. Over 700 students have received their PhD degree in the framework of such an agreement.

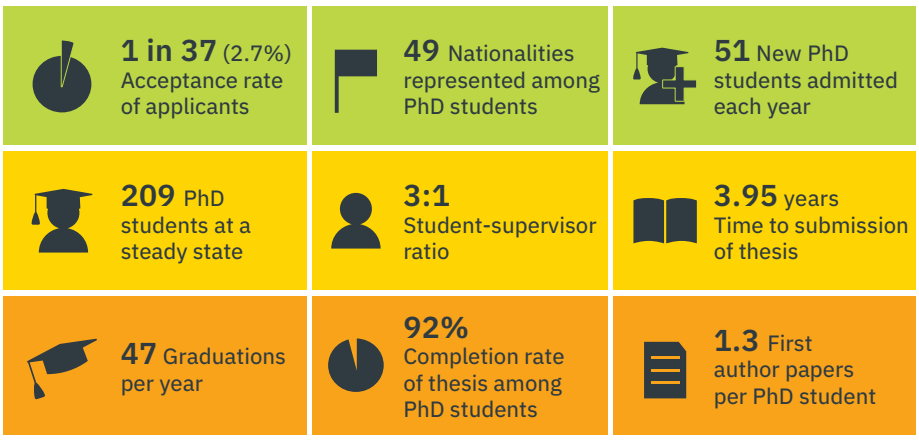

Figure TR1 | EIPP key performance indicators (2015–2019).

The EIPP has grown significantly in the last 20 years; annual class sizes doubled within this timeframe reaching cohorts of close to 60 students in recent years. An increased diversity of educational backgrounds has also been observed with a growing fraction of predoctoral fellows coming from fields outside of biology. To accommodate the growth of the programme and to allow students more flexibility in tailoring training to their own needs, EMBL will adapt the EIPP complementary curriculum. The initial core course will be condensed to cover essential training for all early-career scientists engaged in interdisciplinary life sciences research. This will include modules on research integrity, open science, statistics, critical thinking, planning and analysing experiments, as well as a broad overview of research topics represented at EMBL. Fellows will have the choice to select up to three elective in-depth scientific modules.

EMBL's new scientific themes will be integrated into the PhD curriculum as part of the planned restructuring of the core course. New content will be developed by EMBL faculty – with the support of external experts as needed – and offered to the predoctoral community as soon as possible. New modules will be established that reflect the new EMBL Programme, in, for example, microbiology, infection biology, ecology, and epidemiology. Furthermore, the EMBL data science centre will provide training to PhD students in data analysis throughout their thesis work.

New supervision and mentoring formats will also be explored. Joint EMBL supervisors with complementary expertise could be extremely beneficial for PhD students who work on highly interdisciplinary projects or for those who do not have a traditional biology background. If successful, such co-supervisions could be expanded to include external group leaders at top European academic institutions which would help EMBL form closer ties with member state experts in the new research areas. A similar format could also be considered for industry group leaders working in R&D.

Reaching out to other sectors will be an important focus of EMBL's training and career development portfolio for PhD students. The EMBL Fellows' Career Service will take the lead in establishing an **EIPP Internship Programme**. Students may choose to conduct an internship of up to three months in a non-academic area of their interest, e.g. industry, publishing, patent law, consulting, science policy, science administration, science communication, or science education. Another ambitious project will focus on training the next generation of industry leaders and entrepreneurs. EMBL will cooperate with different local business schools to set up a curriculum that will allow selected predoctoral fellows to pursue a **joint MBA/PhD**. Similar double-degree curricula will also be explored for other sectors, such as science journalism or science policy. This will help meet society's need for highly-skilled policymakers and communicators who are able to build bridges between science and society.

EMBL Postdoctoral Programme

EMBL's scientific excellence makes it an attractive destination for postdoctoral researchers. Approximately 240 postdoctoral fellows from around the world work across EMBL's six sites at any given time. Postdoctoral fellows join EMBL with personal merit fellowships, funds available to the group or team leader, or via one of EMBL's fellowship programmes. The **EMBL Interdisciplinary Postdocs (EIPOD) programme** has an intake of approximately 20 fellows per year. A number of site-specific fellowship programmes involving individual EMBL sites and their local partners also offer 2-3 joint fellowships every year, including the EMBL-EBI–Sanger Postdoctoral (**ESPOD**) Programme, the EMBL-EBI–Cambridge Computational Biomedical Postdoctoral (**EBPOD**) Fellowships, and the EMBL Rome, EMBL-EBI, and the Italian Institute of Technology (**REBIT-POD**) programme. Finally, fellows can join via the **EMBL | Stanford Life Science Alliance Bridging Excellence Postdoc fellowships** or via **EMBL-GSK postdoctoral positions**. Regardless of the route of entry, the fellows are all part of EMBL's Postdoctoral Programme, which seeks to foster early independence while providing individual mentoring, training, and career development support. Like the predoctoral fellows, postdoctoral

fellows benefit from the EMBL Fellows' Career Service, Complementary Scientific Skills Programme and the HR-based Professional Development and Training Programme. Postdoctoral fellows also have many opportunities to develop leadership and networking skills by being a postdoctoral representative, serving on an EMBL committee, contributing to the biennial postdoctoral retreat, and more.

The EIPOD programme has seen continued success in attracting promising young researchers from around the world and fostering interdisciplinary collaboration across the EMBL sites and beyond (Figure TR2). EIPOD fellows work on self-designed interdisciplinary research projects involving two or more EMBL groups. Fellows are able to also involve external academic partners, industry partners, and clinical partners in EIPOD projects. This provides fellows with a wider range of training and also increases EMBL's collaborations across multiple sectors and with member states. Since 2015, 37 external research partners, 84% of whom were from EMBL member states, participated in projects. In the framework of these collaborations, EIPOD fellows address many exciting and challenging biological questions. EIPOD projects have focused on the hunt for new insecticides with EMBL groups and BASF, on understanding drug resistance in tuberculosis patients with EMBL groups, the University of Oxford, and the National Reference Center for Mycobacteria, and on predicting drug mode of action using high-content databases and machine learning with EMBL groups and the University of Stanford. The programme has been successful in obtaining two grants (EI3POD and EIPOD4) from the European Commission under the Horizon 2020 Marie Skłodowska-Curie Actions (MSCA) COFUND programme covering recruitment years 2015–2018 and 2019–2021.

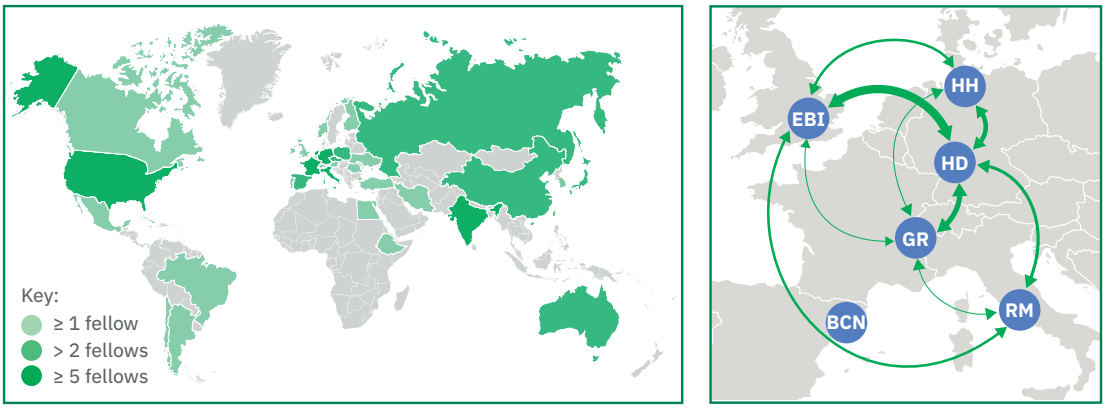

Figure TR2 | EIPOD programme.
Left: Nationalities of the EI3POD and EIPOD4 fellows (2015–2019). **Right:** EIPOD projects involving cross-site collaborations (2007–2019).

The EIPOD programme continues to be a tremendous stimulus for advancing postdoctoral training and truly ambitious interdisciplinary science at EMBL. Several successful training formats that were piloted within the EIPOD programme, were subsequently rolled out to the entire postdoctoral community. A prime example is the EMBL-wide Fellows' Career Service that is based on the pioneering work of the EIPOD career advisor hired under the EI3POD programme. Furthermore, a number of trainings developed for the EI3POD programme have now been made available to all fellows as part of the Complementary Scientific Skills programme.

Looking to the future, EMBL will train postdocs to engage in and propel EMBL's new interdisciplinary scientific directions. EMBL's inherently multidisciplinary environment provides postdoctoral fellows with unique opportunities to develop the skills needed to lead teams composed of scientists with very diverse backgrounds. The EIPOD programme has been successful in large part due to this environment. The EIPOD programme will continue to be funded by EMBL and further developed to encompass the new transversal themes. Specifically, some EIPOD fellowships will be reserved for projects targeting these themes. Training in data management and open science will be available to all fellows. A dedicated workshop on both topics is planned for the EIPOD4 fellows starting in 2020, and will be offered EMBL-wide via the Complementary Scientific Skills Programme.

The career destination study conducted in 2017 (Figure TR3) and biennial surveys indicate that an academic career path is still the main goal of many EMBL fellows. Targeted workshops, such as an early academic career workshop to identify and develop skills needed for academic positions, will be offered. Given that teaching is also an important component of most academic positions, EMBL will identify formal teaching opportunities for fellows to develop their teaching skills which will build upon the existing informal teaching opportunities.

EMBL is establishing a new **Career Accelerator for Research Infrastructure Scientists (ARISE)** programme which, like the EI3POD and EIPOD4 programmes, will be co-funded by EMBL and a MSCA COFUND grant (Chapter 14: People, Processes, and Places). This novel training programme for future research infrastructure (RI) scientists will be implemented by EMBL in collaboration with 46 partner organisations, 17 of which are non-academic and will enable informative **intersectoral secondments** (Chapter 12: Innovation and Translation). The ARISE fellowships are for scientists who seek to advance technology development and operate RIs that provide key scientific services. ARISE is the first fellowship programme of its kind that is providing training for technology developers, allowing them to become highly educated RI scientists. Upon completion of their training, these fellows will have the skills to take on positions as senior scientists or leaders in core facilities, research infrastructures, or technology development groups in academia, industry, healthcare, or other sectors.

EMBL Fellows' Career Service

The introduction of a career service for all fellows in September 2019 was an important development for EMBL's internal training programmes. EMBL career advisors offer dedicated support to enhance the career planning of fellows, thereby promoting successful and timely transitions into their preferred career once they leave EMBL. The current portfolio includes individual support via career guidance appointments and a job application clinic, the organisation of workshops and events, and the provision of career resources. The initial feedback from the fellows' community regarding this service has been overwhelmingly positive and EMBL plans to extend the range of activities in the coming years.

To meet the training and career development needs of EMBL fellows, EMBL conducted a career destination analysis of pre- and postdoctoral fellows leaving EMBL between 1997 and 2016 (Figure TR3). The survey results encouraged the creation of the EMBL Fellows' Career Service. While the majority of EMBL alumni are engaged in academic research, there is evidence of an increasing diversity of careers, and fellows hold a broad range of roles - often at the leadership level - in academia, pharma/biotech, and in other sectors. The outcomes underscore the benefits of EMBL's training programme and also call for incorporating additional training approaches and activities that are geared towards sectors other than academia. EMBL will share experiences and best practice for setting up a career service with its member states and partner institutions.

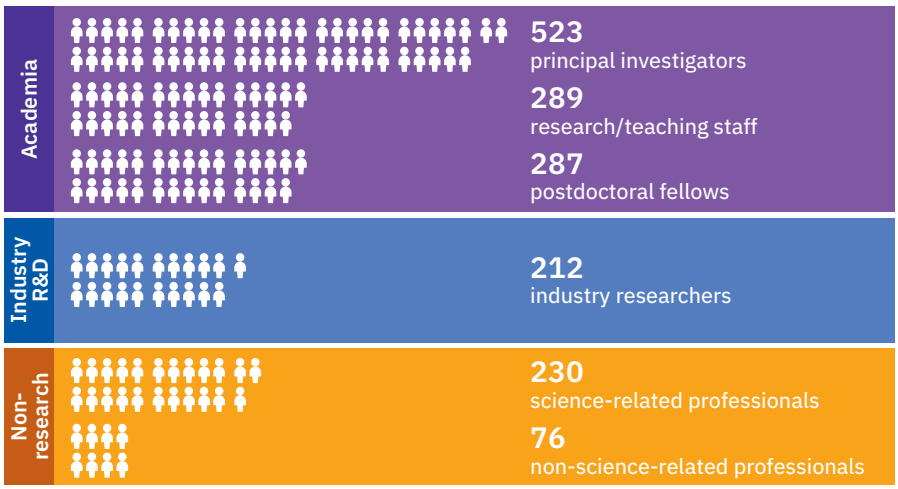

Figure TR3 | Career destinations of EMBL fellows.

Career outcomes were surveyed in 2017 among 1,617 EMBL alumni fellows who left EMBL between 1997 and 2016. This represents 87% of predoctoral and postdoctoral fellows who left EMBL during this time period.

New Training Initiatives for Undergraduate and Master's Students

As part of the training mission, EMBL research groups host many early-stage researchers at the undergraduate and Master's student level. EMBL will create a structured programme for this group, initially focused on Master's students who carry out their practical thesis work at EMBL. Supervision arrangements and a project plan, including targeted training (e.g. complementary courses such as research integrity, critical thinking, and scientific presentation or writing), will be required for each student. Pre- and postdoctoral fellows who take over the day-to-day supervision in the laboratories will complete a dedicated training to prepare them for this responsibility.

To further promote the new research themes, EMBL will link up with relevant Master's programmes at selected universities to attract students with appropriate educational backgrounds. If successful, these collaborations could be further developed into joint Master's programmes or could be built upon to create an EMBL MSc/PhD programme.

Within the framework of EMBL's EIPOD programme, a mentoring scheme **EIPODs Inspire** will commence in 2020. Master's students accepted into the competitive scheme will be paired up with and receive mentoring from EIPOD postdoctoral fellows. EMBL proposes to extend this scheme into a new EMBL-wide summer research internship mentoring programme. This would allow a cohort of 20–30 students from EMBL's member states to experience the unique research environment at EMBL. It will also benefit EMBL pre- and postdoctoral fellows who would like to strengthen their skills as mentors.

Complementary Scientific Skills Programme

Building up a competitive skill set is an essential first step towards a successful career transition after EMBL. The Complementary Scientific Skills Programme was established in 2019 and offers courses to complement the outstanding research training provided by the Laboratory with the aim of rounding the scientific profile of EMBL fellows. In the first year of the programme, 23 new courses covering scientific writing, grant writing, scientific presentation, poster design, working with journalists, scientific project management, lab leadership, preparing for the academic job market, and interviewing for industry positions were offered across EMBL's six sites. While primarily established for the fellow community, the Complementary Scientific Skills Programme is also popular with other categories of scientific staff (group leaders, staff scientists, project officers) who make up 31% of the participants. EMBL plans to expand this programme to incorporate new trainings into the portfolio such as data management, open science, critical thinking, supervision, and teaching. In 2020, EMBL rapidly adapted during the SARS-CoV-2 pandemic and offered many planned trainings online and through digital formats. Based on the overwhelmingly positive feedback from participants, EMBL will expand the catalogue of online workshops in the future. This will further increase the reach of the programme and allow EMBL to provide the same training to the scientific communities at all EMBL sites.

Engaging with Member States

Sharing best practice in training and career development is an important contribution by EMBL to the scientific community, especially for member states. In addition to providing high quality career guidance to EMBL's fellows community, the Fellows' Career Service maintains a blog that features interview-based profiles of life scientists with diverse careers and regularly organises career events. When possible, these events will be streamed to interested institutes in EMBL member states. In order to support institutions in EMBL member states in their provision of career guidance, EMBL will develop a workshop focused on how to set up a career development service for fellows in the life sciences.

Engagement with EMBL member states will include sharing best practice in graduate and postgraduate education, training formats, and workshops. For example, EMBL established an annual workshop and networking event on training with other graduate programmes in member states. The event was a forum to exchange best practice, trends in graduate education and building expertise. This network will be expanded, thereby contributing to strong connections in higher education across Europe. Concepts and plans for new and pertinent workshops planned for EMBL fellows, such as those on open science and data management, will also be shared. Additionally, EMBL will build on recent successes in 2020 with online training to reach a broad community within the member states.

Due to its long-standing expertise in developing meaningful training formats, EMBL is a leading role model for pre- and postdoctoral training. EMBL's fellowship programmes have served as a model for many similar initiatives across Europe. To multiply the impact of the proposed novel training formats, EMBL will continue to share best practice with institutions in the member states. In addition, EMBL's growing community of alumni, including over 500 former fellows who are now group leaders – many in EMBL's member states – are well placed to advocate for the benefits of standard-setting programmes at their next places of employment after EMBL.

External Training for the Scientific Community

Through external training programmes, EMBL enables scientists in and beyond its member states to maximally benefit from EMBL's powerful combination of high-impact research, cutting-edge technology, and state-of-the art training facilities. The programmes provide a forum to initiate and sustain contact between the international scientific community and EMBL's greatest asset – its people. This may be for short periods, through courses, conferences, or webinars, or for longer periods through the EMBL Scientific Visitor Programme. Whatever the mechanism, external training provides vital opportunities to share knowledge and ideas which stimulates new science and discovery. These exchanges not only support EMBL member states, but also help to drive science within EMBL.

Advancing EMBL External Training

EMBL's ambitious plans for its external training offerings reflect the new Programme as well as emerging scientific topics. The requirements of the scientific community continue to shape EMBL's external training programmes.

Course and Conference Programme

EMBL's courses and conferences strive to share the very best of EMBL with the global scientific community. Scientists at all six EMBL sites work with their collaborators worldwide to deliver a rich and dynamic programme representing the full spectrum of EMBL's activities and interests. With **nearly 30 conferences and more than 60 courses each year**, the growing programme, including the **EMBO | EMBL Symposia** and the Scientific Visitor Programme, forms the backbone of EMBL external training. Approximately 6,000 to 8,000 attendees are hosted each year across EMBL for courses and conferences, and many more are welcomed at off-site events or online; around 75% of the participants come from EMBL member states. EMBL's courses and conferences are seen by member state scientists - together with the EMBO Programme - as a leading European programme for receiving excellent training in the life sciences. The Course and Conference Programme strives to provide a curriculum that reflects scientific trends. In recent years, areas of focus have included omics technologies, from genomics and proteomics to metabolomics and lipidomics.

The large datasets connected with these technologies require knowledge on data integration, interpretation, storage, and mining, as well as modelling and prediction. Systems, quantitative, and synthetic biology are also important new topic areas. Courses have been requested on using CRISPR/Cas systems in genome engineering and cryo-electron microscopy in structural biology and imaging. The integration of multi omics data is predicted to be an essential new training topic for the foreseeable future. The programme constantly strives to cover these important topic areas.

In addition, EMBL will direct the evolution of the Course and Conference Programme into the exciting new areas of the Molecules to Ecosystems Programme. The new themes will be integrated in balance with essential core elements. New conferences and courses on topics of global importance, such as species dynamics, biodiversity, phenotypic plasticity, and ecosystem preservation and restoration will be offered, starting in 2020 and 2021. All new conferences and courses will focus on molecular biology approaches, and EMBL's expertise and technologies will be shared through these training opportunities. Other emerging and pertinent topics include personalised health and medicine, machine learning and artificial intelligence in the life sciences, synthetic biology, and neurobiology of behaviour. EMBL's new themes will be prioritised (planetary biology, human ecosystems, infection biology, and theory), and cross-cutting themes such as data sciences will be integrated across the programme. New conferences and courses on topics such as Microbial Infections and Human Cancer and Genomic Data Surveillance of Communicable Diseases are planned. Other new topics will be developed in collaboration with external scientific faculty, for example through the EMBO | EMBL Symposia, EMBO Practical Courses, Wellcome Genome Campus Advanced Courses, and externally funded projects in which EMBL is a partner such as BioExcel, CABANA, or EOSC-Life. New training offerings will also come with the opening of the **EMBL Imaging Centre** in Heidelberg. EICAT will support the scientists in the centre and integrate new imaging courses into the Course and Conference Programme, such as practical courses on cryo-electron microscopy and tomography, or high-level image analysis.

The storage, mining, and analysis of large-scale datasets is one of the most exciting areas and also one of the greatest challenges of molecular biology today. EMBL will develop and integrate new training on data sciences with courses on Mathematical Modelling of Biological Processes and Theoretical Biology. These courses will make EMBL more visible to computational scientists, engineers, and mathematicians, which in turn will help attract experts in these disciplines to EMBL. The creation of the data science centre (Chapter 8: Data Sciences), with an explicit remit to contribute to both external and internal training, will support this ambition.

The Course and Conference Programme and EMBO | EMBL Symposia are coordinated by EMBL group leaders and EMBO members, respectively. On specific courses and conferences, EICAT collaborates with EMBO and other partners, including the companies within the **EMBL Advanced Training Centre Corporate Partnership Programme (CPP), Wellcome Genome Campus' Connecting Science**, and **Cold Spring Harbor Laboratory**. EMBL offers fellowships to cover registration fees and/or travel costs for selected scientists at all stages whose participation depends on receiving financial support. Each year, member state scientists attending scientific events in the **Advanced Training Centre (ATC)** can benefit from approximately 250 CPP fellowships or more than 200 fellowships subsidised by scientific funding organisations, such as EMBO and Boehringer Ingelheim Fonds.

The Course and Conference Programme has increased its portfolio due to the excellent reputation of EMBL's training events in the scientific community, the increased visibility of the programme and venue, and the seamless support by the EICAT team across all six sites. The programme contains important elements that are considered essential by certain groups of scientists; some EMBL conferences are the primary gathering in a given field and attract large audiences, contributing to EMBL's high profile and strong training reputation. Prominent examples are the conferences Transcription and Chromatin, Protein Synthesis and Translational Control, Chromatin and Epigenetics, and The Complex Life of RNA, each of which regularly brings more than

400 participants. There are often hundreds of applications for a small number of course places. EMBL-EBI offers world-leading bioinformatics training courses. These central elements are continuously evaluated and developed to ensure they remain at the forefront of their fields.

Whilst the majority of participants are from academia, EMBL's reach is multi-sectoral. Many partners from industry are involved in EMBL training activities. Many world-leading companies are members of the CPP and several advanced training courses are held in close collaboration with the partner companies. EMBL's industry partners collaborate to develop new training that is relevant for people working in industry. Public sector scientists, especially those from the healthcare sector, also actively participate in EMBL's courses and conferences. Targeted courses and conferences have been developed for these interest groups. Finally, EMBL coordinates its training activities with European research infrastructures, including ELIXIR (Europe's distributed infrastructure for biological information), and Euro-BioImaging (the research infrastructure for biological and medical imaging) as well as other prominent programmes like Cold Spring Harbor and Keystone symposia.

EMBL Scientific Visitor Programme

The EMBL Scientific Visitor Programme gives researchers from its member states and beyond access to EMBL's state-of-the-art core facilities and technology platforms at EMBL. The programme enables visiting scientists to carry out experiments, experience the collaborative scientific atmosphere, and contribute to EMBL's dynamic and international culture. The programme also promotes active exchange with universities and research institutes worldwide. It allows young scientists from less well-funded backgrounds to benefit from the top-quality training at EMBL sites. In order to support EMBL's Molecules to Ecosystems Programme, the Scientific Visitor Programme plans to offer new fellowships and create a sabbatical programme.

In recent years, the Scientific Visitor Programme has been reshaped as the number of scientific visitors has organically increased. Approximately 75% of the 650–700 visitors who come to EMBL each year are long-term visitors who stay for at least three months and up to one year. Many of these visitors are pre- and postdoctoral fellows from EMBL member states, who come to carry out an important experiment or a part of their research project in collaboration with an EMBL group. Visitors who come for shorter visits often make use of EMBL's core facilities, including the genomics and microscopy facilities. Around 300 additional scientific visitors a year are expected in the EMBL Imaging Centre, which will begin providing services in 2021 (Chapter 10: Scientific Services).

New Thematic Fellowships and Sabbatical Programme

EMBL proposes to offer fellowships for visitors at all career levels related to the new themes to enable the brightest early-stage scientists, primarily pre- and postdoctoral fellows, to gain experience at EMBL and contribute towards the new thematic areas. The fellowships will be open to all disciplines of interest, including mathematicians, physicists, or computer scientists, who will help foster emerging topics such as theory and data sciences. Additionally, secondments from member state organisations to engineering groups at EMBL can take place to undertake extended knowledge transfer via, for example, the Genomic Medicine Platform (Chapter 10: Scientific Services).

EICAT will also support the development of a sabbatical programme that will foster high-level knowledge exchange between senior professionals. Sabbatical visitors will be invited according to EMBL scientists' interests, especially in the new areas. The Theory in Biology sabbatical programme was launched in 2020 (Chapter 9: Theory at EMBL). The goal of these three-week to six-month fellowships is to promote theory-based approaches across EMBL through the formation of new contacts and collaborations.

Further calls for fellowships and support activities could be modelled on existing programmes, such as EMBL-EBI's **CABANA project** for capacity building in Latin America. This project currently supports approximately ten visitors a year, including senior researchers, who spend up to six months embedded in an EMBL-EBI group and perform challenge-led projects with the support of the Global Challenges Research Fund. Themed calls can be centrally coordinated. Projects fitting the themes will need to be of mutual interest to both the visitor and the hosting EMBL scientist.

Supporting Capacity Strengthening in EMBL Member States

EMBL scientists informally provide a great deal of training within and beyond EMBL's member states, and EMBL strongly supports the continuation of these activities. Most of these activities are not organised by EICAT but instead are organised on an *ad hoc* basis with support from local staff. Complementing these bottom-up initiatives with a more structured programme for off-site training would increase the support that EMBL provides to the member states and the scientific community, and could catalyse new collaborations between EMBL and scientists in its member states, allowing for greater capacity building in host countries.

TREC, the coastline exploration project (Chapter 7: Planetary Biology), will provide training at several sites in member states. The training will be focused on the technologies installed in the mobile services (Chapter 10: Scientific Services), as well as on sharing expertise at the specific research sites like European marine biology stations. The portfolio will include courses on sample collection and preparation for advanced microscopy and multi omics analysis, as well as the necessary training for the subsequent bioinformatics and data analysis. The training opportunities arising from the TREC project will be complemented by outreach and networking activities (Chapter 15: Public Engagement, Communications, and Outreach) and will also involve citizen science approaches. Member state scientists and group leaders will benefit from excellent training courses without the need to travel, as well as from direct integration into the EMBL scientific network. The member state institutes will gain visibility through involvement in this exciting project.

Enhancing Training Impact and Reach

EICAT is actively enhancing EMBL's **e-Learning programme**. In 2020, EMBL reacted swiftly to the SARS-CoV-2 pandemic by delivering scheduled courses and conferences through virtual formats. The research community enthusiastically embraced the virtual events, which included question and answer sessions and informal networking elements. In line with the next EMBL Programme and to increase the reach of great science, EMBL's External Training Programme will build upon these successes. A lively programme of virtual events will be integrated with pre-existing activities such as EMBL-EBI's **Train Online resource and webinar programme**. The focus of EMBL-wide e-learning will continue to be on the development of high-quality content unique to EMBL, including stand-alone courses on technologies and methodologies that EMBL scientists are the leading experts in. A team of instructional designers will transform the expertise of EMBL scientists into engaging, interactive, and virtual courses and conferences. EMBL will develop a **Thought Leader Webinar Series** on the new themes. Inspirational speakers – from within and beyond EMBL – will provide virtual training in new topics, with a negligible carbon footprint. This will contribute to EMBL's growth in the new themes and provide invaluable training content in an accessible format.

External Training Portal

EICAT will create an online training portal providing seamless access to all types of training (face-to-face, virtual-live, and on-demand). The portal will provide its users with a complete online course and conference catalogue, access to all online training and webinars, a personal page enabling learners to track their individual training paths, and a collaborative space to support the development of communities of practice. Users will be able to find training addressing their field of interest and the biological questions they are trying to answer, the competencies they need to gain, and the format that best fits their needs. The portal will have the flexibility to incorporate new training models, including the thought leader webinars and green conferences.