University of Applied Sciences and Arts Northwestern Switzerland
School of Life Sciences

Study guide
Master in Life Sciences

Chemical Engineering

fhnw.ch/master-lifesciences

Cover Picture:
Elisa sets up the process parameters for a
100 litre multi-purpose reactor.

Quick Facts
Master of Science in Life Sciences FHNW

√ **A coordinated MSc/Master's programme in Life Sciences conducted by the Swiss Universities of Applied Sciences**

√ **Designed for motivated students interested in applied research**

√ **Opens the door to outstanding career opportunities in research, development and production**

√ **Specialisations offered by the University of Applied Sciences and Arts Northwestern Switzerland:**

- Analytical Chemistry
- Applied Cell Biology
- Bioanalytics
- Biotechnology
- Chemical Engineering
- Data Science
- Environmental Technologies
- Organic and Supramolecular Chemistry
- Pharmatechnology

√ **Three semesters full-time study, 90 ECTS credits; part-time studies possible**

√ **MSc / Master's thesis: 40 ECTS credits, modules: 50 ECTS credits**

√ **Admission: good BSc degree in a relevant subject**

√ **Admission deadlines: April 30th (autumn semester) and November 30th (spring semester)**

√ **Start of studies: mid-September and mid-February**

√ **Tuition fees: CHF 750 per semester (Swiss, Liechtenstein), CHF 1 000 (EU), otherwise CHF 5 000; CHF 100 per semester for materials and licences**

The FHNW School of Life Sciences
Introduction

The FHNW School of Life Sciences (HLS) is a leading Swiss School for education and application-oriented research in Life Sciences. With a network of industry and research partners, the HLS is a unique university centred around technology development in medical, natural, environmental and engineering sciences. The state-of-the-art infrastructure facilitates translating cutting-edge research into practice. Benefits for patients, innovative products, intelligent solutions and environmentally friendly technologies are the ultimate goal.

The Master's study programme combines lectures on applied life sciences with practical experience in an eight month Master's thesis. The core of the life sciences study programme consists of scientific knowledge for research and development, coupled with practical experience. Students may assemble their own curriculum from available modules. In order to prepare optimally for a professional career, the course also covers essential management skills. Graduates are ultimately expected to prove their abilities in a competitive and international life sciences environment.

Basel – Centre of the global Life Sciences Industry

The School of Life Sciences FHNW in Muttenz (Canton Basel-Land) is situated in one of the global centres of the life sciences industry. Several international companies have their headquarters in the Basel area, e.g. Roche, Novartis, Clariant, Straumann and Syngenta, to name just a few. Apart from these, around 600 other companies in the life sciences sector conduct development, research or production in the Basel area. Together they offer approximately 30,000 high-powered jobs.

The lecturers of the School of Life Sciences cooperate closely with local industry in joint projects. *In addition, the majority of Bachelor's and Master's theses are completed with a partner in industry.* And the Basel area is not only attractive with regard to job opportunities but is also part of the vibrant Rhine valley region where Switzerland, France and Germany meet and which offers many options for entertainment and leisure activities.

Qualified experts for the growing Life Sciences market
The Master's programme

The MSc study programme gives graduates specialist knowledge enabling them to integrate quickly and effectively into the global industrial life sciences sector and related fields. MSc graduates have broad training and extensive knowledge, combined with in-depth practical experience. During the eight months of their thesis, they demonstrate that they can work independently on demanding projects.

With these qualifications, graduates of the programme are able to plan and carry out projects in the fields of applied research, development, translational research and production. They are also aware of entrepreneurial issues such as budgeting, personnel, deadlines, markets and products.

Graduates are able to present and explain the results of their work in their native language and in English to other specialists as well as to colleagues with different backgrounds. They bring high-level skills and knowledge to multi-disciplinary and interdisciplinary teams.

New career prospects

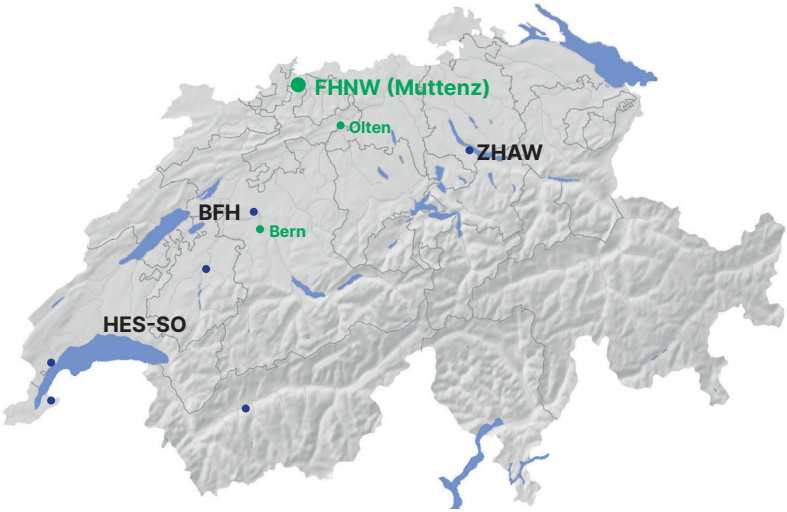
MSc graduates typically hold positions in organisations where they manage and participate in projects that build on their expertise. Such organisations are active in chemistry, biotechnology, environmental protection and nutrition as well as pharmaceutical and medical technology. The Master of Science degree is internationally recognised and allows students to continue their studies with a doctorate in most countries.

Where Life Sciences come alive
The Master's programme

The international Master of Science in Life Sciences is conducted in collaboration with other Swiss Universities of Applied Sciences: Berner Fachhochschule BFH, Haute Ecole Spécialisée de la Suisse Occidentale HES-SO and Zürcher Hochschule für angewandte Wissenschaften ZHAW.

Programme structure
The MSc study programme encompasses lectures (50 ECTS credits) and the thesis (40 ECTS credits). The Specialisation modules are offered by the School of Life Sciences FHNW and take place in Muttenz/Canton Basel-Landschaft. The Core Competence modules and the Cluster-specific modules, which are organised in cooperation with the partner universities, are held in Olten and Bern and are offered partly online.

The modules are offered during the semesters (see pages 10–11). All modules usually take place at least once a year. The students are supported by an innovative e-learning platform.



Study consultation
After acceptance, the Dean of the programme will consult each student regarding which modules shall be taken in which semester. Thus each student will have an individual study programme that best meets his/her interests. It is also possible to complete part of the course at a foreign higher education institution.

Teaching language
The language of teaching is English. This requires that in addition to the technical and scientific skills applicants must be able to read scientific articles and books, follow the lectures, participate in discussions and be able to write the thesis in English on their own. Therefore, it must be emphasised that students who want to undertake the MSc programme need adequate skills in English (see also page 22).

Educational concept
The educational concept of "blended learning" combines independent learning with lessons on site. When preparing course contents, modern forms of teaching and learning such as e-learning and case studies are included. In seminars and workshops, students deal with challenging issues and differing points of view. Complex issues will be explained by the instructors in lessons. In the Master's programme, great emphasis is put on "research learning," where traditional teaching is augmented by individual context-based knowledge generation.

Start
The programme starts in the autumn semester (calendar week 38) or in the spring semester (calendar week 8).

Completion
Successful completion of the course leads to the award of the title "Master of Science" which is recognised around the world.

Learn more
The School of Life Sciences FHNW offers information evenings that provide more details about the MSc study programme. Please check the website for more information and dates.

Structure of the study programme
The Master's programme

Full-time students

The MSc study programme comprises 90 ECTS credits. Shown here is a full-time study plan starting in the autumn semester (1.5 years):

Study plan

Autumn semester		Spring semester			
Sep	**Feb**	**Feb**	**Jun**	**Jun**	**Sep**
Lectures (1st sem.)		**Lectures** (2nd sem.)		**Thesis** (8 months)	
Thesis (3rd sem., 8 months)					

Programme structure full-time students

Master's thesis 8 months from end of 2nd to 3rd semester	40 ECTS credits
Modules	min. 50 ECTS credits

Core Competence Modules

4–8 modules of 3 ECTS
are taken during the first two semesters
(for details see pages 12–13 & 18–19)

Specialist Modules

9–13 modules of 3 ECTS
are taken during the first two semesters
(for details refer to modules groups pages 14–19)

Note: It is possible that modules or final exams take place outside the semester.

Part-time students

It is also possible to study part time. In this case, the studies take approximately six semesters depending on the individual study plan. Part-time students may work in parallel – as a guideline 50 to 60 percent workload is appropriate. Other plans are possible; please consult the Dean.

Study plan

Autumn semester		Spring semester			
Sep	**Feb**	**Feb**	**Jun**	**Jun**	**Sep**
Lectures (1st sem.)		**Lectures** (2nd sem.)			
Lectures (3rd sem.)		**Lectures** (4th sem.)		**Thesis** (8 or 12 months)	
Thesis (5/6th sem., 8 or 12 months)					

Programme structure part-time students

Master's thesis 8 months from end of 4th to 5th semester or 12 months from end of 4th to 6th semester	40 ECTS credits
Modules	min. 50 ECTS credits

Core Competence Modules	Specialist Modules
4–8 modules of 3 ECTS are taken during the first four semesters (for details see pages 12–13 & 18–19)	**9–13 modules of 3 ECTS** are taken during the first four semesters (for details refer to modules groups pages 14–19)

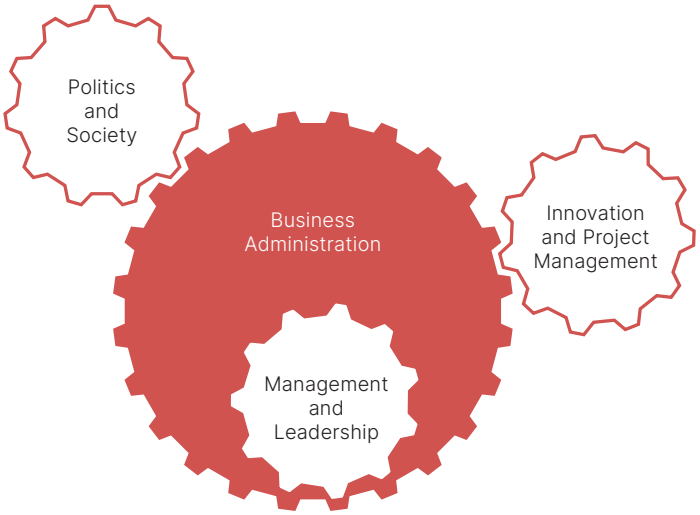
Note: It is possible that modules or final exams take place outside the semester.

Core Competence modules

The Core Competence modules are designed to introduce students to the life sciences industry, focusing on professional life within the industry as well as providing insight into data handling and analysis techniques.

Business, Management and Society
Three of the modules – Business Administration, Management and Leadership, and Project and Innovation Management – focus on providing an understanding of how Life Sciences companies function. In contrast, the fourth module is devoted to the social, political and ethical context within which Life Sciences companies operate.

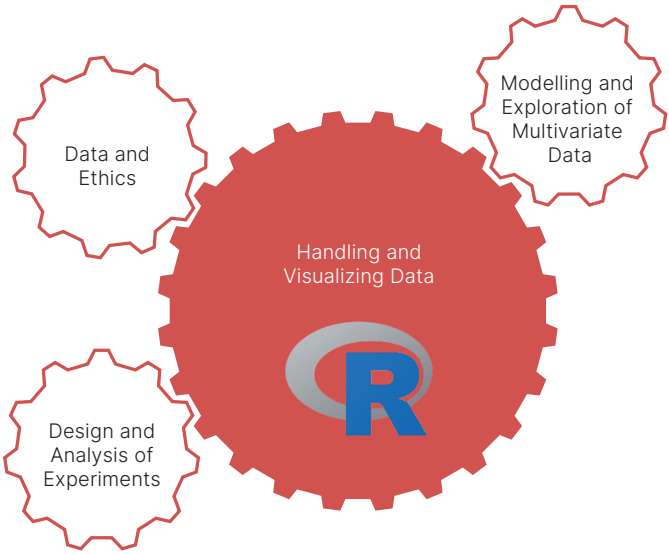
Students who complete these modules will have an understanding of how Life Sciences companies work, how they are managed, and how they are led. They will therefore be aware of diverse entrepreneurial issues and be thoroughly prepared for a career in the industry.



Data

The four Data Core Competence modules (Handling and Visualizing Data, Design and Analysis of Experiments and Modelling, Exploration of Multivariate Data and Data and Ethics) reflect the increasing importance of information in all technical and scientific areas. Today more and more data is generated and gathered than ever, and it needs to be skillfully analyzed in order for companies to profit from it. In three modules students are trained to plan and design experiments, to handle large data sets, to visualize them, and to analyze them with state-of-the-art methods. The modules use "R", a powerful and open software suite for data analysis. The fourth module, "Data and Ethics", is adressed towards data management, privacy and data security.

After having completed the data modules students will have acquired all the necessary skills to analyze their own data, to prepare high quality figures for meaningful data visualization, and to select and apply the appropriate methods for data analysis and data management.



Specialisation
Chemical Engineering

MSc in Life Sciences – Specialisation Chemical Engineering

Climate change, raw material scarcity, digitalization, and renewable materials instead of fossil fuels as the basis for platform chemicals, are major global challenges. These challenges require processes which are sustainable, robust, well-engineered and rapidly available. Finding solutions requires highly trained specialists with sound scientific knowledge and the ability to develop, implement and successfully operate new processes.

Students specialising in Chemical Engineering are offered a tailored training program: in addition to in-depth elements of (bio) chemistry, pharmaceutical and environmental engineering, the course emphasises aspects of safety engineering, sustainability, process development and optimisation. The tension between what is possible and what is necessary and feasible is resolved in special courses and in group work. Modern simulation and calculation tools, and the use of real-time data from innovative measurement techniques for process control and development complete the training.

Modules from related specialisations, in particular Biotechnology, Analytical Chemistry, Organic and Supramolecular Chemistry, Data Science and Environmental Technology complement the specific courses. This broad range of specialised and generic modules allows each student to create an individually tailored study programme (pages 16 – 19).

Students may also study an extra semester at a foreign partner university, allowing them to gain an additional degree (Double Degree option, see page 21 for details).

The MSc includes an eight month thesis; this can be done at the research, development or manufacturing facility of one of our industrial partners, or with a partner at the FHNW's new process technology centre (PTC), with its outstanding facilities for investigating disruptive

technologies and complete processes. The thesis opens the door to successful employment in industry or in academia. Students have an outstanding preparation for challenges awaiting them in their careers in R&D, engineering and production, and can access a wide range of fascinating jobs whose requirement profiles closely match their qualifications.

The MSc in Life Sciences – Chemical Engineering is especially suited for students with a BSc degree in Chemical Engineering, Chemistry, Environmental Engineering or related fields. For admission please consult page 22.

Further Specialisations offered in the MSc in Life Sciences FHNW

- Analytical Chemistry
- Applied Cell Biology
- Bioanalytics
- Biotechnology
- Data Science
- Environmental Technologies
- Organic and Supramolecular Chemistry
- Pharmatechnology

Please consult the respective Study Guides for your information.

Module Groups for the Specialisation Chemical Engineering

	Type	Semester	Venue
Module Group Chemical Engineering (4 out of 5)			
Sustainable Process Development	S	AS	Muttenz
Process Transfer and Scale-Up	S	AS	Muttenz
Reaction Technology	S	SS	Muttenz
Process Development and Technology	S	SS	Muttenz
Process Automation	S	SS	Muttenz
Module Group Electives (4 out of 8 required)			
Continuous Biomanufacturing	S	AS	Muttenz
Continuous Pharmaceutical Production	S	AS	Muttenz
Pharmaceutical Production Facilities	S	AS	Muttenz
Process Technology for Industrial Pollution Control	S	AS	Muttenz
Valorization of Biomass Waste and Side Streams	S	AS	Muttenz
Costs and Benefits of Sustainbale Production	S	SS	Muttenz
Modern Technologies in Organic Synthesis	S	SS	Muttenz
Process Analytical Technology	S	SS	Muttenz

N.B. In total 50 ECTS (meaning 17 modules à 3 ECTS) have to be gained.
Complete Module Offer: www.fhnw.ch/hls/master-ls-module
Webtool to plan your studies: https://planyourstudies.lifesciences.fhnw.ch/

	Contents
	Process simulation (case studies), cost estimations, mass and energy balances, life cycle assessment of processes
	Key performance indicators, mass and energy balances, design of experiment for scale-up, case study with experimental part
	Reactor technology, reaction kinetics, simulation of reactions, operational modes, regulatories
	Seperation principles, mass and energy balances, process design and layout studies
	Control strategies, implementation fo chemometric models, case studies

	Equipment and concepts for continous upstream and downstream units, product quality considerations, economics and regulatories, case studies
	Continuous production of solid forms and of extrudates, incl. laboratory course at an industrial site
	Design of production plants; containment systems; heating, ventilation, air-conditioning (HVAC); water, vapour and gas distribution
	Air: emission reduction, off-gas treatment, water: emission control, industrial water treatment, resource efficiency
	Material flow and recovery, separation and conversion technologies, recovery examples, case study on resource recovery
	Decision making frameworks, cleaner production, circular economy, industrial symbiosis, resource recovery case study
	Photochemistry, electrochemistry, synthesis in flow systems, organocatalysis and biocatalysis
	Process analytical technology in research, development and manufacturing, at-line and online analytics, multivariate data analysis and design of experiments, case studies

S = Specialisation module
CS = Cluster-specific modules
CC = Core Competences

AS = Autumn semester
SS = Spring semester

-1: first semester half
-2: 2nd semester half
-Bx: block week after the semester

Module Groups for the Specialisation Chemical Engineering

	Type	Semester	Venue
Module Group Cluster-Specific (3 out of 5 required)			
Materials Science	CS	AS-1	Olten/online
Physicochemical Principles of Pharmaceutics	CS	AS-2	Olten/online
Green Chemistry	CS	SS-1	Olten/online
Chemistry and Energy	CS	SS-2	Olten/online
Industrial Chemistry Process Safety	CS	SS-B1	Fribourg

Module Group Core Competences (4 out of 8 required)			
Handling and Visualizing Data	CC	AS-1A	Lectures: online Coaching: Muttenz
Data and Ethics	CC	AS-1B	Lectures: online Coaching: Muttenz
Design and Anlaysis of Experiments	CC	AS-2A	Lectures: online Coaching: Muttenz
Modelling and Exploration of Multivariate Data	CC	AS-2B	Lectures: online Coaching: Muttenz
Business Administration for Life Sciences	CC	SS-1A	Lectures: online Coaching: Muttenz
Management and Leadership for Life Sciences	CC	SS-1B	Lectures: online Coaching: Muttenz
Innovation and Project Management	CC	SS-2A	Lectures: online Coaching: Muttenz
Politics and Society	CC	SS-2B	Lectures: online coaching: Muttenz

N.B. In total 50 ECTS (meaning 17 modules à 3 ECTS) have to be gained.
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	Contents
	Solid state bulk materials, crystallographic and electronic structure, structural, optical, mechanical and magnetic properties, metallic and ceramic materials, nanoscale materials
	Interfacial phenomena, surfactants, pharmaceutical nanotechnology, colloids, rheology, pharmaceutical polymers, micromeritics, compaction
	Green chemistry metrices, industrial green chemistry, green solvents
	Chemical energy storage, biogas, bioenergy, photocatalysis, photovoltaics, energy and mobility
	Process safety and production unit design, thermal safety, green process design of hazardous reactions, environmental, health and safety legal right

	Introduction to R, organising data, databases, describing data: scatter, skewness, outliers, visualising data, informative plots
	Personal data security, information security, encrpytion, digital signatures, data stewardship, data ethics, privacy
	Statistical interference, experimental design, feasibility, efficiency and power of experiment designs, statistical analysis, interpretation and visualisation of results
	Modelling: linear, nonparametric and multiple regression, model selection and diagnosis; exploration: visual inspection, principal component analysis, clustering
	Business models, marketing, production, sourcing, capital budgeting, financial accounting, cost accounting
	Management, corporate ethics, strategic management, HR management, leadership, change management
	Entrepreneurship, megatrends, innovation management, presentation techniques, project management
	Politics: a process of negotiation, struggle and compromise; the role of society; public opinion, responsabilitiy, ethics

S = Specialisation module
CS = Cluster-specific modules
CC = Core Competences

AS = Autumn semester
SS = Spring semester

-1: first semester half
-2: 2nd semester half
-Bx: block week after the semester

The Master's thesis
The Master's programme

Amounting to 40 ECTS points, the thesis is the most important module of the MSc programme. It addresses a scientific or technical question of practical relevance and is carried out either at an institute of the School of Life Sciences FHNW, at the site of an industrial partner or at a foreign university or research institute. In all cases, the student is supervised by a member of the school's faculty.

The thesis has to be written in English and lasts eight months in full-time study.

Our Partner Schools

Double Degree

Double-Degree with Linköping University
Selected students on our Master's programme can complete a double degree by taking an additional semester at the Linköping University, earning them two titles of MSc in Life Sciences FHNW and MSc in Chemical Biology from the University of Linköping.

LINKÖPING UNIVERSITY

Double Degree

Double-Degree with UTC Prague
Selected students on our Master's programme can complete a double degree by taking an additional semester at the UCT Prague, earning them the two titles of MSc in Life Sciences FHNW and MSc in Biotechnology and Food Science UCT Prague.

UNIVERSITY OF CHEMISTRY AND TECHNOLOGY PRAGUE

Partner School
The School of Life Sciences has over 40 international partner schools all over the world. Students may spend one seme-ster at a foreign university in selected MSc programmes. In addition, it is possible to do the Master's thesis abroad. The School of Life Sciences is a member of the SEMP (Swiss European Mobility Programme) which supports student exchanges within Europe.

Cooperation with the University of Basel
Students of the MSc programme may visit additional lectures offered by the University of Basel. Please consult the Dean for details.

Universität Basel

General information
Admission and enrolment

Terms of admission
As a rule, outstanding bachelor's degree qualifications are accepted for the MSc programme.

Candidates will be admitted without an entry examination if they have
- gained a BSc in a related subject and graduated with grade A, B or ≥ 5, or demonstrated an equivalent qualification (≤ 2.5 for Germany / Austria)
- the required English skills

Motivated students who do not fulfil the entry requirements entirely might be invited for an assessment interview.

Adequate English competency has to be proven with one of these certificates:

Type of certificate		Required level
CAE	(Certificate of Advanced English)	FCE
IELTS	(English Language Testing System)	5.5
TOEFL	(Test of English as a Foreign Language)	iBT 71
Spoken or Written Academic English	(module of the Bachelor programme at the School of Life Sciences FHNW)	4.5

In the event of a lower English level, the applicants may be admitted but have the obligation to improve their English during the Master's course. They may attend the Advanced English course offered by the School of Life Sciences or may attend other courses. At the end of the studies, students have to prove that they have attained the required English level (see table above).

Application
Deadline for applications is end of April for the autumn semester (start in calendar week 38) and end of November for the spring semester (start in calendar week 8). Please apply online via our webportal.

Fees and grants
General information

Fees and expenses		
Tuition fees per semester for students domiciled in a Swiss canton, or in the Principality of Liechtenstein*	CHF	750*
For students who are legally resident in the EU / EFTA at the start of their studies, the semester fees are	CHF	1000
Tuition fees per semester for all other students	CHF	5000
Materials and licences per semester	CHF	100
Enrolment fee	CHF	200
Graduation fee	CHF	300
It is expected that students own a notebook PC		

Grants

In Switzerland, grants are regulated on a cantonal basis. The canton of your place of residence decides on grants or interest-free loans. In addition to public grants, there are also private institutions that award scholarships.

* Essentially the tuition fee of CHF 750 applies to those students whose parents or guardians are in Switzerland or Liechtenstein; who are citizens of Switzerland, Liechtenstein; who for the previous two years were financially independent due to being employed in Switzerland, Liechtenstein and who did not undertake any higher or further education in this time.

FHNW University of Applied Sciences and Arts Northwestern Switzerland
General information

The FHNW University of Applied Sciences and Arts Northwestern Switzerland is a leading education and research institution with strong links to the surrounding region. It is one of the most innovative universities of applied sciences in Switzerland.

The FHNW comprises nine schools covering the following fields: Applied Psychology, Architecture, Civil Engineering and Geomatics, Art and Design, Business, Education, Life Sciences, Music, Social Work and Technology.

More than 13,100 students are enrolled at the FHNW campuses in the cantons of Aargau, Basel-Land, Basel-Stadt and Solothurn. Around 1,300 lecturers teach 31 bachelor's and 20 master's degree courses as well as a range of practical and market-focused continuing education programmes. FHNW graduates are highly sought-after specialists.

Application-oriented research and development has an equally high priority at the FHNW. With national and international partners from industry, business, culture, government and institutes, the FHNW runs research projects and is an active participant in European research programmes. The FHNW supports the transfer of expertise and technology to firms and institutions: in 2020, application-oriented research and development included 1,291 research projects and 359 service projects.


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We are at your service
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The FHNW incorporates nine faculties:

- FHNW School of Applied Psychology
- FHNW School of Architecture, Civil Engineering and Geomatics
- FHNW Academy of Art and Design
- FHNW School of Business
- FHNW School of Engineering
- **FHNW School of Life Sciences**
- FHNW Academy of Music
- FHNW School of Social Work
- FHNW School of Education

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