

Form regarding practical laboratory skills for the Master's degree program in *Chemical Biology*

Dear applicant for the Master's degree program *Chemical Biology*;

Thank you for your interest in our Master's degree program. For admission to the Master's degree program in *Chemical Biology*, your previous studies and practical laboratory experience must be comparable to those of our Bachelor's degree program in *Chemical Biology*, as the Master's degree program builds on the Bachelor's degree program. In order to decide whether to invite you to an admissions interview with two university professors, we need information about your skills in performing chemical, biochemical, bioorganic, molecular biological and analytical experiments in the laboratory.

Personal information

Last name	
First name	
Date of birth:	
Degree 1, University	
Degree 2, University	
Further degrees and courses	

Please enter **your practical laboratory experience** in the table below. To help you understand the types of practical skills we are looking for, please refer to the list on the last two pages of this document.

Please include only those laboratory experiments and methods that you have performed yourself. **If you did not perform the experiment yourself, but only watched a demonstration, presentation or film, or watched others perform the experiment in a group, this does not count as hands-on experience.**

We do not expect you to have experience with all the techniques on the list for admission to our Master's degree program. However, we do need to know which laboratory techniques you still need to learn.

Note: If you have carried out reactions or other laboratory work that is not listed, please add them to the table as well.

Table: Laboratory skills in hours per week (HPW)

Module / Internship / Work experience etc.	Reactions, Assays, Tests	Methods, techniques, devices, apparatus used	Analytical methods	HPW*	Duration**	Group size
<i>E.g.: Fundamentals of Organic Synthesis (MOC1P)</i>	<i>Radical halogenation, nucleophilic substitution at the sp³-carbon atom, additions / eliminations on C/C double bonds, substitution on aromatic compounds, reduction / oxidation of carbonyl compounds, nucleophilic substitution at the acyl carbonyl carbon atom, condensations with ketones, Mannich-reaction, Aldol-reaction, Knoevenagel and Knoevenagel-Doebner condensation, Enolate alkylation, Grignard-reaction</i>	<i>Use of magnetic stirrer, heating / cooling bath, rotary evaporator, water /oil vacuum pump, setting up and use of vacuum distillation, setting up and use of reflux glass ware with dropping funnel, using extraction funnel, filtration, (re)crystallisation, ...</i>	<i>Determination of product purity (TLC), calculation of yield, determination of melting point, IR-Spectrum, R_f-Value, refraction index</i>	10	15	2

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*HPW = Hours per week, ** Duration = Number of weeks

Fundamental laboratory skills:

Please tick all the methods you are familiar with.

Usage of appliances (please mark all that apply):

- | | | | |
|---|--|--|--|
| <input type="checkbox"/> Magnetic stirrer | <input type="checkbox"/> Water vacuum pump | <input type="checkbox"/> Oil vacuum pump | <input type="checkbox"/> Bunsen burner |
| <input type="checkbox"/> Heating bath | <input type="checkbox"/> Rotary evaporator | <input type="checkbox"/> Other: | |

Setting up and using equipment for (please mark all that apply):

- | | | | |
|---|---|--|---|
| <input type="checkbox"/> Normal Distillation | <input type="checkbox"/> Steam distillation | <input type="checkbox"/> Vacuum distillation | <input type="checkbox"/> Secured stirring plate apparatus |
| <input type="checkbox"/> Working under Inert gas (e.g. Schlenk lines) | <input type="checkbox"/> Soxhlet Extraction | <input type="checkbox"/> Reflux | <input type="checkbox"/> Other: |

Using software such as (please mark all that apply):

- | | | |
|---|-------------------------------------|---------------------------------|
| <input type="checkbox"/> Microsoft Office (Excel, Word, Powerpoint) | <input type="checkbox"/> ChemDraw | <input type="checkbox"/> Other: |
| <input type="checkbox"/> Origin | <input type="checkbox"/> OpenOffice | |

Bachelor's / Master's thesis

- ☐ I have written a Bachelor's thesis

Title:

- ☐ The thesis included experimental work
☐ The thesis was based only on literature reviews
Other:

- ☐ I have written a Master's thesis

Title:

- ☐ The thesis included experimental work
☐ The thesis was based only on literature reviews
Other:

I hereby certify that the information I have provided regarding my practical skills is accurate to the best of my knowledge.

Location, Date

Signature

Important practical laboratory skills:

Fundamental Chemical Operations and Documentation

- **Quantitative and qualitative chemical analysis** e.g. gravimetric and volumetric methods, including acid-base titrations, redox titrations, and complexometric titrations, ion determination.
- **Substance identification and characterization**
- **Proper disposal techniques** (e.g. quenching) for organic and inorganic chemicals, genetically modified organisms, microbial materials, and biochemical waste.
- **Experience in writing scientific protocols** (Citation, Introduction, Theoretical Background, Experimental, Summary and Conclusion, Discussion Outlook)

Organic/Inorganic Chemistry

- **Organic synthesis:** Reactions like different kinds of substitutions (also aromatic substitution), radical halogenation; addition at carbon-carbon bonds, elimination, reduction, oxidation, synthesis of esters and amides, different condensations, Mannich reaction, Aldol reaction, enolate alkylation (examples for reactions performed at TU Dortmund university)
- **Experiments, where you used** syringes, cannulas and transfer cannulas.
- **Characterization of organic substances:** Infrared (IR) Spectroscopy, NMR (^1H , ^{13}C , ^{31}P , ^{19}F), 2D-NMR spectroscopy, Mass Spectrometry (MS), UV/Vis Spectroscopy, Melting and boiling point determination, Refractive index measurement
- **Experiments** under inert gas and exclusion of moisture.
- **Handling hazardous substances** e.g., alkali metals, hydrides, self-igniting substances, bromide) and proper safety protocols.
- **Handling of liquid nitrogen** and working at low-temperature safely e.g. cooling techniques down to $-80\text{ }^{\circ}\text{C}$ and handling liquid nitrogen

Physical Chemistry

- **Experiments and measurements in physical chemistry** (e.g. thermodynamics, chem. kinetics, gas kinetics, transport phenomenon)
- **Calculation** of standard errors, standard deviation, plotting of experimental data, writing protocols.

Biochemistry, Molecular Biology, Synthetic Biology

- **Biochemical product evaluation** using such as RNA, DNA, and proteins using techniques such as: Agarose gel electrophoresis, Polyacrylamide gel electrophoresis (PAGE), Blotting techniques (e.g., Western, Northern, and Southern blotting),
- **Protein analysis:** Protein isolation, purification, and characterization through enzyme assays, enzyme kinetics, and inhibition testing.
- **Molecular biology techniques:** Polymerase Chain Reaction (PCR), transformation/transfection, handling and cultivation of genetically modified organisms, *In vitro* transcription and translation.
- **Microorganism isolation and culture:** Gene editing, working with restriction enzymes, working with microbial cultures and growth measurement
- **Working under sterile conditions**
- **Synthetic Biology techniques:** Cell free protein synthesis, generation of competent bacteria, generation of cell-like compartments, gene-specific amplification

Cell Biology

- **Cell culture techniques:** Cell transfection, siRNA techniques, Western blotting
- **Microscopy:** Fluorescence microscopy, other microscopy and cell analysis techniques
- **Image processing:** Image processing of microscopy data
- **Stimulation and pharmacological manipulation** of living mammalian chimeric cells: Analysis of: cell cycle and its dynamic, cell-cell interaction, vascular transport

Bioorganic Chemistry

- **Synthesis of peptides** and activity testing.
- **Small molecule synthesis** of a Molecular Weight from 100 to 900 g/mol
- **Biocatalysis:** Enzyme isolating and applying them as biocatalysts in reactions.