Handbook
Master of Science
Molecular Plant Science

The Master of Science in Molecular Plant Science shall be set up as a consecutive and research-oriented degree program. Graduates will have learned molecular biological, physiological, and histological methods and procedures and will be able to apply them in experiments. They will possess the ability to develop hypotheses through problem analysis and using methods learned be able to develop experiments to test these hypotheses. Graduates will be familiar with the current discourse on molecular biological methods and, with their professional knowledge, will be able to contribute to social debate. Consequently, they will be in a position to be able to assess the developments in the area of molecular biology including those within a socio-economic context.

1. Semester	Introduction to Molecular Plant	Introduction to lab methods A	Introduction to lab methods B	Introduction to lab methods C
2.Semester	Ethics in Biology	Lab Course A		
3.Semester	Introduction to job	Lab Course B		
4.Semester	Masterthesis			

compulsory elective	compulsory

Inhalt

Introduction to Molecular Plant Science 3
Introduction to Lab Methods - Basic Molecular Biology and Protein Biochemistry ..4
Introduction to Lab Methods - Plant Stress Responses 5
Introduction to Lab Methods - Molecular and Cellular Analyses of Phenotypes 6
Ethics in Biology..... 7
Lab course A - Molecular Plant Physiology 8
Lab course B – Molecular Plant Genetics..... 10
Lab course C – Infection biology 11
Lab course D - Molecular Plant Pathology 13
Lab course E – Developmental biology 14
Introduction to job.....15
Master thesis..... 16

Title:	**Introduction to Molecular Plant Science**				
Module number:	MoPS-01				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Stefan Hoth, Phone: 42816 582, stefan.hoth(at)uni-hamburg(dot)de				
Instructors:	All Instructors: s				
language	English				
Intended learning objectives:	Current concepts of Molecular Plant Science, with special emphasis on Plant Physiology, Plant Development and Plant Pathology				
Contents	Current concepts of Molecular Plant Science, with special emphasis on Plant Physiology, Plant Development and Plant Pathology				
Course types and forms of instruction:	• L:Introduction to Molecular Plant Science • S: Case Studies				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	PV (hrs)
	• L:Introduction to Molecular Plant Science • S: Case Studies		*28* *28*	*56* *56*	*12-*
	Total Workload	*6*	*56*	*112*	*12*
Coursework and examinations:	Formal requirements for examinations: Talk examinations: Oral or written exam (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Introduction to Lab Methods - Basic Molecular Biology and Protein Biochemistry**				
Module number:	MoPS-02				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Julia Kehr, Phone: 42816- 312, julia.kehr(at)uni-hamburg(dot)de;				
Instructors:	Prof. Dr. Julia Kehr				
language	English				
Intended learning objectives:	Students are familiar with currents methods in molecular plant science				
Contents	Inoculation of plants with fungal and bacterial pathogens, Detection of gene expression, Mycotoxin analysis, Callose deposition, Bacterial proliferation assay, Bioimaging with fluorescent and light microscopy, Basic methods and tools of Applied Bioinformatics, Differential cell organelle proteomics upon infection				
Course types and forms of instruction:	• P: lab methods in Molecular Plant Science – course A				8 SEM./HRS
Workload (module components and total):	• P: lab methods in Molecular Plant Science – course A	credits	P (hrs) 104	S(hrs) 100	PV (hrs) 36
	Total Workload	8	104	100	36
Coursework and examinations:	Formal requirements for examinations: Active working examinations: Protocol (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Introduction to Lab Methods - Plant Stress Responses**				
Module number:	MoPS-03				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Stefan Hoth, Phone: 42816 582, stefan.hoth(at)uni-hamburg(dot)de,				
Instructors:	Prof. Dr. Stefan Hoth				
language	English				
Intended learning objectives:	Students are familiar with currents methods in molecular plant science				
Contents	DNA and RNA isolation, PCR, qPCR for detection of gene expression, genotyping and phenotyping of transgenic plants, transient plant transformation, analysis of promoter reporter gene constructs, confocal laser scanning microscopy to determine intracellular localization of proteins tagged with fluorophors, isolation and purification of recombinant proteins, immuno cytochemistry, Immune detection of proteins, western blot				
Course types and forms of instruction:	• P: lab methods in Molecular Plant Science – course B				8 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• P: lab methods in Molecular Plant Science – course B		104	100	36
	Total Workload	8	104	100	36
Coursework and examinations:	Formal requirements for examinations: Active working examinations: Protocol (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Introduction to Lab Methods - Molecular and Cellular Analyses of Phenotypes**				
Module number:	MoPS-04				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Arp Schnittger, Phone: 42816 502, arp.schnittger(at)uni-hanburg(dot)de				
Instructors:	Prof. Dr. Arp Schnittger				
language	English				
Intended learning objectives:	Students are familiar with currents methods in molecular plant science. Moreover, they gain competences to design hypothesis-based study concepts and to analyze data sets statistically. Results are documented and presented adequately.				
Contents	Heterologous overexpression of proteins, protein purification, protein-protein and protein-nucleic acid interaction assays, mass spectrometry, plant transformation, analyses of plant secondary metabolites				
Course types and forms of instruction:	• P: lab methods in Molecular Plant Science – course C				8 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• P: lab methods in Molecular Plant Science – course C		104	100	36
	Total Workload	8	104	100	36
Coursework and examinations:	Formal requirements for examinations: Active working examinations: Protocol (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Ethics in Biology**				
Module number:	MoPS-05				
Semester:	summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Susanne Stirn, Tel.: 42816 533, Susanne.stirn(at)uni-hamburg(dot)de				
Instructors:	Dr. Susanne Stirn,				
language	English				
Intended learning objectives:	Students are familiar with different ethical concepts as a key to understand, why people differ in evaluations of scientific and technical innovations. They are able to develop their own qualified position, to understand societal governance processes and ways to actively participate in societal decision making.				
Contents	Global challenges; ethical concepts; perceptions of scientific and technical innovations in the sciences and the public; preconditions in and consequences for society and the environment; criteria for evaluating innovations; international comparison of government options to regulate innovations				
Course types and forms of instruction:	• V: Ethics in Biology • S: Ethics in Biology				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• V: Ethics in Biology		28	56	
	• S: Ethics in Biology		28	56	12
	Total Workload	6	56	112	12
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Paper (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Lab course A - Molecular Plant Physiology**				
Module number:	MoPS-06				
Semester:	Summer or winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Modules MoPS-02 to MoPS-04 have to be successfully passed				
Module coordinator:	Prof. Dr. Stefan Hoth, Phone: 42816 582, stefan.hoth(at)uni-hamburg(dot)de				
Instructors:	Prof. Dr. Stefan Hoth				
language	English				
Intended learning objectives:	The graduates have deeper knowledge of experimental techniques and research procedures and are able to apply their knowledge in scientific research. They have advanced understanding in molecular physiology and modern plant science in general. The graduates can develop scientific problems, raise hypothesis, and design the required experiments to test hypothesis and finally solve a problem. They are able to document their experimental work and actively present their scientific work.				
Contents	Content of teaching are molecular biology, biochemistry, molecular genetics, imaging, and molecular physiology in plant research. Fundamental and advanced techniques of the different disciplines will be applied to solve a current research problem in plant development (for instance meristem function, senescence, root hair development, auxin signaling), plant stress response (for instance immune responses, abiotic stresses, cell death), and/or intracelluar transport by the cytoskeleton. Techniques cover for instance DNA, RNA, and protein isolation, DNA construct design and production for different purposes (for instance reporter gene constructs, GFP fusions, inducible gene knock-out, gene overexpression), production of recombinant proteins, stable and transient plant transformation, protein detection, protein interaction experiments (for instance yeast-two-hybrid, BiFC, CoIP, MST), crossing of transgenic lines to genetically dissect signaling pathways, many kinds of bioassays , imaging techniques such as TIRF-microscopy to study single molecules and confocal laser scanning microscopy to look into cells in 3-D and non-invasively, RNA sequencing to study gene expression patterns/ transcriptomics, and different staining techniques for cells and tissues.				
Course types and forms of instruction:	• S: Seminar to lab course A • P: lab course A				2 SEM./HRS 14 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• S: Seminar to lab course A		28	28	48
	• P: lab course A		196	300	120
	Total Workload	24	224	328	168
Coursework and examinations:	Formal requirements for examinations: Active working Examinations: Oral presentation of the planned research project after 3-4 weeks, proper documentation of the experimental work in a lab journal and of the scientific progress in short written reports (ungraded). Presentation of the results of the project and discussion of the results within the state-of-the-art in the research area (graded 100%).				
Duration	One semester				
Module frequency:	Annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Lab course B – Molecular Plant Genetics**
Module number:	MoPS-07
Semester:	Summer- or winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Modules MoPS-02 to MoPS-04 have to be successfully passed
Module coordinator:	Prof. Dr. Julia Kehr, Phone: 42816- 312, julia.kehr(at)uni-hamburg(dot)de
Instructors:	Prof. Dr. Julia Kehr
language	English
Intended learning objectives:	The graduates will gain deeper knowledge of experimental techniques and research procedures and will be able to apply their knowledge in scientific research. They will have advanced understanding in molecular biology and modern plant science in general. The graduates will learn to identify scientific problems, raise hypotheses, and design the required experiments to test these hypotheses to finally solve the problems. They will be enabled to document and actively present their scientific work.
Contents	Content of teaching is molecular biology, biochemistry, molecular genetics, analytical methods and plant physiology. Fundamental and advanced techniques of the different disciplines will be applied to a current research problem in plant physiology (for example stress response, nutrient allocation, long-distance signaling). Techniques applied include DNA, RNA, and protein isolation, DNA construct design for expression in plants and microorganisms, production and purification of recombinant proteins, stable and transient plant transformation, protein-protein and protein-nucleic acid interaction experiments (e.g. microscale thermophoresis, zone interference gel electrophoresis, affinity chromatography), small RNA analysis (PCR, microarrays, next generation sequencing).
Course types and forms of instruction:	• S: Seminar to lab course B — 2 SEM./HRS • P: lab course B — 14 SEM./HRS

Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• S: Seminar to lab course B		28	28	48
	• P: lab course B		196	300	120
	Total Workload	24	224	328	168

Coursework and examinations:	Formal requirements for examinations: Active working Examinations: Oral presentation of the planned research project after 3-4 weeks, proper documentation of the experimental work in a lab journal and of the scientific progress in short written reports (ungraded). Presentation of the results of the project and discussion of the results within the state-of-the-art in the research area (graded 100%).
Duration	one semester
Module frequency:	annual
Literature:	Handed out at the beginning of the lecture

Title:	**Lab course C – Infection biology**				
Module number:	MoPS-08				
Semester:	Summer- or winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Modules MoPS-02 to MoPS-04 have to be successfully passed				
Module coordinator:	Prof. Dr. Sigrun Reumann, Phone: 42816-743, sigrun.reumann(at)uni-hamburg(dot)de				
Instructors:	Prof. Dr. Sigrun Reumann				
language	English				
Intended learning objectives:	The graduates will gain deeper knowledge of experimental techniques, research procedures and bioinformatics and are able to apply their knowledge in scientific research. They will obtain advanced understanding in molecular biology, biochemistry, protein chemistry, applied bioinformatics and modern plant science in general. The graduates can identify scientific problems, raise hypotheses, and design the required experiments to test these hypotheses to finally solve the problem. They are able to document their experimental work, interpret and critically evaluate research data and actively present their scientific work.				
Contents	Content of teaching are molecular biology, biochemistry, protein chemistry, molecular genetics, imaging, bioinformatics and infection biology in plant research. Fundamental and advanced techniques of the different disciplines will be applied to solve a current research problem in organelle biology (e.g. peroxisome biogenesis and degradation, pexophagy), infection biology (plant resistance/susceptibility to pathogens) or abiotic stress tolerance. Wet-lab techniques cover, for instance, DNA, RNA, and protein isolation (e.g. 2DE), DNA construct cloning for different purposes (e.g. GFP fusions, gene knock-out or overexpression, site-directed mutagenesis), production of recombinant proteins, stable and transient plant transformation, protein interaction analyses (e.g. yeast-two-hybrid, BiFC), topology studies on membrane proteins, crossing of transgenic lines to genetically dissect signaling pathways, live cell imaging techniques (e.g. self assembly GFP, photoconvertible fluorescent proteins) and RNA sequencing to study gene expression patterns/ transcriptomics. Computational techniques cover, for instance, BLAST searches, targeting signal analyses, orthology and phylogenetic analyses, primer design, homology modeling and structural analyses.				
Course types and forms of instruction:	• S: Seminar to lab course C • P: lab course C				2 SEM./HRS 14 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• S: Seminar to lab course C		28	28	48
	• P: lab course C		196	300	120
	Total Workload	24	224	328	168
Coursework and examinations:	Formal requirements for examinations: Active working Examinations: Oral presentation of the planned research project after 3-4 weeks, proper documentation of the experimental work in a lab journal and of the scientific progress in short written reports (ungraded). Presentation of the results of the project and discussion of the results within the state-of-the-art in the research area (graded 100%).				
Duration	one semester				

Module frequency:	annual
Literature:	Handed out at the beginning of the lecture

Title:	**Lab course D - Molecular Plant Pathology**				
Module number:	MoPS-09				
Semester:	Summer- or winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Modules MoPS-02 to MoPS-04 have to be successfully passed				
Module coordinator:	PD. Dr. Cornelia Heinze, Phone: 42816 227, cornelia.heinze(at)uni-hamburg(dot)de				
Instructors:	PD. Dr. Cornelia Heinze				
language	English				
Intended learning objectives:	Graduates will get a deeper understanding of the molecular, physiological and histological interactions of a pathogen with its host plant. They will be able to apply different methods of modern plant pathology to elucidate the pathogen as well as the host. Due to a general overview about different plant diseases, they are able to design their own experimental framework and carry out the appropriate experiments. They will document and discuss their scientific results.				
Contents	An overview will be presented about major plant diseases. The molecular and physiological interactions between the pathogen and the host plant will be highlighted with an emphasis on the molecular basis of pathogenicity. Methods of bio-imaging (light-, fluorescence-, and electron microscopy) will be used to follow the pathogen during infection. To characterize the basis of pathogenicity, the interplay of genes, proteins, and metabolites like fungal toxins will be determined.				
Course types and forms of instruction:	• S: Seminar to lab course A • P: lab course A				2 SEM./HRS 14 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• S: Seminar to lab course A		28	28	48
	• P: lab course A		196	300	120
	Total Workload	24	224	328	168
Coursework and examinations:	Formal requirements for examinations: Active working Examinations: Oral presentation of the planned research project after 3-4 weeks, proper documentation of the experimental work in a lab journal and of the scientific progress in short written reports (ungraded). Presentation of the results of the project and discussion of the results within the state-of-the-art in the research area (graded 100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Lab course E – Developmental biology**				
Module number:	MoPS-10				
Semester:	Summer- and winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Modules MoPS-02 to MoPS-04 have to be successfully passed				
Module coordinator:	Prof. Dr. Arp Schnittger, Phone: 42816 502, arp.schnittger(at)uni-hanburg(dot)de				
Instructors:	Prof. Dr. Arp Schnittger				
language	English				
Intended learning objectives:	Guided by case studies, the graduates will be exposed to current topics and question in developmental biology. They will learn hypothesis driven versus unbiased descriptive approaches and apply state-of-the-art techniques including classic techniques such generation of fusion proteins with novel tools, e.g. genome-editing by CRISPR/cas and deep sequencing. The graduates learn analytical dissection of scientific question and experimental design. They learn how to proper document as well as present and communicate their data.				
Contents	Content of teaching is developmental biology and its interface with plant physiology, pathology, genetics, biochemistry, and evolution. Topics include in particular cell cycle control, proliferation, DNA damage response, and growth. In addition, meiosis will be studied and the processes of DNA recombination. Techniques include cell biological methods, biochemistry, genetics, molecular biology, and bioinformatics. Cell biology: such as live imaging of proteins by fluorescence microcopy, spreading of chromosomes, immune detection of proteins, etc. Biochemistry: expression and purification of proteins, e.g. kinases, etc. Genetics: Crossing schemes, transmission analyses, etc. Molecular biology: chromatin-immuno precipitation, qRT PCR, etc. Bioinformatics: Analysis of large data sets, identification of motifs, structure prediction, etc.				
Course types and forms of instruction:	• S: Seminar to lab course E • P: lab course E				2 SEM./HRS 14 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• S: Seminar to lab course E • P: lab course E		28 196	28 300	48 120
	Total Workload	24	224	328	168
Coursework and examinations:	Formal requirements for examinations: Active working Examinations: Oral presentation of the planned research project after 3-4 weeks, proper documentation of the experimental work in a lab journal and of the scientific progress in short written reports (ungraded). Presentation of the results of the project and discussion of the results within the state-of-the-art in the research area (graded 100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Handed out at the beginning of the lecture				

Title:	**Introduction to job**				
Module number:	MoPS-12				
Semester:	winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Arp Schnittger, Phone: 42816 502, arp.schnittger(at)uni-hanburg(dot)de				
Instructors:	Prof. S. Reumann, Prof. J. Kehr, Prof. S. Hoth, Prof. A. Schnittger,				
language	English				
Intended learning objectives:	Students have the ability to interpret scientific literature, to integrate their findings into the overall scientific context and to compile them as a publishable scientific presentation. They can conclusively present their scientific findings, while applying various media and technology. They are acquainted with the application for financial and scientific sponsorship. They comprehend the occupational field of molecular biologists.				
Contents	Scientific writing, presentation techniques and writing of grant proposals				
Course types and forms of instruction:	• V: Introduction into job • E: Introduction into job				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	PV (hrs)
	• V: Introduction to job		28	56	
	• E: Introduction to job		28	56	12-
	Total Workload	6	56	112	12
Coursework and examinations:	Formal requirements for examinations: Active working examinations: (pass)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Master thesis**				
Module number:	MoPS-13				
Semester:	*Winter or summer*				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	All Compulsory elective modules have to be successfully passed				
Module coordinator:	Instructors: of the thesis				
Instructors:	*All* Instructors: s				
language	*English*				
Intended learning objectives:	Students are able to think and work self-containedly in the scientific fields of the MSc Molecular Plant Science Biology. They have gained experience in presentation and evaluation of their own experimental work in the context of the current scientific state of the art and they are able to solve scientific problems.				
Contents					
Course types and forms of instruction:	•				
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	PV (hrs)
	Total Workload	*30*			
Coursework and examinations:	Formal requirements for examinations: Active working examinations: Thesis (graded; 90%), disputation (graded; 10%)				
Duration	one semester				
Module frequency:	annual				
Literature:					