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# Welcome to the D-CHAB

The Department of Chemistry and Applied Biosciences (D-CHAB) is devoted to a broad and thorough education of students in chemistry, pharmacy, chemical and bioengineering, and in interdisciplinary sciences. By inspiring our students and by equipping them with theoretical and practical skills, we shape the future of Swiss chemical and pharmaceutical industry and related businesses. By their critical, science-based thinking, our graduates contribute to the development of Swiss society as a whole. By our diversity and internationality, we endow our graduates with a global perspective. Their education is our main contribution to society. As a department of a research university, we train doctoral students and postdoctoral assistants, and we mentor assistant professors with the aim to make them future leaders in their research fields. This endeavor is based on our collaborative research environment and our critical mass in chemistry and chemistry-related sciences. We can thus pursue interdisciplinary research that is thorough and represents the state of the art in all involved disciplines. Our research is directed at fundamental understanding of the structure of matter, of chemical reactions, and of the chemistry of life processes. Furthermore, it addresses the practical issues that arise for Swiss industries, Swiss society, and, indeed the world as a whole, from a changing environment. Future focus areas include catalysis, chemical biology, materials chemistry, ultra-fast and sustainable chemical processes, the new opportunities that arise from digitalization and machine learning in our fields, and the contribution of chemistry and pharmacy to health sciences.









#### **D-CHAB | Department Overview**

#### Mission and Organization of the D-CHAB

The D-CHAB aspires to be the premier address for Swiss and international researchers at all levels, from doctoral students to Full Professors, in the molecular sciences, the preferred address for ambitious Swiss and European students in Chemistry, Chemical Engineering, and Pharmaceutical Sciences, and a preferred academic partner for the chemical and pharmaceutical industry worldwide.

As shown in the organizational chart, the D-CHAB consists of five institutes that represent the three core disciplines of chemistry (LAC: Inorganic Chemistry, LOC: Organic Chemistry, LPC: Physical Chemistry), engineering aspects (ICB: Chemical and Bioengineering), and pharmaceutical sciences (IPW). To function smoothly, this large and diverse department requires professional infrastructure and service units in order to ensure safety, to provide informatics and mechanical workshop support, to manage the technically sophisticated laboratory building HCI, to provide access to literature and other information sources, and to ensure fast, convenient, and economical supply of consumables. Situated in the HCI building, ICBP and HCI Shop are catering to the needs not only of D-CHAB members but also of other departments. Furthermore, the D-CHAB sustains a lean public relations and outreach unit and contributes to professional education with a teaching laboratory for the education of chemistry technicians.

Teaching is organized along the curricula and implemented by the institutes. Each set of bachelor and master curricula with different character is usually supervised by its own Director of Studies.



#### Who is Who at D-CHAB

The Department Head, elected for two years, is the point of contact between ETH Zurich Executive Board and the Department. He/ She chairs the Department Conference and Professors' Conference, implements their decisions and represents the Department to the outside world. He/She is responsible for the proper use of the departmental financial resources and ensures that all interest groups can voice their concerns and contribute their ideas for the development of the Department. He/She chairs all doctoral examinations and can be substituted in this function only by his/ her Deputy or by a former Department Head.

**Department Coordinator and Controller:** The Coordinator of Department is the point of contact between the school management, the departments, and the institute administration. He/she supports and relieves the department head, and manages the departmental business in many different areas. He/She is responsible for Department and Professor's conferences, internal meetings, and represents the D-CHAB at conferences and committees. As Controller, he/she is responsible for the department's financial planning, budgeting and controlling. He/she heads the doctoral administration.

Department Coordinator Teaching: The Coordinator of Academic Affairs is responsible for planning, coordination, and controlling department conferences and make recommendations. in the field of education and teaching, for organizational issues in Teaching Commissions: A Director of Studies heads a teaching curriculum development and master student admission. The tasks are also in the area of regulatory affairs, in this function he/she commission (three at D-CHAB), which acts as an Advisory Body communicates with the staff of the Rectorate. He/she heads the and files motions to the Department Conference. Teaching com-Study Administration Offices for Chemistry, Chemical Engineering, missions discuss teaching evaluations, propose changes in the Biochemistry - Chemical Biology, Interdisciplinary Sciences and curricula and are involved in the revision of program regulations. Pharmaceutical Sciences. His/her team is completed by an Edu-The Coordinator Teaching, lecturers, students, and academic staff cational Developer who is, for example, in direct contact with the are represented. The responsible Student Administrator acts as faculty and thus has direct knowledge of lecturers' specific needs secretary of the meetings, which are held twice per semester. in their teaching activities.

#### **Conferences & Comissions**

**The Department Conference** is the supreme decision-making "body" of the D-CHAB. It elects the Department Head and his or her Deputy as well as Committee Heads and Delegates to ETH Committees. Furthermore, it files motions to ETH Zurich Executive Board. Members of the Department Conference are all the elected professors and representatives of the group of postdocs, senior scientists, doctoral students, undergraduate students, and of the administrative and technical staff. The Department Conference meets six times per year.

The Professors' Conference conducts all business related to habilitation, promotion of professors, evaluation of assistant professors, and the initiation of tenure procedures at ETH Zurich level. It can file motions to the Department Conference. The Conference meets at least six times per year (additional meetings possible).

The Meeting of the Heads of Institutes (Executive Board) is held monthly and chaired by the Department Head. The Executive Board consists of the Department Head, his/her Deputy and all Heads of the Institutes. Permanent guests are the Department Coordinator and Coordinator of Academic Affairs, the responsible for the HCI building, the responsible for Human Resources at the D-CHAB and the head of the HCI Shop. This meeting serves as an Advisory Board to the Department Head and as a platform for communication between the Department Administration and the Institutes. It may prepare resolutions for the attention of the department conferences and make recommendations.

**Strategy Commission:** The Strategy Commission of the Department consists of representatives of all five institutes. This commission is responsible for drafting the four-year strategic planning documents of the Department, which are approved by the Department Conference. **Tenure Commission**: The Tenure Commission of the department organizes the evaluation of assistant professors, as stipulated in ETH regulation RSETHZ 510.21, and the preparation of tenure proceedings. It consists of representatives of the five institutes, which must be associate or full professors. The Tenure Commission reports to the Department Conference.

#### Committees

Master Programs Admission Committees: Any holder of a federal or federally accredited Swiss or Liechtensteinan matriculation certificate is entitled to start Bachelor's studies at ETH Zurich (the only exception is the medical curriculum, where admission is based on an ETH Zurich external entry exam). Bachelor graduates are entitled for consecutive Master studies. However, all other students must apply formally if they wish to enter a Master program. The Admission committees to the degree programs determine whether the candidates fulfil the requirements and submit a recommendation for admission or rejection to the Rector.



**Doctoral Committee:** Applicants to the Doctoral Program directly contact a prospective advisor, who suggests a topic for research and may interview the candidate to determine suitability. When the prospective advisor has provisionally accepted the candidate, the office of the Prorector for Doctoral Studies handles the admission procedure. An evaluation is conducted of the candidate's background, which includes two key criteria: (1) whether the undergraduate program of study of the candidate matches in scope and content that of the D-CHAB at ETH Zurich and (2) the performance of the candidate in relevant courses as judged by the transcript of grades. Depending on the evaluation, the Prorector's office may suggest extended doctoral studies. In such cases the Doctoral Committee decides on the extent of these studies. Within twelve months after provisional admission by the Prorector of Doctoral Studies, students are assessed by an aptitude colloquium based on a doctoral plan (further details on page 45).

#### **Delegates for ETH Zurich Functions**

**D-CHAB Members in ETH Zurich Positions**: Several professors of the D-CHAB are or were part of the extended leadership of ETH Zurich, and act, e.g., as Vice President for Research and Corporate Relations, Associate Vice President for ETH Global, and Vice Rector for Doctoral Studies.

**For Good Scientific Practice:** In 2018, the Executive Board of ETH Zurich established a school-wide commission for Good Scientific Practice, which acts as an interface between strategic planning and the research basis. It coordinates teaching topics for this subject, updates regulations on scientific integrity, and can propose candidates for the function of Trusted Intermediaries. The delegate of the D-CHAB represents the department in this commission and reports back to the Department Conference.

**Further ETH Zurich-wide commissions:** D-CHAB has representatives in the Tenure Commission of ETH Zurich. Furthermore, there are Department delegates in the Lecturers' Conference, professors, who are members of the Research Commission or represent the D-CHAB in the Environmental Commission, and delegates of ETH Zurich President for professorial appointments.

#### **Delegates for Specific D-CHAB Functions**

**For IT Support**: The D-CHAB has an IT Support Group (ISG), which is composed of the ISG lead (ISL) and the IT coordinators - one for each institute and one for the Information Center Chemistry | Biology | Pharmacy. The ISG is responsible for the IT support and for the maintenance and development of the IT infrastructure in the department, and is coordinated by the department's delegate for IT. The ISL represents the department in the ETH-wide commission of experts in IT (ITEK).

For the Chemistry | Biology | Pharmacy Information Center: The Committee for the Information Center is composed of representatives of the five institutes of the D-CHAB, two representatives of the Department of Biology and one representative each of the Department of Material Sciences and of the student associations for chemistry and biology. It controls the use of financial and personnel resources assigned to the Center by the D-CHAB and D-BIOL and meets twice per year to approve expenses and the operational policies proposed by the Head of the Information Center.

**For Public Relations and Science Communication:** The delegate is entrusted with the Public Relations activities and Science Communication. He/She reports to the Department Conference.

**For Safety, Health & Environment:** The delegate chairs the departmental Safety, Health, and Environmental Protection Committee, liaises with the central SGU unit of ETH Zurich, and reports to the Department Conference.

**For Buildings:** All the rooms for teaching and research at D-CHAB are provided by ETH Zurich, who is also responsible for their maintenance. However, the only partial air-conditioning required by Swiss federal law and a large part of the infrastructure of the building are best run by the department, mainly because they are safety-related and critical for access to the experimental facilities. Hence, responsibility for this technical equipment "Betriebstechnische Anlagen" (BTA) has been delegated to the department. Maintenance of BTA is supervised by an engineer, who, together with the delegate, coordinates a commission composed

of representatives of each of the five institutes of the D-CHAB as well as of the other Departments who operate laboratories in the HCI building. The commission identifies equipment failure, including systematic defects, coordinates large-scale maintenance operations, ensures a coherent procurement policy for BTA, evaluates service contracts, and prepares an annual budget.

**For Workshops:** The delegate for the workshops heads a committee, consisting of representatives of the five institutes of the D-CHAB and a representative of the D-MATL, which is responsible for the maintenance of equipment, replacement of obsolete machinery, and acquisition of new machines with support from ETH Zurich equipment program and from the departmental share of overhead funds. He/She reports to the Department Conference.

**For Central Administration/HCI Shop:** The delegate supports the leadership of the HCI Shop in its service to departmental research, chemical inventory, and laboratory courses.

**For Teacher Training in Chemistry:** The delegate participates in the teaching of the course "Lehrdiplom für Maturitätsschulen" and bears the main responsibility for the course unit "Fachwissenschaftliche Vertiefung mit pädagogischem Fokus" in the subject Chemistry. She/he is a member of the ETH Teaching Conference on Didactic Training, is the contact person for scientific matters related to teaching and admission issues, and advises students.

For Chemistry Laboratory Technicians: The D-CHAB delegate for the Lehrlabor oversees the management of the Chemistry Lehrlabor on behalf of the department and acts as a liaison person with ETH Berufsbildung

Furthermore, there is a delegate, one for **Continuing Education** and one for the **Awards Committee**. They are responsible for the management and administration of their areas.

### Faculty

The total student number enrolled in BSc and MSc curricula at the D-CHAB has steadily increased during the past decades, for instance, by 56% from 2008 to 2018. While the number of new entrants fluctuates more strongly than total headcount, it also shows an upward trend. In order to keep the quality of our teaching, we need to increase faculty numbers approximately proportionally to student numbers. This mandates that, upon retirement, faculty needs to be replaced without gaps and that replacements at assistant professor level need to be made ahead of time, since assistant professors carry a much-reduced teaching load. Furthermore, we expect further growth in student numbers in the future, in part because a new chemical biology curriculum has recently been introduced. Therefore, we expect a slight growth of faculty. Regarding research strategy, new appointments are increasingly being made at the interface between disciplines.

#### Service Units at D-CHAB

#### **The Central Mechanical Workshop**

The central mechanical workshop of the D-CHAB is an integral part of the research infrastructure of the department by providing comprehensive services to all of its members. It is equipped with state-of-the-art machinery, such as five-axes milling machines, laser-welding devices and 3D printers. The workshop designs, manufactures and assembles custom-made scientific instrumentation in close collaboration with the research groups of the D-CHAB. The members of the workshop also handle infrastructural tasks, such as the delivery systems for cryogenic gases (helium and nitrogen) or the installation of laboratory equipment. They develop, repair and maintain the research equipment and provide consulting support on all mechanical guestions. The members of the mechanical workshop also closely collaborate with the research groups in the realization of complex research equipment. The central workshop is organized in two units, one being associated with the LPC and LOC, the other one with the ICB, LAC and IPW. The two units are independent, both reporting to

their respective institutes or laboratories. Nevertheless, the two units work in close collaboration, exchange knowledge and share the machinery. They jointly plan and coordinate the acquisition and replacement of the machines. The particular strengths of the D-CHAB central workshop originate from its operational principle and lean management structure. The workshop members are deeply involved in the conception, planning and execution of the research infrastructure, which optimizes the quality of the products at minimal time investment. An efficient cost-sharing principle supported by the department circumvents time-consuming item-by-item billing.

#### HCI Shop

The HCI Shop is a service facility of the D-CHAB covering a vast range of services for research groups as well as for student laboratory trainings (semester practicums). Where useful and practical, these services are accessible also to researchers within the entire community of ETH Zurich. In general, the HCI Shop takes over commercial and administrative duties from researchers as much as possible, allowing scientists to stay focused on research activities. One of the strong points of the HCI shop is to sell articles across the counter. There are >3'300 items on stock from which the approx. 1'200 customers can choose. A personal HCI shop card identifies each customer and the HCI shop staff hands over the requested goods using a barcode scanning system. This way, the sum is directly debited to the account on file. Besides typical laboratory consumables and chemicals, also the wide range of safety articles previously sold by SGU are available over the counter at the HCI shop. Further key services, such as ordering of chemical reagents and lab consumables by a specialized database in an automated way or via a team of sourcing specialists, a repair service for standard lab equipment and the cleaning of laboratory glassware help the research groups save time. A separate desk provides pressured gases and large containers filled with standard organic solvents. Another key area for the D-CHAB is to support the management of laboratory rooms used for student trainings: Each semester, the HCI Shop integrates into a specialized IT system up to 1250 students who belong to 18 training units. Those students are assigned to 25 dedicated labs

within the HCI-building. Each lab bench within these rooms is passing it on to the end user within the HCI building. Some further equipped on demand with an initial set of chemicals and cleaned tasks of interest to all research groups within the department are glassware tailored to the needs of the respective practicum. The managed by the HCI Shop, which are: The supervision of cryogenic gases (liquid helium, liquid nitrogen), the inventory management students obtain keys for the duration of the lab course in order to for all institutes of the department, and the refund of the VOC lock their lab glassware and chemicals in their respective benches. At the end of the semester, all sales to students are consoli-(Volatile Organic Compounds) tax from the Swiss government. All dated and finally invoiced by the central finance services. From resources are paid by the D-CHAB, hence all goods sourced are the logistical point of view, the HCI Shop along with its post office sold to the customers without surcharge. Currently, the HCI shop is the hub for fine distribution of mail arriving at the HCI building. is providing 30% of all its services to institutes not belonging to the D-CHAB. This fraction is increasing. Another dedicated team is in charge of receiving bulk orders, usually delivered on pallets, from the courier or the distributor and



HCI Shop: over 3.300 chemicals and items are in stock.

#### **D-CHAB I Department Overview**

#### Chemistry | Biology | Pharmacy Information Center

The Chemistry | Biology | Pharmacy Information Center (ICBP), www.infozentrum.ethz.ch, is a joint facility of the D-CHAB and the D-BIOL, funded by both departments, and integrated into the operational structure of the D-CHAB. It supports BSc and MSc students, doctoral students and postdocs, senior scientists, and professors from the above departments as well as from the D-MATL and the D-HEST regarding all guestions on information and knowledge management. The ICBP acts as a scientific information skill center, with teaching considered to be a major function. The curriculum developed by the ICBP ensures that students acquire necessary skills in information management and retrieval as part of their education in chemistry, life sciences and materials science. This includes the capacity to judge the relevancy of scientific information as well as the development of knowledge management expertise. In addition, information consultants, who are PhD level scientists, support researchers and lecturers, scout and evaluate new information solutions, and are complemented by a team of library professionals. Finally, the ICBP is also a place to learn and study, and a library with tailored subject-specific services.

Unlike in the past, libraries are no longer solely a provider of printed information, but also educate students, lecturers, and researchers on information and knowledge retrieval, management, analysis, and visualization, as many of the numerous possibilities for doing these are either unknown or underutilized. Thus, since 2012 the ICBP focuses on awareness and teaching initiatives, while providing both library and research services as well as a learning space for students.

The ICBP raises awareness through several channels, the website, newsletters, alerts and Coffee Lectures as well as various onboarding activities.

Firstly, there is the website which was redesigned in 2013 to serve as an information hub for students, lecturers and researchers, no longer focusing on the catalogue, but aiming to direct users to appropriate information solutions. Core features are the dynamic modules "databases" and "tools", curated collections focusing on both quality and licensing through ETH. While many libraries



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have now developed similar websites, this functionality is to our knowledge still unique.

As an additional channel for outreach the ICBP is publishing Infozine – the magazine for users of scientific information, both in English and German. Being freely available, Infozine has several hundred external subscribers – although it is tailored to an ETH Zurich audience.

As Infozine addresses a heterogeneous user group, very specific information cannot be published there. To be able to also disseminate this kind of news, the ICBP created a personalized news service, Infocus, which sends out short news alerts based on an individual's interest profile.

There are often new tools or services that deserve or need a more personal introduction or even a hands-on demonstration so that potential users can realize their benefit. For this purpose, ICBP has developed the Coffee Lectures format, which combines both the awareness and the training approach. Coffee Lectures were invented and introduced already in 2007 by Dr. Oliver Renn in a corporate setting and in 2013 were adopted to the needs of ETH Zurich and successfully launched. Since then, more than 100 universities and institutions around the world have taken up this format (blogs.ethz.ch/coffeelectures).

Among the onboarding activities for students, doctoral students, postdoctoral students and new professors is the "Erstsemester Survival Kit" – given to all first-year students, the Welcome Kits for new scientific staff from the D-BIOL and the D-CHAB, and the Guide for Incoming New Professors, as a basis for a personal introduction into ICBP services.

#### Teaching (Education & Training)

In addition to the above-mentioned awareness activities, the ICBP is using different approaches to establish a curriculum for information literacy, ensuring that students know and use the full power of both licensed and freely available information solutions. Some of its initiatives are part of the course catalogue of ETH Zurich. Teaching starts with introductions for first year students, up to courses for Master and doctoral students, focusing on scientific information retrieval and management but also scientific writing and presenting. There is also a course for doctoral students, "Scientific Information Retrieval & Management in Life Sciences and Chemis-

try", which was developed in 2014 by Oliver Renn. One of the target audiences is doctoral students of the "Zurich Life Science Graduate School", which also includes students from the University of Zurich - an addition suggested by D-BIOL. The course started in 2014 with 15 doctoral students and now has around 140 enrollments from up to eight departments. Courses are accompanied by other formats, like the Research Group Seminar Menu Cards. The idea behind this format is that getting into a training program is easier and more likely if it is enjoyable. As with a menu card in a restaurant, research groups can select an information meal consisting of several courses, ranging from starters to a dessert. The selected menu of a research group is discussed with a representative of the research group or the Principal Investigator and is very much adopted to a research group's needs and their research guestions and, thus, usually requires guite some time for preparation. Since 2015, the ICBP also contributes to the CompiCampus Courses, by regularly giving courses on ChemDraw and PyMOL. On a regular basis, the ICBP will organize and host half- or full-day trainings with specialists from external database providers. The main goals of these events are keeping our researchers up to date on the latest developments in their most-used tools, as well as offering a platform for addressing advanced guestions and applications.

#### **Research Services**

Information Consulting: The scientific staff of the ICBP consider themselves to be Information Consultants, being able to consult on many different issues in information retrieval, analysis, and management. The number of inquiries is steadily increasing. Furthermore, the ICBP has built up expertise on Electronic Laboratory notebooks (ELNs) and offers trial installations, particularly for new research groups, allowing them to find an ELN of their choice. *Data Retrieval*: With the growth of research using deep learning application to address chemical and biological questions, high quality chemical data sets have become increasingly sought-after. ICBP's specialists strive to make such information sources more broadly accessible to our researchers rather than procuring them on a case-to-case basis.

*Science Communication*: With the ever-increasing number of scientific publications, researchers struggle to make their papers known and read. The ICBP helps in using social media platforms



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to reach a larger audience, but also assists in the creation of lay summaries and making research findings accessible for a broader non-expert community. Furthermore, support is offered for the evaluation of the outreach activities.

*Collaborations*: ICBP's subject experts stay in regular contacts with the providers of scientific databases. Regular contributions to testing of and feedback to new features ensure that the needs of academic researchers are met in ongoing development. Further, this activity helps to identify new trends and brings valuable capabilities to the attention of researchers in a timely manner.

#### Library Services

While ETH Library acquires and manages the contracts for e-journals, e-Books and databases (partly on behalf of the ICBP), the ICBP acquires printed books based on an acquisition profile that aligns acquisitions between ETH Library and ICBP. Since 2015, the ICBP has built up a collection on "auxiliary skills", an area very important to educate students broadly, also in critical thinking. The ICBP is part of the Swiss Library Service Platform (SLSP), which enables searching and ordering books and media from 575 libraries via a common web interface. The ICBP is an open-stack library, with books grouped according to subjects. The taxonomy for this cataloging was developed by the ICBP and is continuously adapted. Since 2014, a color code system was introduced for both the shelves and the web to improve orientation.

#### Learning Space

At ETH Zurich, learning spaces for students are limited. The ICBP tries to provide as many learning spaces as possible, while also striving for an excellent environment for studying. In 2013, a sofa lounge was created for relaxed reading and learning. For students' group projects and group learning, we provide six small rooms with flipcharts. Furthermore, as students and researchers now all use mobile devices and tablets, all seats are equipped with power outlets. Additionally, the lockers we provide on a semester-long basis are also equipped with power outlets. The ICBP has extended its opening hours in the evenings and is open on four Sundays during the main examination period.

### **Public Relations D-CHAB**

Public Relations D-CHAB acts as a bridge between the department and the public, in close cooperation with Corporate Communication of ETH Zurich. While Corporate Communication covers a wide range of topics reflecting the broad research spectrum at ETH, PR D-CHAB focuses on communication work related to the topics of chemistry, chemical biology, pharmaceutical sciences, chemical and bioengineering.

#### The target groups are

- the general public (Swiss taxpayers and citizens)
- teachers and students at primary and secondary schools
- decision-makers in industry and politics
- business and industry representatives
- the chemical scientific community, incl. adjacent disciplines
  ETH alumni as a whole.

Public Relations D-CHAB aims to convey to the public the importance and value of chemistry, and to arouse passion, especially among younger people, for chemistry. As the D-CHAB is one of the largest departments of ETH Zurich, it covers a wide span of research activities, yielding about 700 scientific publications. Apart from that, there are also many activities and initiatives that are of interest to the public.

The outreach activities focus on news stories (audio, video, fotos, text) that are communicated via the website as well as other channels of the department, and on events. However, since the restart of PR in 2019, much more is planned and yet to come. This includes a better visibility on YouTube and social media (Twitter, Instagram), to connect young people to chemistry, the D-CHAB and ETH Zurich – which has already started.

PR D-CHAB is now also monitoring how the D-CHAB, its research, its members and its activities are covered in the media, allowing to improve press relations and the impact on the various outreach activities. PR D-CHAB organizes various events, like the Ružička Award Ceremony, the Day of Open Labs (TOL), but also chemistry experiment sessions for children and guided tours for the public. PR D-CHAB is also in charge of the museum in the HCI building, the collections of the D-CHAB and the collection's website. Tours on various topics are held annually for the public and anyone interested, either as part of the ETH Public Tours or as part of other offers such as Science City.



Chemical and Pharmacognostic Collection of the D-CHAB in the HCI building.

#### **Chemical & Pharmacognostic Collection**

Chemistry has many faces, some of them shaped historically. The exhibition in the HCI- building (Floor H), curated by PR D-CHAB, provides interesting insights. A major part of the collection consists of the pharmacognostic collection on stimulants and addictive substances, which was established about 100 years ago by Prof. Dr. Dr. h.c. Carl Hartwich. In the six showcases, selected objects of the approximately 500 instruments and objects for smoking tobacco, opium and hashish, chewing betel and coca, drinking tea, coffee, cocoa, kawa, mate and sake are displayed, as well as a number of beautiful, botanical herbal books.

The exhibits in the chemical collection, on the other hand, show a variety of instruments and convey an idea of student life / the laboratory atmosphere of the last 150 years (also available as virtual 360° lab tour), as well as research work by three Nobel Prize winners in Chemistry from ETH Zurich.

Those who are fond of colors, instead, will be fascinated by the well-preserved cloth pattern books by Dr. Adolf Jenny-Trümpy (also available as online catalogue) and the collection of historical dyes, including various exhibits on indigo.

TIP ⊃ Find more information on the exhibits, the cloth pattern book-catalogue and the virtual 360° lab tour on: https://chab.ethz.ch/en/outreach/collections.html

The entry to the exhibition is free. The opening hours correspond to the HCI building entrance hours: Monday–Friday: 8.00–18.00.



#### Nonus Ordo, Fol. I.

# CELEBERRIMIEYSTETTENSIS

### Horti, Icones Plantarum Vernalium,

Andragora fœmina Pythagoricà allufione, qui, quòd hominis truncum artúf-gue utcunque repraefentaret, radicibus quandóque duo crura & clunes referenti-bus, Anthropomorphon dixit ; nomen fuum traxiffe videur à Germanicà de-nominatione. Man & fragen / quafi hominis effigiem gereret. Cætera anilia circulatorum commenta, fculpendo inde formam hominis ad fuas fuperfitiones efformantia, potius riden-da qu'an rimanda & admiranda cenfeo. Radices promiffe, craffæ, capillaribus fibris hirfutæ, fa qu'an rimanda & admiranda cenfeo. Radices promiffe, craffæ, capillaribus fibris hirfutæ, fa qu'an rimanda & admiranda cenfeo. Radices promiffe, craffæ, capillaribus fibris hirfutæ, fufer intus albæ; trifidis vel bifidis proceffibus demiffis, crurum modo inter fe convolu-is diferminantur: folia prope terram gerunt, quafi orbiculatim digefta, longa, venofa, rugo-herifa, Hippolapathi ferè formà, virore nigricantia, ac in acutum coafa: flores inter hæc planimi fingulatim longis pediculis efferuntur, è quinis fub cœruleo pupurafeentibus a ali-quantim albidis folijs, & tenuibus aliquot ftaminulis, in medio conflati, quibus fuceedunt ma-la divorunda, per maturitatem luteo pallefcentia, odore fua veolenti faporem inducenta.

De Mandrag, vid. Dodon. 454. fol. Ccefalp, lib. 5. cap. 24. f. 215. & 216. Cluf LXXXVII.f.à quo noîtra defcripta videtur. Lobel. Obf. 138. Adv. 160. Lugdunenf.1726. Cam. Epit, Matth. 818. fol.

Hort, Med, 95, fol, Matth, C. Bauh, 759, fol, C. Bauh, Phytopin, 303, fol, German: Altaun das Afriblein, Cam. Matth. Germ, 379. fol. Durant. 573. fol.

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CHelidonium minus. Tefticulus Sacerdotis Sylvatici Favagello Cœfalpini. Ejusdem ra-diculæ caput callofum, in oblongas plurimas, tritici magnitudine, ftrumofas, carnofas appendices coacervatas definit: caulis, palmum altior, longis pediculis fubvehit foliahedera-cea, virore fplendentia, lævia, rotunda, Afari modo, obtufa, & fubinde obfolete purpurante mædia in medio notata : flores radiati, luteo foliorum nitore ftaminula tenuia, concoloria, obfident.

A9

Dodon, 49, fol. Cœfalp, lib. 14, cap.7, fol. 546. Lobel, Obf. 323. Adv. 256. Lugdunenf 1048. Epit, Cam. Matth. 403, fol. Matth. C. Bauh. 468. & 469. Phytopin, C. Bauh. 610. German: Frigwarh/Blatter-Braut/Bayen-Braut. Trag. 35. lib. 1. Fuchf. 333. cap. Tabern. 427. lib. fecundo. Cam. Matth. Germ. 208, fol.

Durant. 235. fol.







#### Science Communication D-CHAB



3D-printed molecular weave to illustrate the article "Weaving with nanothreads"

Until now, science communication was mainly done through journal articles and, respectively, through scientific publishers. With the advent of Open Access publishing, preprint publishing and the threat of extinction of scientific journals and the move towards platforms may shift responsibility to make their research visible even more to the researcher. Today, there are already multiple channels that scientists can use to broadcast their research output. New possibilities for additional outreach come up frequently, including new formats.

Science Communication D-CHAB was established in 2014, when ETH Zurich decided to implement a new web content management system and the D-CHAB saw the urgent need to better showcase its research achievements to the scientific community and the public. Thus, a new web representation was designed and launched in 2015, aimed both for external und internal communication and automated workflows, ensuring that the web pages are always up-to date. Today, Science Communication D-CHAB (SC) has the following responsibilities (since 2020 partly in cooperation with PR D-CHAB):

- Management and continuing development of the D-CHAB website
- Management of the News & Events channel of the D-CHAB
- Management of the events calendar of the D-CHAB
- Management of the information displays in the HCI lecture hall building
- Management of the publication list of the D-CHAB
- Management of the visualization of research areas of the D-CHAB

The publication list and the visualization of research areas are developments of SC. This publication list (www.chab.ethz.ch/publications), based on the researcher's Scopus ID, is automatically updated daily. Optionally, Altmetrica data, which is hidden by default, can be made visible for all publications with one click. Where available, Altmetric data show where publications of our researchers are mentioned outside the scientific literature, such as EU policy documents, news articles, social media or other platforms. The interactive visualization of the department's research areas (see page 51) can be found at https://chab.ethz.ch/en/research/ research-areas.html. Here, the whole faculty is listed in one column, and all research areas found at the D-CHAB are listed in a second column. Hovering with the mouse over a research area shows connections to all professors from this field. Hovering over a professor's name, on the other hand, connects her or his name to all research areas she or he is working in. This provides an intuitive overview on our research portfolio at the D-CHAB.

In the past, SC frequently identified major research achievements of the D-CHAB, published in journal articles and wrote news stories which were directed to the scientific community but also the interested and educated public. The highlights were generally based on interviews with the researchers, and visualizations in 2D and 3D are generated where appropriate. The coverage was in addition to the outreach activities by Corporate Communications, as Corporate Communications covers only very limited only major breakthrough that are additionally of major interest to the public. These activities are currently on hold.

#### **Departmental Platforms**

#### Molecular and Biomolecular Analysis Service (MoBiAS)

In September 2016, the Molecular and Biomolecular Analysis Service (MoBiAS, mobias.ethz.ch) was formed to optimize both the efficiency and use of the financial resources by centralizing instrumentation from individual research groups and departmentalizing core services including mass spectrometry and elemental analysis. MoBiAS supports research activities in the Department of Chemistry and Applied Biosciences (D-CHAB), as well as various research groups in other departments, by providing excellent infrastructure and scientific know-how for the analysis of organic, inorganic, and biological molecules. Since it was established, Mo-BiAS has integrated two existing groups (Mass Spectrometry (MS), and Elemental Analysis (EA) and has established a large Open-Access platform. In 2021, MoBiAS moved to the departmental level.



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**Organizational structure** The MoBiAS director is responsible for the daily operation and for the future development of the group. The director reports to the MoBiAS Steering Committee. The Steering Committee consists of representatives of the various Institutes from the D-CHAB and the D-MATL which constitute the majority of users of the facility (LOC, LAC, IPW, LPC, ICB, D-MATL). The facility has three modes of operation. (1) Drop-off Service where MoBiAS staff perform the various analyses. (2) Assisted access, where customers are trained on the specialized instruments to perform routine analyses themselves and (3) Walk-up Open Access (OA). Facts and Figures The MS Service is equipped with 6 high-end mass spectrometers with the 3 most widely used ionization sources (Electrospray, MALDI and Electron Impact). The service analyses about 10'000 samples per year varying from small organic synthetic molecules to polymers to intact proteins. Early in 2019, a new MS was installed, enabling the analysis of complex peptide mixtures for the Biological Chemistry initiative. In 2020 MoBiAS also started facilitating projects requiring large scale sample measurement (high throughput screening). The Elemental Analysis Service (EA) determines the elemental composition of substances by combustion analysis (Carbon, Hydrogen, Nitrogen, Oxygen, Sulphur) and Ion Chromatography (Chlorine, Bromine, Fluor, Iodine). The EA lab analyses about 5500 samples per year. The Open-Access LC-MS and MALDI-TOF machine park are in extraordinary high use, with an estimated 50'000–60'000 analyses per year. The diverse array of analysis techniques, combined with the technical skills and experience of the team members, make MoBiAS a well-recognized and valued platform. Its key strength is to deliver analytically solid results with a fast turnaround.

#### Small Molecule Crystallography Center (SMoCC)

In December 2012, the X-ray structure analysis facilities of the Laboratories of Organic and Inorganic Chemistry (LOC and LAC) were merged into the D-CHAB's Departmental Technology Platform "Small Molecule Crystallography Center" (SMoCC, smocc.ethz.ch/). This has been a quite remarkable achievement, considering that the previous owners had to agree on the transfer of their instruments and infrastructure to the new platform, which reflects the trustful cooperative spirit within the department. The SMoCC is jointly operated by the institutes LOC, LAC and IPW, but open for all other institutes, too. It supports the research activities in the D-CHAB by providing a variety of characterization techniques, in particular diffraction methods (powder and single crystal X-ray diffraction).

**Organizational structure** With two scientists and one lab technician the SMoCC has three permanent staff members. The managing director is responsible for the operation and reports to the Steering Committee, which represents the three institutes

operating the platform: LOC, LAC, IPW. Also the managing director and the staff crystallographer are members of the Steering Committee.

Facts and Figures The SMoCC operates in total twelve diffractometers (eight single crystal and four powder diffractometers). Two service modes are offered to customers. In the full service mode, samples are received and results of the structure analyses are delivered together with all material, pictures and text necessary for publication. Three diffractometers and the work force of one scientist and the lab technician are mainly dedicated to this mode. The output has been over 570 crystal structures in 2021, which is more than twice as much as in 2012, before the formation of the SMoCC. In the open access service mode, direct access is offered to diffractometers (single crystal and powder diffractometers) for trained doctoral and MSc students. Support and expertise are provided for tackling non-standard problems. Here the output is presently about 1500 structures and 1500 powder diffractograms per year. SMoCC contributes to the education of students in crystallography by teaching (three courses in the fall semester), by seminars, internships, MSc theses, BSc theses, and semester projects and hands-on training at the instruments. SMoCC hosts the Cambridge Structural Database and distributes it to all academic institutions in Switzerland. The main users LOC and LAC share the running expenses and most of personnel cost, IPW contributes 20% of a scientist position. Any revenues from occasional external analyses contribute to covering the running costs.



#### **D-CHAB | Department Overview**

#### Nuclear Magnetic Resonance (NMR) Pool

The Departmental NMR Platform is distributed into three service facilities: LOC, IPW and LAC/ICB.

The NMR facility of the Laboratory of Organic Chemistry (LOC) covers the NMR-spectroscopic needs of over 200 scientists and hosts the NMR lab courses in the Analytical Chemistry curriculum (ca. 100 students per year). Apart from the LOC, also other research groups in the D-CHAB and other departments, as well as at PSI and EMPA use the facility to a minor extent. External customers from small and medium-sized enterprises occasionally submit samples to the NMR service, paying customary market rates (< 1% of the sample load). The platform offers routine experiments on hands-on or fully automated spectrometers as well as the measurement of more demanding NMR experiments carried out by specialists. All spectrometers are embedded in a facility wide IT-system allowing safe and efficient sample submission, spectrometer reservation and central data storage.

The NMR service operates ten solution-state instruments ranging from 300 to 600 MHz. The two 600 MHz spectrometers are both equipped with high-sensitivity cryo-probes also allowing experiments on sub-milligram samples. For samples requiring solid-state NMR there is a long-standing, close collaboration with the LAC NMR facility. To ensure an economical and environmentally responsible use of exhaustible resources, all instruments are connected to the D-CHAB helium recovery facility operating together with the on-site D-PHYS helium liquefaction plant. The director of the facility is responsible for the operation of the NMR service. She/He also teaches the undergraduate courses in NMR spectroscopy within the Analytical Chemistry curriculum and actively supports research projects within the institute and the department via scientific collaborations and technical advice. She/He is assisted by three expert technicians. The technicians are also responsible for the training of new users. Continuous financial investment is necessary to keep the NMR service at a state-ofthe-art level of instrumentation. Financial planning and allocation of resources is organized within the NMR-steering committee of D-CHAB/D-MATL consisting of all NMR group leaders and facility directors. The committee is responsible for the NMR mid-term investment planning that is directly coordinated with ETH Zurich

Vice President of Research. In recent years, an increasing need for standard characterization (COSY, HSQC, HMBC) of samples that are not substance-limited was becoming apparent. This need could successfully be met in 2017 by the replacement of two hands-on 300 MHz spectrometers by two open-access Bruker Avance NEO spectrometers (500 and 400 MHz) equipped with BBFO smart probes and sample changers. But there is also an increasing load of substance-limited samples (including peptides and proteins) that need instruments with even higher sensitivity.

#### The NMR facility of the Institute of Pharmaceutical Sciences

(IPW) provides Nuclear Magnetic Resonance (NMR) Spectroscopy services for the members and research groups in the IPW. It is managed by one staff scientist with the support of one to two PhD students as assistants. Two spectrometers (400 and 500 MHz) are being operated with one available for open access. The open access spectrometer is mainly used for routine solution state NMR on common nuclei for analytical purposes while the other spectrometer is available to advanced solution state NMR techniques (e.g. VT, quantification and multi-dimensional resonance experiments) and operated mainly by the facility staff. The facility's task itself is to provide practical and scientific support for research and teaching within the IPW. The facility also supports other governmental organizations from outside ETH regarding NMR.

The NMR facility of the Laboratory of Inorganic Chemistry (LAC) and the Institute for Chemical and Bioengineering (ICB) provides Nuclear Magnetic Resonance (NMR) Spectroscopy services for the members of the research groups in D-CHAB (LAC, ICB) and D-MATL. It operates 10 NMR Spectrometers (200-700 MHz) with capabilities ranging from open access, routine solution state NMR on common nuclei for analytical purposes to advanced solution state NMR techniques (e.g. Variable Temperature, kinetics, DOSY, quantification and multi-dimensional double- and triple-resonance experiments) on nuclei in the frequency range from 1H down to 103Rh. In addition, the facility has extensive solid-state NMR capabilities with double- and triple-resonance Magic Angle Spinning probes using 1.3 through 7mm rotors on a number of its spectrometers including two with DNP capability. The goal of the facility is to provide practical and scientific support for research projects or lab courses needing just routine analysis all the way through to support for highly complex projects which have NMR as their main focus. On occasion the facility will also support

NMR facility of the LOC at the D-CHAB.



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academic projects from researchers outside the three partner institutes. The facility is run by a staff scientist / manager with the support of PhD students as part-time assistants.

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NMR facility of the LAC / ICB at D-CHAB.

### SU Management

As a department with laboratory spaces, especially chemistry labs, the D-CHAB is strongly aware of the importance of safety and the protection of the environment. So, teaching safety and environmental management, controlling laboratories and writing reports, updating guidelines, and maintaining and testing equipment is fundamental for being able to perform cutting edge research at the D-CHAB. The safety standards are considered highest in international comparison. The department strives for zero incidents and aims for the best possible protection, implementing state-ofthe art technology and measures. Therefore, the D-CHAB has set up its own unit for safety and the protection of the environment. The Safety and Environment Management (SU Management, from German "Sicherheit und Umwelt") is the safety authority deployed by the Department Head of the D-CHAB. Its principal mission is to ensure the adequate implementation of the Safety and Environmental Policy in the D-CHAB and in the entire HCI building.

SU Management is characterized by the spirit of mutual help and cooperation. The SU Manager takes care of the business operations and is the contact person when an incident is reported. Furthermore, the SU Manager is mentoring, advising and training the institutes' safety representatives, internship supervisors and technical platforms of the department on safety issues. The SU management acts according to the guidelines of the expert group Occupational Safety Coordination (Kooras, from German "Koordination Arbeitssicherheit"). In Kooras, users and representatives of Safety, Security, Health, and Environment (SSHE) of ETH Zurich together, with the representatives of the departments present in the HCI building (D-CHAB (SU), D-BIOL, D-HEST, D-MATL), compile answers and solutions for safety-relevant questions.

#### **Training and Information**

The SU management has a portfolio of mandatory trainings, information events, exams, guidelines, and information material. The continuously updated safety guidelines as well as a correct risk assessment are taught in various mandatory and informal lectures and seminars, training for safety officers, administrative

staff and news assistants included. All new persons working at the department have to pass an online safety entry test within their first three weeks of work. Persons working in the labs must also take the Safety Lecture exam. In addition, there are also safety videos available as well as Safety parcours: Two rooms that contain obvious and hidden safety relevant deficiencies and scenes of misconduct, which were encountered on past laboratory inspections and could serve here as training example. SU Management also releases a regularly updated safety manual. This manual provides all information on good practices in laboratory safety and environment, technical infrastructure, emergency management, and risk management. It can be downloaded from the SU Management homepage. This also applies to the safety lectures and further guidelines and documentations, such as guidelines for the correct disposal of waste, which are updated continuously. The guideline on risk assessment includes a detailed analysis on past incidents, what measures were taken, and how these incidents could have been avoided by applying the rules from risk assessment.

#### Safety Maintenance

Regular safety inspections help to reduce the risk of accidents, ensure that security measures are implemented correctly, and allow to determine whether machines and laboratory infrastructure need maintenance work. These safety inspections are carried out biennially in all technical rooms and laboratories (additional inspections possible). After all inspections, laboratory safety reports are written which are kept in a database accessible through SU management. Since 2009, research groups are evaluated according to their safety culture and how they carry out their safety supervision duties. In the case of severe breaches of the safety regulations or in case of safety relevant incidents the SU management informs the professors. Together they look into the issue, take the necessary steps, and elaborate a report on the incident. If a system error has been detected, SU Management will inform Kooras and, if necessary, discuss the case with the Department Head. Additionally, the SU management maintains a list of incidents and compiles incident statistics on a quarterly basis. Together with the safety inspections, these measures help to reduce incidents.

- building can report all safety concerns such ethz.ch) or hotline: 044 633 48 12
- chemicals. Usage of the Toxlabs is docudetailed description of the planned experiment is required.
- station and replacement of the laboratory local cooling water system.
- HCI building.
- work in the building.
- infrastructure.
- with an emergency power supply, emergency cold water supply, CO2backup system for all freezers, and a centralized alarm system are available for all research groups.



#### **D-CHAB | Department Overview**

### Strategy

#### Teaching

Qualitatively and quantitatively excellent teaching is a priority in the D-CHAB. There is a substantial contribution from postdocs, senior scientists and doctoral students whose efforts are essential to the department's teaching. Furthermore, the D-CHAB explicitly follows a policy in which the elected professors carry full teaching loads at both the Bachelor (BSc) and Master (MSc) level. The D-CHAB recognizes that chemistry, as an academic discipline, is built up hierarchically. This implies a clearly structured curriculum, especially in the lower semesters. A feature of our Chemistry curriculum is the requirement to take lectures in each of the subdisciplines throughout the entire Bachelor program. Specialization thus begins only at the Master level, but, even then, the Chemistry Master's students in the D-CHAB take mandatory courses in Organic, Inorganic, and Physical Chemistry. It is the basic position of the D-CHAB that our chemistry students need a thorough grounding in the fundamentals with the full breadth of the field. This position is reflected in the department's position with respect to new faculty appointments. At the same time, we offer curricula in Interdisciplinary Sciences with a focus on physics and chemistry or on biochemistry and physics. Students of Interdisciplinary Sciences select from the courses offered to students of the respective pure sciences and take them together with these students. Within reason, they are free in this selection but receive extensive guidance from the Director of Studies of this curriculum. The Master curriculum in Pharmacy is focused on educating pharmacists for Switzerland. Therefore, it is based on a catalogue of learning objectives as specified in the Swiss Federal Law on Medical Professions (MedBG). To additionally cater for the needs of academic and industrial research in pharmacy, we additionally offer a Master curriculum in Pharmaceutical Sciences. Both Master curricula are based on the same Bachelor curriculum in Pharmaceutical Sciences. Our Bachelor curriculum in Chemical Engineering forms the basis for a Master curriculum in Chemical and Bioengineering. While scientific research is interdisciplinary, our teaching requires faculty who can teach the fundamental courses in the traditional disciplines. The D-CHAB considers this position to be essential to the maintenance and extension of our strength in the

field. Disciplinary teaching is organized along Institute lines. Nevertheless, we recognize the need for a more departmental teaching structure, which is one of our two strategic goals in teaching. Our second strategic goal in teaching is the establishment of a curriculum in Biochemistry - Chemical Biology, which provides students with in-depth theoretical and practical training in the core subjects of chemistry, biochemistry and molecular biology. The Bachelor program started in 2020, the Master starts in 2023. Especially the Master's program will be developed in close collaboration with the Department of Biology (D-BIOL).

#### Research

We hold that top-down research strategy misses the point by streamlining research to predictable outcomes. Most breakthroughs are unpredictable from a birds eyes perspective, as history of science teaches. Each field has its inherent logic of progress and the real discoveries are made by those who are excellent and at the forefront of their fields. Research strategy at departmental level is mainly about hiring the right people. The most important criterion in that is excellence, the second criterion is a research program that is creative and fits into the environment of the department in some way, and the third criterion is a personality conducive to collaboration and to inspiring students and co-workers. Chemistry is a central science which borders on many other disciplines, such as materials and life sciences, physics, and engineering. We consider it as our Grand Challenge to understand and shape matter and reactions from the molecular to the human scale and from the shortest times underlying chemical reactions to the life time of a chemical plant. This Grand Challenge gives rise to three main directions, which are interlinked:

Making things "better, cheaper, faster": Catalysis, Reaction design and engineering, Novel reactors (incl. microfluidics), Systems engineering, Integration across time-scales, size-scales, and process steps, Life-cycle analysis and sustainability.

Understanding, predicting, and building functional molecular and materials complexity: Theory, Artificial intelligence, machine learning, data mining, Novel synthetic methods, Natural and unnatural products synthesis, Drug discovery and design, New functional materials.

Revealing Structure and Dynamics: Theory, Spectroscopic methods and instrumentation, Analytics.

In order to pursue these goals, we need to intensify our existing collaborations with the Departments of Biology, Physics, Materials Science, Information Technology and Electrical Engineering, Computer Science, Environmental Systems Science, and Health Sciences and Technology and we need to establish more such collaborations. We also recognize the opportunity for more joint efforts with the Paul Scherrer Institute (PSI), the Swiss Institute for Aquatic Research (Eawag), the Eidgenössische Materialprüfungsanstalt (EMPA), our sister university in Lausanne (EPFL) and other Swiss universities, especially the University of Zurich. We strongly believe that, apart



"Collaborations are essential to research as they allow the scientific question to be studied from different angles and obtain complementary insights." Prof. Sereina Riniker

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from strategic appointments in the indicated research directions and creating a collaboration-rewarding atmosphere, there is no need for steering our research top down. Creativity arises from giving scientists the freedom to find their own path.

#### **Together Strong – Research Collaborations**

Science is a team effort, also at the D-CHAB. The visualization provides an overview of research collaborations since 2009 between the D-CHAB and Swiss as well as worldwide research institutions. To the interactive map: https://chab.ethz.ch/en/research/collaborations.html

An interactive map shows the research collaborations of the D-CHAB (affiliation data retrieved from Scopus / Elsevier)

#### The Society for Women in Natural Sciences (WiNS)

Historically, the natural sciences have been a male-dominated arena. However, times are changing, and many initiatives help to accelerate this process and close the so-called leaky pipeline. One of these initiatives was the creation of WiNS at D-CHAB. In 2014, female doctoral students, postdoctoral co-workers, and scientific staff founded The Society for Women in Natural Sciences (WiNS) as a networking platform to connect female members, both socially and scientifically. It is organized by a committee consisting of a president, a vice president, a treasurer, an IT responsible and a communication officer as well as representatives of all departments and adjacent institutes. All female students, doctoral students, postdocs, professors and scientific staff from the D-CHAB and, more recently, also from the Department of Biology (D-BIOL) at ETH Zurich can become members. The membership is free. The overall aim of WiNS is to increase awareness for gender stereotypes and provide support for women in science. The Society is approaching this by organizing a broad range of events centered around three main topics: Awareness: WiNS hosts yearly events to raise awareness on issues that concern all of us, but currently are often faced by women in scientific environments, for instance implicit bias, sexual harassment or juggling a family and career.

**Career:** WiNS organizes events (e.g. career series) with inspiring successful professionals from industry and academia to share their experiences and empower women in their career paths. Fun: WiNS holds additional events like a joint breakfast to promote the interaction among female scientists.

WiNS seeks to provide a space for the underrepresented student- and workforce at D-CHAB and D-BIOL. Therefore, some

events are exclusive for women and non-binary people. Nevertheless, WiNS considers it crucial to include everybody (especially men) in the discussion of gender issues, and organizes a lot of events open to all. Learn more on https://wins.ethz.ch/



#### Human Resources, Gender Monitoring and Action



ETH Zurich provides information about the situation of equality and diversity at ETH Zurich as a whole and in the departments of the university. In the D-CHAB, the ratio between men and women in technical and administrative personnel is constantly balanced, but most recently, the proportion of women has exceeded 50%. Regarding the scientific staff at department level at ETH, there are two categories: those that start with a near-balanced proportion of

women and men at the Bachelor's level, but where the proportion of women generally starts to decline from the doctoral level onwards (a phenomenon better known as "leaky pipeline"), and those with a consistently low proportion of women at all academic career levels. The D-CHAB falls in the former one. In the last years, however, the D-CHAB achieved new records regarding the percentage of female assistant professors. Also regarding the level of female representation among students and doctoral candidates, the D-CHAB is among the departements that have a (slightly) above average percentage of women in these categories. Nevertheless, there is still room for improvement. Thus, efforts to further equalize the gender ratio will continue in the future. Initiatives such as WiNS, also make an important contribution here (see blue box).

Since 2019, the report not only covers the equal opportunity situation regarding men and women but also provides information on the diversity of the ETH Zurich community. Regarding the international composition, for instance, the level of internationalisation is quite high at ETH Zurich, especially concerning levels of postdoc, senior assistant/scientific staff and assistant professor. The Equality Monitoring report of ETH Zurich is updated anually.

#### Events

#### **Awards & Honorary Lectures**

Ruzicka Prize. The Ruzicka Prize, based on an endowment of Nobel laureate Leopold Ružicka, is annually awarded to a young talented researcher who is selected by a Prize Committee comprising the Head of Department, representatives of Swiss Chemical Society, of a Swiss university, and of Swiss chemical industry, as well as the Heads of Institutes. It is considered as one of the most important Swiss prizes for the promotion of young chemists.

Peter Speiser Award. Since 2014, the Institute of Pharmaceutical Sciences bestows the Peter Speiser Award to an eminent scientist in its research field.

ETH Zurich Chemical Engineering Medal. Since 2013, the Institute for Chemical and Bioengineering awards the ETH Zurich Chemical Engineering Medal to an outstanding individual for his/her exceptional contributions in the broad field of Chemical Engineering.



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Prelog-Lecture. The annual Prelog Lecture, established in 1986 by the Laboratory of Organic Chemistry, honors Nobel laureate Vladimir Prelog. It is awarded to an eminent scientist in the field of organic chemistry.

Richard R. Ernst Lecture. The Richard R. Ernst Lecture was established in 2009 by the Laboratory of Physical Chemistry and the Division of Chemical Research of Swiss Chemical Society to honor Nobel laureate Richard R. Ernst. It is devoted to the relation between science and society.

L. M. Venanzi Distinguished Lecture. The Laboratory of Inorganic Chemistry hosts the L. M. Venanzi Distinguished Lecture bianually since 2014 to honor an outstanding scientist in the field of inorganic chemistry.

Eschenmoser Lecture. The Laboratory of Organic Chemistry inaugurates the Eschenmoser Lecture honoring the contributions of Prof. Albert Eschenmoser to the fields of organic synthesis and biological chemistry.



**Chemtogether:** VCS and VAC are jointly organizing Chemtogether, an annual industry fair on the G-floor of the HCI building on the ETH Hönggerberg campus, where over two days, about eighteen companies from the chemical and pharmaceutical industry offer information on careers in their field.

The organizing team of Chemtogether consists of students and doctoral students of the D-CHAB, who organize the event voluntarily and independently. Chemtogether is supported by the association of chemistry students, VCS, and the association of doctoral students, VAC, as well the corresponding umbrella organizations VSETH and AVETH. chemtogether.ethz.ch

TIP ⊃ Life Science Days connect life scientists to career opportunities beyond academia. These days are organized by the Life Science Zurich Young Scientists Network (LSZYN) in collaboration with University of Zurich and ETH Zurich. https://www.lifescience-youngscientists.uzh.ch/en.html **Chemconnect:** The goal of chemconnect is to provide the undergraduate and doctoral students at the D-CHAB with a platform to find and offer opportunities for semester projects, Master and doctoral theses and more. In addition, it allows companies from the chemical industry to advertise their job offers to the students directly. More information can be found at info@chemconnect. ethz.ch. Chemconnect is supported by the organizations represent-ing the undergraduate and doctoral students at the D-CHAB, respectively. In a joint effort with Chemtogether, its aim is to enable students and employers to connect with each other. chemconnect.ethz.ch

Visitors at Chemtogether



#### **Student Organizations**

The D-CHAB cooperates with various student organizations, but also with other academic associations. A comprehensive list of all organizations can be found on the D-CHAB website.

#### VCS: Student union of the chemists, chemical engineers and interdisciplinary scientists

The board of the VCS consists of 13 students from different semesters and study paths which are supported by their respective committees. This structure enables the board to delegate some tasks to lighten the workload of the board members and ensure that each committee can work. As a professional association of VSETH (Verband der Studierenden an der ETH), the main task of VCS is to represent the D-CHAB students towards the department, and via VSETH towards the Executive Board of ETH Zurich. As a student union. VCS tries to offer its almost 900 members a good work-life balance by organizing a variety of social events, often together with other student unions to enable the exchange. To give the students a first glimpse into industry, VCS organizes excursions to industry partners. To make studying easier, VCS organizes information events where students of higher semesters present different options in the curriculum to younger students aiding in the process of choosing specialized study paths. Moreover, VCS has seats in the department's teaching commissions to ensure that the input from students is incorporated into decisions made by those committees (e.g., curriculums revision). The VCS publishes the student magazine "Exsikkator".

#### vcs.ethz.ch



## VAC: Union of the Assistants at the Chemical Labs of ETH Zurich

The VAC (the union of the doctoral students, postdocs and scientific staff of D-CHAB) is one of the departmental associations that together with the others make up AVETH. Its mission is to represent the scientific staff in departmental matters as well as providing support to and fostering a community among its members. Improving the working conditions of researchers and the ensuring effective supervision of doctoral students at the D-CHAB are therefore core goals of the VAC. Representation is achieved in part by the VAC holding seats as well as voting rights in both the departmental conference as well as in the teaching commissions. Furthermore, the VAC influences the culture and science of D-CHAB through its participation in the selection committees for new professors. To foster the community, the VAC provides a range of career and social events throughout the year among which are the "Newbie events" which strive to provide new members of the department with valuable administrative information, and facilitate their integration into D-CHAB. VAC membership numbers average about 250 people (majority doctoral students), which make up around half of the doctoral students at the D-CHAB.

vac.ethz.ch



#### **APV: Association of the Pharmacy Students at ETH** Zurich (Akademischer Pharmaziestudierenden Verein)

The association's board consists of 13 students with five committees of delegates who support their dedicated board members. The association is part of VSETH and asep (association suisse des étudiants en pharmacie), which represent the interests of the pharmacy students on a national as well as an international level and promotes bonding between the different pharmacy student associations in Switzerland. The APV. established in 1910. is one of the older student associations, currently representing more than 450 pharmacy students at ETH Zurich. The goal of the APV is to provide a varied everyday life as well as interesting and diverse studies close to practical experience for pharmacy students. So, the APV has seats in various higher education policy bodies at the D-CHAB in which the interests of the students are represented. The association is strongly involved in the evaluation of the degree program of pharmaceutical sciences, as well as in the elaboration of new curricula. The APV's services include the organization of preparatory courses for the examinations, as well as the organization of social events. Strong focus is placed on the integration of the freshmen, wherefore various events such as a freshman weekend. a godfather system and workshop for learning strategies are organized. Due to an improved collaboration with the VCS, the VAC and the PSA, on the social as well as on the education policy level, the cooperation at the Chemtogether and the chemconnect was achieved. The APV publishes the "Tonikum".

#### apv.ethz.ch



#### **PSA: Pharmaceutical Scientists' Association**

The Pharmaceutical Scientist Association (PSA) was founded in 2006 to represent doctoral students and postdocs of the Institute of Pharmaceutical Sciences. It currently counts 66 members. Yearly, the PSA board - consisting of a sports, social, career, media and politics team, a treasurer, president and vice-president – is elected by the attendees of the general assembly. The PSA's main activities are the representation of its members in departmental commissions, organization of networking and career events and providing a platform for doctoral students and postdocs of the institute to get to know each other. This includes a wide range of activities throughout the year, including alumni events, educational lectures, social gatherings and sports tournaments. Further, PSA tries to support new members by organizing newbie events and aim at promoting interactions with other institutes of the department by hosting joint social events. There is also a monthly casual TGIF (every last Friday of the month) at the PSA lounge. Furthermore, the D-CHAB Counseling Helpdesk offers confidential support, advice and assistance and operates through volunteer efforts of PSA as well as VAC, independently of the boards.

PSA's aim for the future is to foster communication and interaction between members of the institute and support the doctoral students and postdocs of the institute in their interests. Future challenges will be to increase the networking with other institutes, as well as outside institutions.

#### psa.ethz.ch





#### The D-CHAB offers five undergraduate degree programs on Bachelor

- BSc Chemistry
- BSc Chemical Engineering
- BSc Pharmaceutical Sciences
- BSc Interdisciplinary Natural Sciences
- BSc Biochemistry Chemical Biology

#### as well as five degree programs on Master

- MSc Chemistry
- MSc Chemical and Bioengineering
- MSc Pharmacy
- MSc Pharmaceutical Sciences
- MSc Interdisciplinary Sciences
- MSc Biochemistry Chemical Biology

The new program BSc Biochemistry – Chemical Biology has been introduced in HS 2020. It provides students with a sound theoretical and practical education in the core subjects of chemistry, biochemistry and molecular biology. Building on a broad base of basic scientific knowledge in mathematics, physics and general chemistry, students are taught an in-depth understanding of organic chemical and biochemical reaction mechanisms, including chemical synthesis and research into the mode of action of biologically active substances. The BSc degree in Pharmaceutical Sciences constitutes the basis for further consecutive MSc studies either in Pharmacy or Pharmaceutical Sciences. The latter curricula have recently undergone a thorough revision in order to adapt them to new federal regulations.

The teaching philosophy of the D-CHAB has always been characterized by a broad education in the fundamental disciplines of chemistry, while being adaptive towards new interdisciplinary developments. The scope of the courses offered by our department at BSc level in inorganic, organic, and physical chemistry is wide and deep, conveying a broad spectrum of fundamental aspects. These are complemented by courses in mathematics, physics, biology, and informatics. The wide range of research interests and activities of our faculty members guarantees for state-of-the-art

content and treatment of the various topics. Various laboratory courses, case studies, and semester research projects convey practical knowledge about how to manipulate, analyze and characterize chemicals and processes. Chemistry at ETH Zurich is an experimental science that requires profound fundamental understanding. Thus, we educate young people so that they understand chemistry as an integral whole and are well-prepared to pursue doctoral studies and thereafter enter successful research-oriented careers, both in industry and academia. The D-CHAB is convinced that a thorough theoretical and practical education, as described and lived, will continue to ensure the high quality and reliability of ETH Zurich chemists and chemical engineers for decades to come. Our experimental education is based on a modern and high-quality laboratory infrastructure. Space constraints impose limitations on future growth in student numbers. Teaching chemical disciplines at the D-CHAB relies on the proven traditional approach based on a combination of lecture courses, exercises and lab courses. The focus is on the content. The fact that our graduates are highly demanded by the private sector suggests that their skills and knowledge are appreciated, and that time-honored methods also have their merits. Overall, the D-CHAB is offering



Director of Studies Student Administration Mobility Advisor

BSc Chemistry

**MSc Chemistry** 

#### **BSc Chemical Engineering**

**MSc Chemical Engineering** 

Director of Studies Student Administration Mobility Advisor

#### **BSc Biochemistry - Chemical Biology**

MSc Biochemistry - Chemical Biology (fall 2023)

Director of Studies Student Administration Mobility Advisor

#### **Continuing Education**

Doctorate Delegate

262 courses (spring and fall semester), from Bachelor to doctoral curricula adhere to the European Credit Transfer System (ECTS), degrees including postgraduate education. which pursues the goal of encouraging and simplifying mobility. One credit corresponds to 25–30 hours of work and acquisition of **Degree Programs** 60 credits per year is expected. Hence, a BSc comprises 180 ECTS, while an MSc comprises 90 ECTS. A small amount of credits, typi-All our degree programs have two stages, the first leading to a BSc cally two per year, is assigned to subjects outside the core subjects degree that can be obtained after three years and the second to a (Science in Perspective). Swiss students having obtained a feder-MSc degree that typically requires at least three more semesters ally accredited Swiss high-school degree (Matura) are accepted of study. German is the instruction and examination language for without additional requirements. BSc studies and English for MSc studies, with the exception of Due to legal requirements, the **BSc Pharmaceutical Sciences** the Pharmacy MSc where knowledge of German is required. Our and MSc Pharmacy curricula, which prepare students for the

#### **Study Programs**

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BSc Interdisciplinary Sciences	
MSc Interdisciplinary Sciences	
Director of Studies Student Administration Mobility Advisor	
BSc Pharmaceutical Sciences	
MSc Pharmaceutical Sciences	
Director of Studies Student Administration Mobility Advisor	
MSc Pharmacy	
Director of Studies Student Administration Mobility Advisor	

Post Graduate Courses in Pharamceutical Sciences	
Delegate	
Laboratory Technician Training (Lahrlabor Chemie)	
Delegate	

Eidgenössische Apothekerprüfung (Swiss Federal Examination of Pharmacists), are the most structured ones. On the other hand, the MSc in Pharmaceutical Sciences provides students with a lot of flexibility in choosing their courses (22/90 credits). Course lists for the BSc curriculum are available for spring and fall semester. The basis examination of the BSc in Pharmaceutical Sciences after the first semester consists of two examination blocks, which together correspond to 49 credits. The MSc degree in Pharmacy requires four semesters, involves an internship in a public pharma cy (Assistenzzeit) of at least 26 weeks, and prepares students for the Eidgenössische Apothekerprüfung (Swiss Federal Examination of Pharmacists). Conversely, the MSc in Pharmaceutical Sciences, which requires 1.5 years, prepares students for a career in academia or industry (see course list for spring and fall semester). Nevertheless, in the past approx. 20% of students with a MSc Pharmacy degree have opted to perform a doctoral thesis. For both MSc programs 30 credits are assigned to the Master's thesis.

The **Chemistry BSc** curriculum is strongly structured to ensure a sufficiently broad and deeply founded basic education. Compared to Chemistry curricula at many other universities, the D-CHAB puts a strong emphasis on mathematics and physics. At the same time, we believe that a true chemist must be skilled in the laboratory and must have a sound education in all three core disciplines of chemistry: organic, inorganic and physical chemistry. Our students acquire the necessary skills for performing challenging syntheses and for handling dangerous substances. Consequently, the fraction of credits for elective subjects in the Chemistry BSc is relatively small.

The **Chemistry MSc** curriculum also requires students to follow obligatory courses in all three core subjects of chemistry (18 credits). Further courses (minimum of 19 credits) can be selected from a list (compulsory elective subjects). Practical skills are acquired in small research projects, industry internships, and laboratory courses (26 credits), with the research projects being most popular among the students. Science in context comprises 2 credits and 25 credits are assigned to the Master's thesis, which can be pursued outside D-CHAB or even outside ETH Zurich upon agreement. The **BSc** curriculum in **Chemical Engineering** is even more strongly structured than the one in Chemistry. The first year, which is devoted to education in chemistry, physics, mathematics, and informatics, is identical to that of the chemistry BSC curriculum.

The curriculum comprises laboratory courses in all core subjects of chemistry as well as in chemical engineering. The solid chemistry background and appreciation for molecular aspects are unique features of our chemical engineers. The third year focuses entirely on engineering aspects, specialized mathematical methods, techno-economic analyses, and safety. It comprises two case studies devoted to process design and simulation. There are no electives. The MSc curriculum in Chemical and Bioengineering requires students to choose at least one course from each of the core subjects "Biochemical engineering", "Products and Materials", "Process Design", and "Catalysis and Separation" (together 24 credits). Further courses (minimum of 23 credits) can be selected from a list (compulsory elective subjects). Practical skills are acquired in research projects, industry internships, and computationally-oriented case studies (16 credits). Electives in Science in Perspective comprise 2 credits and 25 credits are assigned to the Master's thesis. For students who thrive on less structured curricula and have broad interest in the natural sciences, D-CHAB offers a BSc and a MSc in Interdisciplinary Sciences. The degree program is research-oriented and aims at providing an interdisciplinary education in the natural sciences, with specialization in either a Physical-Chemical or a Biochemical-Physical direction. This entails careful counselling of students with respect to the choice of courses, because, from the second year onwards, each student has her or his individual study program. The Director of Studies is supported in this counselling by representatives of all departments involved in this program (D-CHAB, D-PHYS, D-MATL, D-BIOL and D-USYS). The goal of the program is to provide students with a thorough education in more than one discipline. Consequently, students attend the selected lecture and laboratory courses in mathematics, chemistry, physics, biology and material sciences together with the students of these subjects. The first year consists of compulsory courses, including laboratory courses, and provides a solid basic education and a sufficient level of the basis examination. Only a small number of compulsory courses is required in the second year and at least 32 ECTS must be acquired in elective courses, for instance, lab courses, seminars or excursions. The emphasis on research requires the students finally to carry out an additional Bachelor's thesis (15 credits). In the Master's program choice of courses is most flexible according to the choosen major.

This program ends with a Master's thesis of typically 20 credits. by classical blackboard work, which is appreciated by students Further details can be found in the Study Guide. and is well adapted to learning speed and leads to higher 'lec-The BSc curriculum in Biochemistry-Chemical Biology (180 credturer intensity' than other forms. Alternative didactical formats its) provides a theoretical and practical education in chemistry, (e.g., flipped classroom, clicker question-and-answer sessions, biochemistry and molecular biology with a later focus on organic assisted self-learning) are also practiced, but overall we believe chemical reaction mechanisms, including the chemical synthesis frontal instruction to be highly efficient when it is accompanied and the exploration of how biologically active substances work. by tutorials in small groups. Student evaluations of our courses, The degree program contains fundamental subjects (mathematincluding free-text comments, do not suggest that they see this ics, statistics, physics, computer science, biology, inter alia), core differently. Involving the students more during classical lectures subjects (inorganic, organic, physical and analytical chemistry, biis certainly appreciated by them and increasing efforts are investochemistry, inter alia) and block courses which combine lectures ed in this direction. In general, lecture courses at BSc level are with experimental work, seminars and work on the literature. The taught by associate and full professors, tutorial organization may MSc in Biochemistry-Chemical Biology (120 credits) provides be supported by a postdoctoral co-worker or senior scientist, and in-depth specialization with a focus on experimental scientific tutorials are given by doctoral students and occasionally postdocs work in the fields of chemical biology, bio-chemistry and organic or student assistants. A Study Center Chemistry, staffed by stuchemistry, as well as their interfaces with biology, bio-analytics, dent assistants, helps students with problems related to first-year pharmacy and areas of biomedicine. The degree program contains chemistry. Laboratory courses are usually organized by senior core and elective subjects, block courses, semester papers and a scientists, in some cases adjunct professors, under the supersix-month Master's thesis. vision of an associate or full professor. Teaching in laboratory courses is mainly conducted by doctoral students, who receive **Teaching Approaches** specific instruction to this end. In higher semesters, laboratory courses have been largely substituted by research projects, which Across all curricula, conventional lecture courses combined are performed in individual research groups. They are typically with tutorials in smaller groups (10-15 students) are the main supervised by doctoral students, occasionally also by master way of teaching theoretical concepts. In many cases, this is done students, postdocs, senior scientists, and professors. To preserve



#### D-CHAB | Teaching

our broad education philosophy, the students are encouraged to carry out their research project, Bachelor's thesis, Master's thesis and doctoral studies in different groups. It is common that students use research projects as well as the Bachelor's or Master's thesis in order to find a research group for doctoral studies that fits their interests and skill set.

#### **Examinations and Grading**

In general, laboratory courses and research projects are pass or fail, while examinations corresponding to lecture courses and the Bachelor's and Master's theses are graded. The grading scale ranges from 1.00 (lowest) to 6.00 (highest) in steps of 0.25. The lowest sufficient grade is 4.00. In the first years, most examinations are grouped into blocks (Basisprüfung). In that case, the average grade of the block must be 4.00 for passing and the individual courses may be differently weighted. The exam blocks corresponding to the courses of the first year (Basisprüfung) consist entirely of written exams.

In higher semesters, some or even the majority of exams are oral (typically 30 minutes). We believe that oral examinations are the better measurement of knowledge and understanding, but acknowledge that they are not feasible in lecture courses with more than about 60-80 students. In case of oral examinations, each student has an individual schedule, which is mostly centrally organized by the Examination Office of ETH Zurich Academic Services. Our semesters run from the third week of September to Christmas (fall semester) and from the third week of February to the end of May/beginning of June (spring semester). In the programs of Biochemistry - Chemical Biology and Interdisciplinary Sciences, laboratory courses extend into semester breaks for capacity reasons. Examination periods are scheduled from the last week of January to the beginning of the spring semester and in August. This arrangement gives students ample time for revision and preparation, especially in summer.

Examinations can only be repeated once. Failure in passing of an exam block, or of an individual examination not belonging to a block, leads to exclusion from studies of this subject and of closely related subjects, also at other Swiss universities. Because of these high stakes, borderline cases of failing are discussed in a conference of all examiners (Notenkonferenz) taking place at the end of each examination session. Borderline cases are clearly defined, which ensures equal treatment. Examiners check their records and decide whether a grade could or could not be raised. All examiners of the block vote whether a borderline fail can be converted to a borderline pass.

Typically, a third of the students fails the basis examination either twice or leaves without making a second attempt. This loss is unavoidable given the ETH Zurich admission criteria. Dropout rates in higher semesters are much lower, but represent a continuous cause of concern.

#### **Teaching Infrastructure**

Lecture Halls Most of our lectures are taught in the HCI building adjacent to our offices and laboratories. Occasionally, we teach in other buildings of the campus Hönggerberg, which are within easy walking distance. In rare cases, we teach in the city center, mainly in the main building of ETH Zurich, in order to avoid that the students commute back and forth between the two campuses, which would entail loss of one lecture hour in the direction from the city center to Hönggerberg campus. The number and capacity of lecture halls and seminar rooms is not ample, but sufficient for the current student numbers and teaching loads. They might allow for a modest growth in student numbers. Rooms for special lectures and seminars, and especially for large special events directed at the general public, are sometimes hard to find during the semesters, which occasionally causes problems for events directed at high school students.

Infrastructure for Lab Courses The situation is less favorable for laboratory courses. While the quality of the laboratories is very high, the building was designed for lower student numbers than we currently have. Some of the more complex courses, e.g., those in which students learn to handle dangerous substances, do not have capacity for further growth. Since modest growth of student numbers cannot be excluded, given that we do not control admission, we may be faced with the choice of either lowering the standards or extending lab course capacity. If the latter cannot be done by extending space for student labs, we would need to offer lab courses in shifts, on Saturdays, or outside semester. Neither of these solutions are easy to realize. The semester break in January is needed for exam preparation.

#### **Quality Management Teaching**

The guality of our teaching and examinations is assessed by the lecturers and supervisors of lab courses themselves, by anonymous evaluations of courses by students (an official three-stage process: semester feedback, course evaluation and exam evaluation), and by structured discussions in the Teaching Commission, at Department Conferences and at so-called informal "Sandwich Lunches" with students (once a semester). Professors and senior scientists are committed to excellent teaching. Quality management in teaching is first and foremost by appointing the right people and by distributing courses among them in an optimal way. The latter task is performed at institute level. However, teachers need more feedback than just examination results. Evaluations by students, supported by the Educational Development and Technology (LET) office of ETH, can be useful. Student evaluations, including free-text comments, are sent to lecturers, evaluations are examined by the Director of studies, the Coordinator Teaching and the Educational Developer. Issues are discussed in the Teaching Commissions, where the D-CHAB student representatives are generally very active. A consolidated feedback is prepared, which is then discussed with the lecturers concerned. The Teaching Commissions also play a lead role in preparing and monitoring changes in regulations, curricula, and major changes in the organization of teaching. Whenever necessary, the discussion is continued on a broader basis in the Department Conference.

#### **Teaching Export and Import**

The D-CHAB teaches students from other departments in chemical subjects and computer-assisted science. We take care to provide such teaching at a high level. For each subject group, we have named a D-CHAB professor who communicates our requests and feedback to the lecturers in other departments. 43



Thanks to a HoloLens, students can circle and investigate a virtual protein (Protein rendered with MOE, Chemical Computing Group, CCG, Canada).

## HoloLens goes Education – Molegram Explorer & Molegram Scientist

The invention of Microsoft's HoloLens allows holograms to be projected into a real room opened a new door for science and education. The group Computer-Assisted Drug Design of Prof. Gisbert Schneider developed – under the lead of Dr. Jan A. Hiss and supported by the ETH LET department and the company afca – the mixed reality apps Molegram Explorer & Molegram Scientist. The apps are used during practical classes to improve the understanding of 3D molecular surfaces and the basic concepts of ligand-receptor interaction. Being subject of constant development now the apps make use of the new HoloLens 2 hardware enabling students to touch a protein, walk around it or even dive into it opening up a new perspective on the world of molecules.

https://cadd.ethz.ch/education/hololense.html

#### **Computational Chemistry with a Touch**

A big problem of research and teaching in chemistry is that the tiny world of molecules is elusive to our senses. This makes a truly intuitive understanding of many chemical phenomena very hard. A group, led by Prof. Markus Reiher, tackled this problem: Building on their work on real-time quantum chemistry, they searched for a way to make quantum chemical simulations intuitive. They found it by coupling so-called haptic devices to their computer program. A haptic device appeals to the tactile sense through force feedback; it allows one to manipulate a molecule while directly "feeling" the resulting (quantum) forces on atoms. Now, a person is able to both see and feel the results of their structural manipulations, rendering the simulation immersive.

#### https://doi.org/10.48550/arXiv.2011.03256



Studying molecules using virtual reality (Prof. Markus Reiher)

#### Interacting with Molecules

By making quantum chemical simulations very fast, it is possible to simulate the behavior of a molecule in real time. Such a direct, immediate delivery of calculated energies and forces is the key for the interactive simulation of the molecular world. A way to increase immersiveness is to abandon the two-dimensional computer screen and couple the simulation to a three-dimensional display in virtual reality (VR). The group of Prof. Markus Reiher implemented this with the software "Narupa" developed at the university of Bristol by Prof. Glowacki and coworkers. This set-up allows to even meet in VR while physically being in Zurich and Bristol with calculations running in real-time on a cloud service in Frankfurt.

#### https://doi.org/10.1021/acs.jpca.9b01006

#### **Teaching Innovation**

Although established methods of teaching are often too easily discounted, ETH Zurich continuously needs to reinvent itself, also in teaching. Lectures become stale when given too many times in the same way. Expectations of students change from generation to generation (though less than is often assumed) and teaching can only be efficient if it adapts to these changes. Dr. Jan Hiss, for example, from the group Computer-Assisted Drug Design, led by Prof. Gisbert Schneider, takes advantage of the HoloLens technology and invented with partners the mixed reality apps Molegram Explorer & Molegram Scientist. They are used during practical classes to improve the understanding of molecular structures (see blue box). Furthermore, the practical class "Computer-Assisted Drug design accompanied by the lecture "Methods in Drug Design", combines a Moodle online course and simplified versions of software tools for modelling with a handson industry inspired project experience. It has become popular beyond pharmacy students as an elective course. This project was a finalist for the 2016 KITE Award. Apart from nominations for the KITE Award, professors from the D-CHAB were twice successful in winning the Credit Suisse Award for Best Teaching. Another example is the project by Prof. Cornelia Halin Winter:

the revision of the Pharmaceutical Sciences curricula, triggered by changes in Swiss federal law, was taken as an opportunity to rethink not only the MSc in Pharmacy curriculum, but also the MSc in Pharmaceutical Sciences, which prepares for a career in pharmaceutical research. Dr. Niels Sievertsen from Prof. Erick M. Carreira's group has developed the Apoc app on Advanced Problems in Organic Chemistry (for iOS and Android) to offer personalized learning material from a large database. Dr. Gunnar Schwarz from the group of Prof. Detlef Günther has introduced the project seminar Methods in Elemental Analysis that complements a corresponding lecture by supervised direct project work in small groups and the Theoretical Chemistry group, led by Prof. Markus Reiher, is experimenting with virtual reality settings: they developed possibilities for an interactive and literally tangible simulation of the molecular world (see blue boxes, page 44). These are just a few examples of many innovative teaching projects at D-CHAB.

#### Student Counselling

ETH Zurich stipulates that the students are assessed within The first point of contact for students are our student administratwelve months after provisional admission. Assessment is by tors. More intricate questions are answered either by our Coordinasubmission of a doctoral plan and by an Aptitude Colloquium. tor Teaching or by the Directors of Studies. The Directors of Studies Two weeks before the Aptitude Colloquium, the doctoral candidate are also responsible for interpreting regulations, if special requests submits a doctoral plan to the members of the Aptitude Commitarise for elective subjects or for external projects or theses. tee. In parallel, D-CHAB Doctoral administration must be informed about the submission. The plan contains a one-page summary as **Doctoral Studies** well as a detailed description of the research project and specifies teaching obligations, special obligations within the research group, and a schedule for extended doctoral studies, if applicable. The obligatory template is available on D-CHAB website.

Doctoral studies are first and foremost about becoming a scientist who can carry out independent research. However, at the current degree of specialization it may still be useful to extend knowledge Deviations from the research plan are possible and are discussed by lectures and in summer schools. At least 12 ECTS credits, each during annual appraisal interviews. All students are assigned a corresponding to 25–30 hours work, must be acquired during second scientific advisor, who is also involved in the scientific part doctoral studies. of these interviews. Doctoral studies typically take four years and The main component of doctoral studies is a substantial research at most six years.

project that extends knowledge in chemistry, chemical engineering, or pharmaceutical sciences. Such a project is offered by an adjunct, assistant, associate, or full professor, in most cases together with an offer for employment. Occasionally, doctoral students bring their own personal grants with them.

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To recruit doctoral students, excellent teaching and excellent supervision of research projects during studies as well as of Bachelor's and Master's theses is crucial. Professors generally receive a large number of unsolicited applications. Although only a small fraction fits the required profiles, some of these applicants are indeed of exceptional guality, and are invited for interviews and hired. Occasionally, positions related to a grant need to be filled on a timescale incompatible with hiring an ETH Zurich graduate or a suitable person who applied on their own initiative. In these cases, the position is advertised, and interviews are conducted. Many of our MSc graduates decide for doctoral studies at ETH Zurich. Still, a substantial fraction of our doctoral students is recruited from outside ETH Zurich. Hereby, graduates from ETH Zurich and Swiss universities with a MSc degree in an appropriate field are accepted without conditions, whereas graduates from other countries may need to complete extended doctoral studies depending on their education profile. Entrance exams must be passed within the first year of doctoral studies, for which the students are provisionally accepted.

Examination & Quality Management The examination of the Aptitude Colloquium is performed by an Aptitude Committee that normally consists of a chair, who is nominated by the Doctoral Committee of the department, by the thesis supervisor, and by the

second advisor. The duration should not exceed 45 minutes. The doctoral thesis is submitted by the student and is assessed by the supervisor (reviewer) as well as at least one additional reviewer. Starting in 2024, the second reviewer must be external to ETH Zurich. It is usual to have more than two reviewers, especially if the work was collaborative or if a senior scientist was involved in the supervision. The thesis can be accepted or accepted on the condition that certain changes are made, or rejected. The examination committee, consisting of all reviewers and chaired by the Head of Department or his/her representative, decides on the acceptance of the thesis with or without mandatory revision, on a deadline for revision, and on passing or failure of the oral examination. A single thesis revision and a single repetition of a failed oral exam are allowed.

Generally, doctoral exams at D-CHAB are held on Wednesday afternoons. They are not open to the public and last 60 minutes. Additionally, within the last year before the doctoral examination, doctoral students must present their research work publicly. The duration of the presentation is 20-40 minutes. Afterwards there will be a discussion. Details regarding content, procedure and organization are regulated by the laboratories and institutes of the D-CHAB. However, the lecture is not part of the evaluation of the doctoral examination. If the doctoral thesis and the oral examination are exceptionally good, the candidate may be suggested for an ETH Medal. At most 8% of all doctoral students may receive this medal. The application must be approved by the department. The final decision is with the Rector.

In the period 2011–2017, for instance, the average number of doctor degrees awarded by the D-CHAB was 99 per year and the average number of new entrants was 125. The drop-out by doctoral students generally happens within the first year or shortly thereafter. The quality of doctoral education is ensured by having all examinations chaired by the Head of Department, or, a small number of experienced representatives. Additionally, doctoral students regularly report on their progress in group seminars. In cases of conflict between doctoral students and supervisors, the students can turn to the Head of Institute or Head of Department. The number of such cases, however, is low.

#### **Continuing Education Programs and other Offers**

The D-CHAB offers a number of formalized programs in continuing education - Certificate of Advanced Studies (CAS) "Pharmaceuticals" - CAS "Radiopharmacy" - DAS "Preparation for the Federal Examination in Pharmacy" – "Teacher Training in Chemistry" The DAS program is aimed at persons with a foreign pharmacist certificate, who are required to pass a Swiss federal examination in order to work in their profession in Switzerland. The Teacher Training is aimed at our own students of Chemistry, Chemical Engineering, and Interdisciplinary Sciences, who want to acquire a teaching diploma (Lehrdiplom für Maturitätsschulen) that enables them to teach chemistry or biology (the latter except for Chemical Engineering students) at high-school level. Details on the CAS programs can be found under the corresponding links. In addition, two courses aimed at industrial chemists are offered in collaboration with Swiss Chemical Society (SCS).

Laboratory technician training (Lehrlabor Chemie): This unit, located in the direct proximity to the research laboratories of the D-CHAB, deals with the planning and implementation of the training of prospective EFZ laboratory technicians specializing in chemistry. The apprenticeship lasts three years. The specialty of trained laboratory assistants is the practical performance of chemical experiments and the analysis of reaction products using common spectroscopic methods. The focus is on the production of chemical compounds (synthesis), as well as their characterization and testing. In the field of analytics, EFZ laboratory technicians specializing in chemistry also examine various substances and specific ingredients. The teaching lab equipment includes a wide variety of instruments, including: GC-MS, HPLC, Redisep Rf+ automated column with UV detector, 10 fume hoods/chapels, rotary evaporator, UV/VIS photospectrometer, pH meter, equipment for melting point determination, refractometer, large thermostatic bath and a variety of different glassware and apparatus. The requirements for the apprenticeship as a laboratory technician EFZ specializing in chemistry are high. Good performance in the subjects of chemistry, physics and mathematics are therefore absolutely necessary.



D-CHAB | Research

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#### **Research Areas**

The research portfolio of the D-CHAB encompasses the core disciplines of chemistry as well as the interface of this central science with physics, biology, medicine, and materials research. We have a broad range of synthesis capabilities starting from small organic and inorganic molecules, via organometallic compounds and solid materials to natural products and modified peptides, proteins, and enzymes. Some of these compounds are developed as materials, such as functional oxide materials, semiconductor guantum dots, organic supramolecular assemblies and self-organized inorganic nanostructures, flame retardants, electrolytes, and electrode materials. A common theme across the chemical and chemical engineering institutes is catalysis, with a focus on heterogeneous catalysis. Apart from making things, we focus on characterizing materials and biological systems and on understanding their structure, dynamics, and function. We have particular strengths in analytical chemistry, based on mass spectrometry, in magnetic resonance and in optical spectroscopy and are linked to electrochemistry at the Paul Scherrer Institute (PSI) via a dual professorship. Our department pursues research across the board in computational and theoretical chemistry, with method development efforts in guantum chemistry and guantum dynamics, at the interface between guantum and classical molecular dynamics, and in the application of machine learning approaches in computational chemistry. Our research borders on physics with ultrafast laser spectroscopy, on biology with structural characterization of proteins, their complexes, and their misfolded fibrillar aggregates, and on medicine with the development of diagnostic tools, therapeutic products, and the identification of molecular drug targets. Our engineering efforts are devoted to molecule-efficient and energy-efficient processes, biotechnology, microfluidic approaches and multiscale modelling.

#### **Professional Development**

#### **Promotion of Young Academics**

The D-CHAB provides opportunities for young scientists at all levels: from doctoral studies to short postdoctoral stays in

world-leading research groups, to gradually building an independent research portfolio as a postdoctoral and senior assistant, to non-tenure track and tenure-track assistant professorships. This diversity is necessary, since neither people nor fields are alike. Not everyone who aspires to a research career and is capable wants to immediately - or, indeed, ever - build their own large group. For instance, our adjunct professors (Titularprofessoren) are internationally highly recognized in their fields. As a leading chemistry department, we act as a fertilizer for our science by educating a larger number of young scientists that are needed to ensure a good pipeline of academics. In addition, it is important to hire them from the largest possible pool. Since only diversity attracts diversity, this requires some effort in identifying excellent scientists from minority groups and encouraging them to apply. A majority of our doctoral students and postdocs is not Swiss. Notably, the D-CHAB had an almost exclusively male professorship until about 10 years ago, while the fraction of female doctoral students fluctuates between 30.5% and 34%. Since 2011 we have succeeded in appointing a fraction of female professors that matches the fraction of doctoral students. By continuing our efforts in identifying excellent female candidates for open positions, we hope to further improve the balance and ultimately converge it to the balance among our students.

#### **Tenure Process**

The tenure process at D-CHAB follows a guideline that is binding for the whole of ETH Zurich. Tenure track assistant professors are evaluated after 1.5, 3 and 5 years. The mid-term evaluation after 3 years involves a decision on reappointment and the final evaluation after 5 years is the basis for initiation of the tenure proceedings at ETH level.

#### **Publication Philosophy and Output**

To date, numerous ways have been proposed to measure scholarly research output and other performance indicators have been suggested. ETH Zurich is among the signatories of the San Francisco Declaration on Research Assessment (DORA). The DORA recommendation states that research and researchers

should be assessed by content and not metrics, and that the sciopen access fraction is limited, since researchers in chemistry entific content of a paper is much more important than publication tend to publish in society journals, i.e. from GDCh (Gesellschaft metrics or the identity of the journal where it has been published. Deutscher Chemiker), ACS (American Chemical Society), RSC (Royal Society of Chemistry) and SCG (Swiss Chemical Society). Scholarly output cannot only be defined as original research papers, since review articles, book chapters, and books also foster These journals are an important revenue stream for scientific further innovation and creation of knowledge. Such publications societies. The average of number of review articles and books are indispensable for students and young researchers to build up chapters remains about the same over this seven-year period, expertise in a field. The number of open-access articles roughly about 6% and 2%, respectively. doubled from 2012 to 2016 and is about stable since that year. The

### ETHZ Catalysis Hub (SwissCAT+ East)

The Catalysis Hub SwissCAT+ East is hosted by the D-CHAB in the HCI building and funded by the ETH Domain. It is split across the two Swiss federal institutes (EPFL and ETHZ) according to specific expertise and is open to the entire scientific community, devoted to data-driven, high-throughput and automated experimentation in the field of homogeneous and heterogeneous catalysis. Since the end of 2022, the Hub is operating with three scientific experts and an administrative assistant. Three laboratories, for a total surface of 180 m2 are being installed to host state of the art instrumentations already offering numerous capabilities for exploration and development of catalytic processes. One of the main objectives of the Catalysis Hub is to digitize all the input/output of the experiments and use advanced computational tools (AI/ML) to support closed-loop experimentation and identify chemical descriptors leading to a given catalytic activity / reaction mechanism. The ETHZ Catalysis Hub also provide to its user statistical experimental design tools to reduce the number of experiments needed to screen a given parameter space. The Hub is expected to grow with a foreseen extension of 80 m2in 2025. A strong collaboration is foreseen with the members of D-CHAB, and, the broader Swiss community, in particular with NCCR Catalysis.

https://swisscatplus.ethz.ch/

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### NCCR Catalysis

Our guality of life depends on inventions like fertilizers, medicines, energy or fuels, that are manufactured through chemical processes, most of which use catalysts. However, many current practices in the manufacture, use and disposal of these everyday products are unsustainable. Examples include the widespread reliance on non-renewable fossilbased resources for chemical manufacture, large amounts of waste, and lack of efficient recycling processes. NCCR Catalysis, a National Centre of Competence in Research funded by SNSF and led by Javier Pérez-Ramírez (D-CHAB, ETH Zurich) and Jérôme Waser (EPFL) since 2020, wants to change this by making Switzerland an internationally recognized hub for sustainable chemistry research, education, and innovation. The consortium designs catalytic processes for the efficient transformation of renewable feedstocks into energy carriers and building blocks, and their subsequent elaboration into customized products. To ensure the implementation of these routes, NCCR Catalysis integrates modern cross-disciplinary approaches exploiting advances in experimental and digital tools for catalyst discovery and optimization and building a framework for better decisionmaking by introducing suitable sustainability metrics. The consortium aims to develop more sustainable chemical value chains for reducing the ecological footprint.

https://nccr-catalysis.ch



### Centre for Origin & Prevalence of Life (COPL)

How did life on Earth begin? How did it develop and is there life on other planets? In the Centre for Origin and Prevalence of Life (COPL), more than 40 research groups from five departments – among them the D-CHAB – will work together with their counterparts across the world to investigate the mysteries of the origins of life on and beyond the Earth. The Centre will focus on four main research areas: 1. Which chemical and physical processes made the formation of living organisms possible? 2. Which other planets may host life? 3. How do planetary environmental conditions develop that are hospitable to life, how does this life change a planet's characteristics?; 4. What other forms of life could exist? Many research collaborations with international institutions and teaching programs are to be established, as well as up to six new professorships at ETH Zurich. These professors will join the faculty and will primarily focus on research topics relevant for the Centre. Furthermore, the NOMIS Foundation-ETH Fellowship Program has been launched to give young scientists the opportunity to conduct research on the origin of life. Fellows will have the opportunity to be hosted simultaneously in two research groups. The Centre will be located both on the city-centre ETH Zurich campus and on the Hönggerberg campus. In addition to Nobel Prize laureate Didier Queloz, it will be co-directed by ETH Zurich professors Roland Riek (D-CHAB, LPC), Cara Magnabosco (D-ERDW) and Sascha Quanz (D-PHSY). The Centre is financed by funds from the Executive Board, participating departments and research groups A scientific collaboration has been established with the Paul Scherrer Institute (PSI), which is also contributing to the Centre. A Science Steering Committee (professors from the participating departments) will be responsible for the Centre's research strategy and will advise the management team. An administrative unit will oversee the finances and communication.

https://copl.ethz.ch/



Amino acids (coloured blocks) accumulate in the right position. There is considerable evidence that they were involved in the initial chemical processes that gave rise to living organisms.



1.2 GHz, 28 T: the world's strongest persistent magnet for NMR in the HCI building (NMR hall)

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NMR spectroscopy has a long and remarkable history at ETH Zurich. Starting with Hans Primas in the early 1960s, NMR spectroscopy became an important research topic at the Chemistry Departement. For many years, Richard Ernst, Nobel Prize laureate and Professor at the D-CHAB, and his group were one of the leading groups in the development of magnetic resonance methodology in EPR and NMR spectroscopy. One of Richard Ernst's magnets is still in use at D-CHAB but has been since moved to the large NMR hall at ETH Zurich's Hönggerberg campus. This 1000 m2hall is located in the HCI building under one of the ponds between the fingers and houses currently a total of seven high-field NMR magnets, including 600, 700, and 850 MHz liquids and solids spectrometer and since 2020: a 1.2 GHz magnet from Bruker with a field strength of 28 T. This allows the investigation of structure and dynamics in biomolecules and materials. In addition to commercially available equipment, the NMR Hall is also the site of new magnets. The equipment in the NMR hall belongs to the NMR research groups at the Laboratorium für Physikalische Chemie but is available in collaborations also to other researchers at ETH Zürich.

#### Laboratories and Institutes

The D-CHAB is organized into five Laboratories and Institutes: - Laboratory of Inorganic Chemistry (LAC) - Laboratory of Organic Chemistry (LOC) – Laboratory of Physical Chemistry (LPC) – Institute for Chemical and Bioengineering (ICB) – Institute of Pharmaceutical Sciences (IPW) The five units represent the three core disciplines of chemistry (LAC, LOC, and LPC), engineering aspects (ICB), and pharmaceutical sciences (IPW). The following pages describe for each laboratory and institute the mission, the organization and governance, the facilities, teaching and research.

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Arosio, Paolo Bezdek, Málé ----Bode, Jeffrey W. ----Burden, Andrea -Carreira, Erick M. Chen, Peter Coperet, Christophe deMello Andrew Eyer, Klaus -Grass, Robert Grützmacher, Hansjörg Guillén-Gosálbez, Gonzalo Günther, Detlef Halin-Winter, Cornelia Hall, Jonathan Jeschke Gunnar Jomer, Kiell -Kast, Peter Kovalenko, Maksym V. Krämer, Stefanie Lang, Kathrin -Leroux, Jean-Christophe Lippert, Thomas Morandi, Bill -Mougel, Victor -Perez-Ramirez, Javier -Quitterer, Ursula Richardson, Jeremy D. --Riek, Roland Schibli, Roger Schneider, Gisbert Shih, Chih-Jen -Stark, Wendelin Jan Steinegger, Patrick Thilgen, Carlo VanBokhoven, Jeroen A. Wennemers, Helma Yamakoshi, Yoko Yamauchi, Yohei Zenobi, Renato Zeilhofer, Hanns Ulrich

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Explore our research areas and groups via the interactive visualization on: chab.ethz.ch/en/research/research-areas.html

#### Research Area

3D Printing Aerosols Analytical Methods Artificial Intelligence Bioinspired Chemistry Biologics Biomacromolecules Biomaterials Biopharmaceutics - Catalysis - Chemical Biology - Chemical Engineering - Computational Chemistry - Coordination Chemistry Diagnostics Digital Chemistry Directed Evolution - Disease Research Drug Delivery Drug Formulation - Drugs Electrochemistry - Energy Storage Engineering - Enzymes Functional Materials - Imaging - Immunology Lab on a Chip - Medicinal Chemistry - Microfluidics Molecular Physics Nano Sciences Natural Products - Organic Synthesis Organometallic Chemistry Pharmacoepidemiology Pharmacokinetics Pharmacology Polymers Quantum Chemistry Radiochemistry Radiopharmaceuticals - Reaction Mechanisms Single Cell - Spectroscopy Supramolecular Chemistry Surface Chemistry Sustainable Chemistry Theoretical Chemistry Virus Cell Biology





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Wordclouds of ICB, IPW, LAC, LOC, LPC, generated from publication titles of all five institutes (2021) retrieved from Scopus / Elsevier.

#### Institute for Chemical and Bioengineering (ICB)



#### **Mission Statement**

The Institute for Chemical and Bioengineering (ICB) consists of seven chairs; four full professors, two associate professors, one non-tenure track assistant professor and one chair situated at both ETH Zurich and the Paul Scherrer Institute. ICB is governed by a board comprising all elected professors. Research activities within the ICB focus on a broad range of topics within the fields of chemical and bioengineering, reflecting the breadth of chemical value generation. These include chemical aspects of energy, catalysis, sustainable chemistry, nanomaterials engineering, biochemical engineering, digital chemistry, microfluidics and the application of engineering principles to emerging topics such as diagnostics. Our basic aim is to apply chemical engineering principles to the most important challenges in chemical, materials, medical, biological and energy research, and solve technological problems of global significance. The ICB takes responsibility for the education of chemical engineers at ETH Zurich. A distinctive aspect of our curriculum is the teaching of chemical engineering students with their chemistry

counterparts during the first two years of their undergraduate studies. During this initial period, students are exposed to fundamental aspects of chemistry, biology, physics and mathematics, with core chemical engineering subjects being taught in the final two years. Importantly, all students are furnished with knowledge necessary for the development, design, and operation of industrial processes. This approach equips our undergraduates with a broad and deep knowledge of chemical and biological phenomena, and reflects the growing importance of molecular engineering principles. Such an emphasis is especially relevant for Switzerland, with pharmaceutical and biotech industries employing over 180,000 people, representing 4.5% of GDP and contributing 45% of the country's exports. A key aspect of institute activities is the direct transfer of novel research into practical applications through knowledge, technology transfer and the creation of new companies. ICB has a deep-rooted involvement with industry, having extensive collaborations with the biotech, pharmaceutical, chemical and energy sectors.

Facilities Mechanical Workshop, Electronics Workshop, High Teaching The first two years of the Bachelor program provide Pressure Lab, NMR Laboratory (jointly operated with the D-MATL students with a strong foundation in the chemical sciences, and LAC) Workshop and support facilities (including electron mimathematics, physics and biology. In the third year, students croscopy) are central to the success of the experimental research are exposed to the core engineering disciplines and problems within the ICB. One of the ICB professors directs NCCR Catalysis, related to the design and development of industrial processes and which has strong links to Cat+, a facility for high-throughput products. Experimental work in laboratories is complemented experimentation in catalysis research. The High-Pressure Labwith the construction of a tool-box of simulation models personoratory provides facilities and support for chemical reactions at alized for each student. Within the Master's curriculum, compulhigh pressures and temperatures, with standard autoclaves rated sory lectures are offered in biochemical engineering, product up to 350 bar and 400 C°. The Electronics Workshop supports all and materials, process design, catalysis and separation science. research groups within the ICB in regard to the construction and These are supplemented by a variety of elective courses, which maintenance of electronic instruments. The Mechanical Workshop offer high flexibility towards individual research areas of interest. provides an extensive range of services, including the design and In addition to lectures, substantial time is spent in the laboratory, construction of bespoke instrumentation, the repair and maintewhere theoretical concepts are applied to real-world problems. nance of research equipment and support regarding mechanical Importantly, Hands-on experience of world-leading research is tasks (e.g. 3D printing). The NMR Laboratory provides NMR specobtained through a seven-week project/industrial internship, tra recording services, maintains NMR hardware and assists in case studies in process design and a five-month research project. client-specific problem solving and spectra interpretation.



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#### Institute of Pharmaceutical Sciences (IPW)



#### **Mission Statement**

The Institute of Pharmaceutical Sciences (IPW) is devoted to cutting-edge research at the interface of life sciences, biotechnology and chemistry with the aim to develop concepts, targets, and prototypes for tomorrow's diagnostics and therapeutics. Teaching in Pharmaceutical Sciences is offered at the Bachelor, Master and Doctoral level. Furthermore, we offer postgraduate training courses. The mission of Pharmaceutical Sciences education at ETH Zurich is to enable graduates to assume positions of responsibility in all areas of the pharmaceutical and public health care sector, including community and hospital pharmacies, regulatory authorities, academia, and the pharmaceutical industry. In line with our motto "from concepts to prototypes", research activities at the IPW include:

 the study of relevant physiological and pathological processes, for the identification and validation of molecular targets,
 the discovery, characterization, synthesis, optimization and engineering of novel ligands for pharmaceutical applications, 3) the development and testing (*in vitro* and/or *in vivo*) of novel drugs and excipients, and of novel formulations.

More recently, with a new Chair in Pharmacoepidemiology, the IPW has started to explore the effects of drugs at the population level following market approval. This highly interdisciplinary area can intersect the fields of biostatistics, pharmacy, medicine, informatics, psychology, and toxicology." Research groups at the IPW perform research on various molecular classes of pharmaceutical agents, including small organic molecules, peptides, therapeutic proteins and nucleic acids. Some of these research activities, which are performed in collaboration with national and international partners, have led to the creation of spin-off companies and to the translation of products from the bench to the clinic.

**Facilities** While many research activities at the IPW take place within the individual research groups, access to interdepartmental facilities of ETH Zurich (e.g., the EPIC center for animal exper-

imentation, ScopeM for advanced microscopy or the Functional Genomics Center Zurich) is crucially important for many groups of the IPW. The institute contributes financially to the Workshop and to the MoBiAS analytical unit of the D-CHAB. In addition, it runs certain technology platforms at the Institute level (e.g., FACS, BIAcore, mass spectrometry).

**Teaching** The IPW offers a Bachelor education in Pharmaceutical Sciences (3 years), followed by two Master programs (2 years): – Pharmacy

– Pharmaceutical Sciences

The Pharmacy Master is an accredited study program that provides students with a broad set of knowledge and experimental skills that are required to become pharmacists. It also habilitates students to take the federal exam, which is necessary to perform a professional activity in Swiss pharmacies, according to the Swiss *Medizinalberufegesetz*. The Master study program

#### Institute Board

Institute Chair and

Vice Chair are changing regularly

Prof. Yohei	Ass. Prof. Andrea	Prof. Michael	Prof. Cornelia Halin	Prof. Jonathan	Prof. Jean
Yamauchi	Burden	Detmar		Hall	Christoph
			Pharma-		Leroux
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in Pharmaceutical Sciences provides in-depth knowledge of the drug development process and insight into working areas, which are relevant for the pharmaceutical industry and for academic research. The scientific courses within the program are taught by faculty members. Industry-specific subjects are covered by experts from the pharmaceutical industry. The pharmaceutical industry ranks among the most innovative and profitable sectors of the Swiss economy. Moreover, applied, pharmacy-related courses are primarily taught by pharmacists working in community pharmacies or hospitals.



#### Laboratory of Inorganic Chemistry (LAC)



#### **Mission Statement**

Inorganic Chemistry plays an increasingly important role in the most societally demanded technologies: sustainable catalysis, energy conversion and storage, sensing, data storage and quantum communication technologies, as well as in separation and recycling technologies. With its diverse expertise, the Laboratory of Inorganic Chemistry (Laboratorium für Anorganische Chemie – LAC) is well-positioned to be at the global forefront of scientific and technological advances. The activities of LAC encompass the development of novel synthetic methods as well as the design of functional molecules and materials. Inorganic Chemistry at ETH Zurich tackles various aspects of organometallic/coordination and solid-state chemistry in relation to molecular/surface/materials chemistry, which are all pivotal for developing molecules/building blocks/materials with tailored properties. Besides developing methodologies to prepare compounds and materials, and to control the functionalization of surfaces, LAC also develops analytical

spectroscopic and microscopy tools to understand materials and nanostructures at the molecular level or to identify new properties, elements or entities. These methods include techniques such as elemental and isotope mass spectrometry, nuclear spectroscopy, nuclear magnetic resonance, X-ray diffractometry, electron microscopy, electronic and vibrational spectroscopy, electrochemistry, and single-photon spectroscopy, as well as the characterization of electronic transport. In this context, the research groups of LAC develop inorganic compounds and materials with applications ranging from (i) catalysis for the efficient, selective, and atom-economic syntheses that include the conversion of small molecules (COx, N2...), (ii) sensors/detectors and stimuli-responsive materials (iii) flame retardants, (iv) polarizing matrices for MRI, (v) electrode materials and electrolytes for Li-ion and post-Li batteries to name but a few. The LAC has developed close collaborations with the Eidgenössische Materialprüfungsanstalt (Empa) and the Paul

Scherrer Institute (PSI) over the years. Within ETH Zurich, LAC paras stopped-flow kinetic and elemental and isotope laboratories ticipates in large research collaborations (e.g., NCCR Catalysis) and (Gunther group). in capacity-building initiatives spanning materials research and catalysis. An example is the Laboratory for Multiscale Materials Teaching LAC participates in teaching at the Bachelor and Master Synthesis and Hands-on Education (SynMatLab), an ETH+ project levels at D-CHAB and offers courses to other departments. Our founded in 2018 (together with the D-MATL, D-INFK, D-MAVT). lectures cover all aspects of general and inorganic chemistries, More recently, SwissCat+, a collaboration between ETHZ and EPLF, from the molecular to the solid-state realms. Besides the profeswas launched in 2021 to provide state-of-the-art equipment in sors and the senior scientists, a dynamic and dedicated team of data-driven discovery and development of catalysts and functiondoctoral students are also involved in the active supervision of al-materials-based high-throughput experimental and computaundergraduate or Master students in laboratory courses – general tional approaches. chemistry (1st year), synthetic chemistry (2nd year), solid-state chemistry (2nd year) and analytical chemistry (2nd year) - as well Facilities Mechanical workshop, HTE@ETH (High-throughput exas in exercise sessions and in projects within research laboratoperimentation for catalysis, Copéret group), NMR facility (including ries. As part of their PhD and our lecture series, doctoral students state of the art Dynamic Nuclear Polarization spectrometers at give public lectures on their work; a yearly symposium is also organized where PhD representatives from each LAC group present various fields), SynMatLab-Laboratory for Multiscale Materials Synthesis and Hands-on Education (Kovalenko group), SMoCC their research findings.

"Small Molecule Crystallography Center" (LAC, LOC, IPW), as well



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#### Laboratory of Organic Chemistry (LOC)



#### **Mission Statement**

The central focus of the Laboratory of Organic Chemistry (LOC) is the relation between structure and function in complex molecules and assemblies of molecules. Our approach to the problem takes as its principal tool the synthesis of the molecules and their assemblies. Additional tools we use for this endeavor are analytical methods development, with applications, theory, in both qualitative and quantitative incarnations, and increasingly, inspiration and assay in biological systems. In the latter, a more clearly molecular orientation distinguishes us from the neighboring biological institutes. While the interface between organic chemistry and the life sciences has had a long history in the LOC, stretching from natural products structure elucidation and synthesis, to biosynthetic pathways in secondary metabolism, to enzyme mechanisms, and even studies of possible prebiotic chemistries pertaining to the origin of life, the LOC has the opportunity to build a Biochemistry & Chemical Biology curriculum and research program more systematically.

Objects	Methods				
Natural Products, Bioactive, and Small Molecules	Synthesis				
Organo- and Peptide Catalysts	Analystical and Spectroscopic Methods				
Organometallic Catalysts	Kinetics, Mechanism and Theory				
Supermolecular Assemblies, Noncovalent Interactions, Nanoscience	"Omics" and Cellular Assay				
Proteins /Enzymes					

Facilities As the research needs of the LOC groups have evolved, **Teaching** The LOC provides a strongly focused program with cotechnology platforms providing technical services at a high level ordinated lectures in the first four semesters covering the basics have become increasingly important. While the fundamental of organic chemistry systematically, and increasingly specialized organizational unit in the LOC is the research group of an individofferings in the fifth and sixth semester of the Bachelor curricuual professor, the Institute operates central facilities collectively lum. The Master curriculum includes of an obligatory preparativefor itself and the rest of the department. These include the NMR ly-oriented course, and a wide palette of electives. The LOC is also facility, with 12 high-field instruments from 300 to 600 MHz, one of the main contributors to the laboratory courses ("Praktika") MoBiAS, in which analytical services from mass spectrometry in the D-CHAB, both at the introductory level in dedicated labo-(with 4 large instruments) to elemental analysis and calorimetry ratories, and via obligatory and elective semester projects in the research groups. have been consolidated, and a part of the departmental Mechanical and Electronics Workshops. The LOC is a major user, if not the operator, of further technical infrastructure, of which the EULER computational cluster, X-ray crystallography by SMOCC, imaging by ScopeM, and the Functional Genomics Center Zürich are particularly important.

## Institute Board

Institute Chair and

	Prof.	Prof.	Prof.	Prof.	Prof.
	Kathrin Lang	Bill Morandi	Peter Chen	Erick Carreira	leffrey Bode
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		Chemistry	Homoneneous	Products	biotogy
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erv	Support S				
		Heinz Benz			
		lectronics Shop			
	Christoph Bärtschi				
		echanical Shop			
		Bertran Rubi			

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#### Laboratory of Physical Chemistry (LPC)



#### **Mission Statement**

In the Laboratory of Physical Chemistry (LPC), we investigate the structure and dynamics of matter over the entire range from isolated atoms, molecules, and clusters, via nanostructures, macromolecules, and biomolecules to macroscopic systems in the gas, fluid, and solid phases, extending it to the electrochemical solid-liquid interface. The emphasis is on a molecular description of matter, which is at the heart of the activity of all research groups in the institute, be it experimental or theoretical. Method development has always played a central role in the research strategy of the LPC and has contributed to its international visibility. Experimentally, we develop and use various techniques of high-resolution spectroscopy in the time and frequency domains, such as nuclear magnetic resonance (NMR), electron paramagnetic resonance (EPR), microwave, infrared (IR) and optical (VIS, UV, and vacuum-UV) spectroscopy, including femto- and atto-second spectroscopy. The availability of, and the commitment to, outstanding mechanical and electronics workshops is an essential

aspect of the experimental activity of the laboratory and represents one of its competitive advantages. The theory groups cover all areas of modern theoretical chemistry, i.e., ab-initio quantum chemistry, molecular-dynamics simulation and quantum dynamics, and also have a focus on method development, with both fundamental and algorithmic components. An important part of the research at the LPC is devoted to the application of the theoretical and experimental methods developed in the institute to a broad range of scientific problems in chemistry, biology, physics and the material sciences. The fundamentally interdisciplinary nature of both the methodological and the applied research projects, as presented in the report of the individual groups, highlights the special role played by the LPC at the crossroad of all branches of the natural sciences. This interdisciplinary aspect, which has led to a large network of collaborations with other groups within the D-CHAB and in other departments, is also reflected in the teaching and educational activities of the institute. The professors of the institute do not only contribute to the chemistry curriculum but also provide service lectures to other departments. The laboratory has also played, and still plays, a central role in the educational programs Computational Science and Interdisciplinary Sciences.

#### Facilities

- Electronics workshop
- Mechanical workshop
- Chemical synthesis laboratory

- NMR Laboratory (part of D-CHAB-NMR) The workshop facilities are key to the success of the experimental research groups of the LPC. The facilities are operated with high efficiency, applying a bottom-up approach: Each experimental group has a designated technician who is specialized in the fields important for the re-

		Staff (	Committee —	Institute Institute Cf Vice Chair are cha		
Prof. Beat Meier Solid State NMR Spectroscopy	Prof. Sereina Riniker Computational Chemistry	Prof. Gunnar Jeschke Electron Paramagnetic Resonance	Prof. Markus Reiher Theoretical Chemistry	Ass. Prof. Jeremy Richardson Theoretical Molecular Quantum Dynamics		
	Titl. Prof. Philippe Hünenberger Computer Simulation of Molecular Systems	Titl. Prof. Matthias Ernst Solid State NMR Spectroscopy	Dr. Eri Laborat Hansjürg Scl Schneider, Electronics and Ma Mark	Support S Frich Meister ratory Classes Schmutz / Andreas er, Daniel Freund ics Development Maintainance rkus Traber		

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search of the group. All technicians (e.g., all electronics engineers) have their work place in the same area to foster the exchange of ideas and expertise.

**Teaching** LPC lectures have a strong mathematical focus already in the basic courses. The advanced lectures introduce students to the latest developments in the broad field of physical chemistry. The LPC is committed to the continuous development of its teaching activities, as illustrated by the new block concept in the general-chemistry lecture and the new computational-chemistry parts of the practical courses.



# **Curious for more?**

Come and visit us on the Hönggerberg.

Department of Chemistry and Applied Biosciences (D-CHAB) HCI Building Vladimir-Prelog-Weg 10 8093 Zurich, Switzerland 

### Impressum

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